PROJECT MANUAL

CITY OF TUCKER
DEKALB COUNTY
TUCKER, GEORGIA

ITB 2024-010
TUCKER TOWN GREEN
CONSTRUCTION PROJECT

ISSUE FOR BID

Issued: May 21, 2024
File No.: 3808805

BARGE DESIGN SOLUTIONS
2839 Paces Ferry Road SE, Suite 850
Atlanta, GA 30339

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SECTION 000000 – TABLE OF CONTENTS

GENERAL

This Project Manual follows the CSI Master Format Document Identifying System and Cost Accounting Numbers.

Nonapplicable division and section references have been omitted.

Recipients of Bidding Documents must consult the Table of Contents to determine the full scope of the work involved and to ensure that all pages of the Project Manual and Drawings have been included.

Neither the Owner nor the A/E will be responsible for bids submitted that are based on incomplete Bidding Documents.

DIVISION 32 EXTERIOR IMPROVEMENTS (continued)

DIVISION 33 UTILITIES

END OF SECTION 000000

DOCUMENT 000107 - SEALS PAGE

1.1 DESIGN PROFESSIONALS OF RECORD

A. Architect:

1. Gregory Walker
2. Georgia License # RA010522
3. Responsible for Sections in Divisions 01-10 except where indicated as prepared by other design professionals of record.

B. Landscape Architect

1. Raigan K. Carr
2. Georgia License # 1183
3. Responsible for the following Sections.

033001
040511
044302
055000.01
079200.01
129300
321313
321314
321373
321416
321640
329113.19
329119
329200
329300
329301

C. Civil Engineer:

1. Rodney A. Hall
2. Georgia License #046625
3. Responsible for the following Sections.

020100
024119
031100
311000
312000
312319.16
312333
321113
321116.16
321123
330561
331100
331213
333100
334000
334915

D. Irrigation Designer

1. Michael Clark
2. Certification #000570
3. Responsible for the following Sections.

328400

E. Structural Engineer:

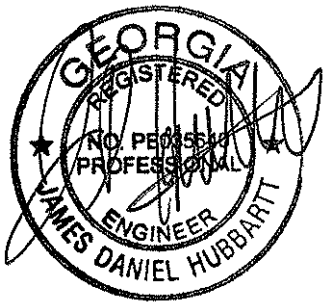
1. Karen Mole Jenkins
2. Georgia License # SE000175
3. Responsible for the following Sections.

013330
014525
032000
033000
036200
042200
051000
061519
312301

F. Mechanical Engineer (Plumbing and HVAC):

1. James Daniel Hubbartt
2. Georgia License # PE035640
3. Responsible for the following Sections.

224000
230100
230593
230700
233000



G. Electrical Engineer:

1. Charles C. Esslinger
2. Georgia License 027956
3. Responsible for the following Sections.

260100
260910
261000
264000
264500
265000
267500

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City of Tucker

Invitation to Bid
ITB # 2024 – 010

TOWN GREEN CONSTRUCTION

BID MANUAL

City of Tucker
1975 Lakeside Parkway, Suite 350
Tucker, Georgia 30084

CITY OF TUCKER INVITATION TO BID
ITB #2024-010 TOWN GREEN CONSTRUCTION

INVITATION: The City of Tucker (City), requests that interested parties submit formal electronic bids for the construction of the Town Green. The general scope of work for this two-acre town center park includes earthwork, utilities, below-ground detention, hardscape for flatwork and walls, roadwork with parking, restroom building, custom pavilion, fountains, landscape features, site furnishings, plant material and irrigation. Bids will be accepted until the date and time listed below and will be awarded to the lowest responsible and responsive bidder. The City reserves the right to negotiate with the lowest responsible and responsive bidder as provided for in O.C.G.A. § 36-91-21. Addenda and updates to this bid manual will be posted on the City of Tucker website www.tuckerga.gov/bids or may be requested by email procurement@tuckerga.gov.

BID ACTIVITY SCHEDULE These dates will need to be adjusted	
Bid Issued	May 21, 2024
Deadline for Questions for Pre-Bid Conference	May 28, 2024 at 2:00pm (EST)
Pre-Bid Conference (Mandatory)	May 30,2024 at 2:00pm (EST)
Deadline for Questions	June 4, 2024, at 2:00 p.m. (EST)
Responses to Questions Posted (Addenda)	June 7, 2024
Bid Deadline	**June 20, 2024 at 2:00 P.M. (EST)**
Award at Council Meeting	July 8, 2024
Completion from Notice to Proceed	330 Days

SCOPE OF WORK: Refer to Exhibit A.

QUESTIONS: Submit all questions in writing to procurement@tuckerga.gov. Reference Bid #2024-010

PRE-BID CONFERENCE: A mandatory pre-bid conference is scheduled for Thursday, May 30, 2024 at 2:00pm EST. Attendees will meet at Tucker City Annex located at 4228 First Avenue, Tucker, GA. A walk to the nearby site visit will follow the office meeting.

ADDENDA: Responses to the questions received will be by addenda and will be posted on the City website. The signed acknowledgement issued with each addendum must be submitted with the bid. It is the vendors responsibility to verify if any addenda were created.

SUBMITTAL REQUIREMENTS: Submit an electronic copy of the full bid to procurement@tuckerga.gov no later than June 20th at 2:00 P.M. Be sure to name the proposal file with ITB #2024-010 and your company name.

BID OPENING: All bids received prior to the deadline will be opened publicly at 2:00om EST at Tucker City all located at 1975 Lakeside Parkway, Suire 350, Tucker GA. Preliminary Bid results will be posted on the City's website, www.tuckerga.gov/bids, following the opening of bids.

ITB #2024-010 TOWN GREEN CONSTRUCTION

BID DOCUMENT SUBMITTAL REQUIREMENTS:

1. Cost Proposal/Bid Form (Exhibits B & C)
2. W-9 Form (Provided)
3. Certificate of Insurance
4. Contractor Affidavit (Provided)
5. Subcontractor Affidavit for each Proposed Subcontractor (Provided)
6. Proposed List of Subcontractors
7. Bid Bond Form (Provided)
8. Contact Form (Provided)
9. Related Experience and References (Provided)
10. Acknowledgement of Addendum issued with each Addendum.

Responses must be received by the date and time specified. (Addenda will show any schedule updates). Late receipt of bids will not be considered regardless of email issues. Proposals received after the opening time will be filed unopened. The City of Tucker reserves the right to reject any and all proposals or any part, to waive any formalities or informalities to make an award and to re-advertise in the best interest of the City. No proposals received orally/phone.

PURPOSE, INTENT AND PROJECT DESCRIPTION

The City of Tucker (City), requests that interested parties submit formal electronic bids for the construction of the Tucker Town Green. The improvements generally consist of demolition of existing structures and parking lots, moderate earthwork and clearing and grubbing, construction of new custom pavilion, restroom building (including electrical, water and sanitary sewer connections), water features, stormwater features and infrastructure including underground detention, sanitary sewer infrastructure, sidewalks, specialty paving, lighting, landscape areas, compactor enclosure, on-street parking and road improvements.

The complete scope, plans, and other relevant information for ITB 2024-010 is available for download on the City of Tucker website: www.tuckerga.gov/bids or request via email to procurement@tuckerga.gov .

GENERAL CONDITIONS

The contractor shall execute the work according to and meet the requirements of the following:

- Georgia Department of Transportation (GDOT) Specifications, Standards, and Details;
- DeKalb County Department of Watershed Management Design & Construction Standards Manual
- The Contract Documents including but not limited to the scope of work, plans, and specifications;
- City of Tucker ordinances and regulations;
- OSHA standards and guidelines; and
- MUTCD Guidelines

The contractor will be responsible for providing all labor, materials, and equipment necessary to perform the work. This is a lump sum bid. Progress payments will be made based on a percentage of actual work completed.

The contractor is responsible for inspecting the jobsite prior to submitting a bid. No change orders will be issued for differing site conditions.

The successful bidder must have verifiable experience at construction of similar projects in accordance with these specifications. Bidder shall provide at least three examples and reference information (including company name, project name, contact name, phone number and email address) demonstrating experience successfully completing projects of similar scope.

10% retainage will be withheld from the total amount due the contractor until Final Acceptance of work is issued by the City. The City and/or designated representatives will inspect the work as it progresses.

Progress Payments shall be made in arrears upon review of satisfactory completion of work.

PROSECUTION AND PROGRESS

The Contractor will mobilize with sufficient forces such that all construction identified as part of this contract shall be substantially completed within 330 days of Notice to Proceed. The contractor will be considered substantially complete when all work required by this contract has been completed (excluding final punch list work).

Upon Notice of Award, the Contractor will be required to submit a Progress Schedule.

Normal workday for this project shall be 7:00AM to 7:00PM and the normal workweek shall be Monday through Friday. The portion of Railroad Avenue adjacent to the project site will be closed full time during the course of construction. Other lane closures as needed are limited to the hours of 9:00AM to 4:00PM with 48-hour prior notice required for city approval. The City will consider extended workdays or workweeks upon written request by the Contractor on a case by case basis. No work will be allowed on national holidays (i.e. Memorial Day, July 4th, Labor Day, etc.).

The work will require bidder to provide all labor, administrative forces, equipment, materials and other incidental items to complete all required work. The City and/or designated representatives shall perform a Final Inspection upon substantial completion of the work. The contractor will be allowed to participate in the Final Inspection. All repairs shall be completed by the contractor at contractor's expense prior to issuance of Final Acceptance.

The contractor shall be assessed liquidated damages in the amount of $500.00 per calendar day for any contract work (excluding punch list items) that is not completed within 330 days of Notice to Proceed. Liquidated damages shall be deducted from the 10% retainage held by the City. The contractor will also be assessed liquidated damages in the amount of $500.00 per calendar day for not completing any required Punch List work within 45 calendar days.

The contractor shall provide all material, labor, and equipment necessary to perform the work without delay until final completion.

The contractor shall provide a project progress schedule prior to or at each preconstruction meeting. This schedule should accurately represent the intended work and cannot be vague or broad such as listing every road in the contract.

The contractor shall submit a two-week advance schedule every **Friday by 2:00p.m to the City or its designee**, detailing scheduled activities for the following week.

All submittals are to be provided to the City or its designee by the Contractor prior to commencing any work.

UTILITY COORDINATION

The City of Tucker is coordinating with Georgia Power to relocate existing overhead powerlines to underground. Most of this work is located in the Railroad Avenue right-of-way, and a portion of the work traverses the middle of the project site from Railroad Avenue to the north property line. It is anticipated that this work will be completed prior to the start of the Town Green construction, however a portion of the work may be still underway following notice to proceed for the Town Green. Updates will be provided to the bidders as available during the bidding phase of the Town Green. Contractor may be required to designate a Worksite Utility Coordination Supervisor as noted in Supplemental Specification, Section 107.21 (attached).

PERMITS AND LICENSES

The contractor shall procure all permits and licenses, pay all charges, taxes and fees, and give all notices necessary and incidental to the due and lawful prosecution of the work.

RIGHT OF WAY AND EASEMENTS

This project does not require any Right of Ways or Easements that have not been previously coordinated by the City. The project is adjacent to CSX right-of-way in which one minor stormwater structure will need routine maintenance. The Temporary Right of Entry Agreement, included in these documents, will need to be executed prior to entry into the CSX right-of-way for the required scope of work.

BONDING AND INSURANCE REQUIREMENTS

No bid may be withdrawn for a period of forty-five (45) days after the time has been called on the date of opening.

All bids must be accompanied by a Bid Bond of a reputable bonding company authorized to do business in the State of Georgia, in an amount equal to at least five percent (5%) of the total amount of the bid.

Upon Notice of Award, the successful contractor shall submit a Performance Bond payable to the City of Tucker in the amount of 100% of the total contract price. The successful contractor shall also submit a Payment Bond in the amount of 100% pursuant to O.C.G.A. § 36- 91-70 and 90.

The contractor shall procure and maintain the following insurance policies:

1. Commercial General Liability coverage at their sole cos and expense with limits of not less than $5,000,000 in combined single limits for bodily injury and/or property damage per occurrence, and such policies shall name the City of Tucker as an additional named insured.
2. Statutory Workers Compensation and Employers Liability Insurance with limits of not less than $1,000,000, which insurance must contain a waiver of subrogation against the City of Tucker and its affiliates.
3. Commercial automobile liability insurance with limits of not less than $1,000,000 combined single limit for bodily injury and/or property damage per occurrence, and such policies shall name the City of Tucker as an additional named insured.

EXISTING CONDITIONS / DEVIATION OF QUANTITIES

All information given in this ITB concerning quantities, scope of work, existing conditions, etc. is for information purposes only. It is the Contractor's responsibility to inspect the project site to verify existing conditions and quantities prior to submitting their bid. This is a lump sum bid and no payment will be made for additional work without prior written approval from the City. At no time will Contractor proceed with work outside the prescribed scope of services for which additional payment will be requested without the written authorization of the City.

The City reserves the right to add, modify, or delete quantities. The City may also elect to add or eliminate certain scope of work items at its discretion. The Contractor will be entitled to any adjustment of pricing or any other form of additional compensation because of adjustments made to quantities and/or work locations. Contractor will be paid for actual in-place work completed and accepted. All other work required by this ITB, plans, specs, standards, etc. but not specifically listed herein shall be considered "incidental work" and included in the bid prices.

PROTECTION AND RESTORATION OF PROPERTY AND LANDSCAPE

The contractor shall be responsible for the preservation of all public and private property, trees, monuments, roadway signs and markers, fences, grassed and sodded areas, etc. along and adjacent to the road or street, and shall use every precaution necessary to prevent damage or injury thereto, unless the removal, alteration, or destruction of such property is provided for under the contract.

When or where any direct or indirect damage or injury is done to public or private property by or on account of any act, omission, neglect or misconduct in the execution of the work, or in consequence of the non-execution thereof by the contractor, he shall restore, at his/her own expense, such property to a condition similar or equal to that existing before such damage or injury was done, by repairing, rebuilding or otherwise restoring as may be directed, or she/he shall make good such damage or injury in an acceptable manner. The contractor shall correct all disturbed areas before retainage will be released.

ADJUSTING UTILITY STRUCTURES TO GRADE

All sewer manholes and water valves are to be adjusted to grade by the contractor.

CLEANUP

All clean-up work shall be performed daily. Operations shall be suspended if the contractor fails to accomplish clean-up within an acceptable period of time. Construction debris shall be removed

from publicly accessible gutters, sidewalks, yards, driveways, etc. Failure to perform clean-up activities may result in suspension of the work.

SAFETY

Beginning with mobilization and ending with acceptance of work, the contractor shall be responsible for providing a clean and safe work environment at the project site. The contractor shall comply with all OSHA regulations as they pertain to this project.

SPECIAL CONDITIONS

Contractor to call 811 for utility locates. Minor field adjustments may be necessary or directed by the City.

SUBCONTRACTOR

Any contractor utilizing a subcontractor must submit a proposed list of subcontractors and a Subcontractor Affidavit (attached).

EXHIBIT A

SCOPE OF WORK

The Bidder agrees to furnish all labor, materials, equipment, and incidentals necessary for the construction, testing, and placing into operation of the Tucker Town Green, all in accordance with the drawings and specifications.

EXHIBIT B

BIDDER'S REPRESENTATIONS

1. Bidder has examined and carefully studied the Bidding Documents, the other related data identified in the Bidding Documents, and the following Addenda, receipt of which is hereby acknowledged.

Addendum No.	Addendum Date
_____	_____
_____	_____
_____	_____
_____	_____

2. Bidder has visited the Site and become familiar with and is satisfied as to the general, local and Site conditions that may affect cost, progress, and performance of the Work.

3. Bidder is familiar with and is satisfied as to all federal, state and local Laws and Regulations that may affect cost, progress and performance of the Work.

4. Bidder has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions relating to existing surface

or subsurface structures at the Site (except Underground Facilities) that have been identified in SC-4.02 as containing reliable "technical data," and (2) reports and drawings of Hazardous Environmental Conditions, if any, at the Site that have been identified in SC-4.06 as containing reliable "technical data."

5. Bidder has considered the information known to Bidder; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and the Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, including applying the specific means, methods, techniques, sequences, and procedures of construction expressly required by the Bidding Documents; and (3) Bidder's safety precautions and programs.

6. Based on the information and observations referred to in Paragraph 3.01.E above, Bidder does not consider that further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performance of the Work at the price(s) bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents.

7. Bidder is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents.

8. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and the written resolution thereof by Engineer is acceptable to Bidder.

9. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance of the Work for which this Bid is submitted.

10. Where this Bid Form contains the provision for a bid based on a lump sum price, the Bidder shall be responsible for having prepared its own estimate of the quantities necessary for the satisfactory completion of the Work specified in these Contract Documents and for having based the lump sum price bid on its estimate of quantities.

COST PROPOSAL

1. Base Bid:
Furnish all labor, materials, equipment, and incidentals necessary for the construction, and placing into operation of the Tucker Town Green, all in accordance with the drawings and specifications and not included in items 1 through 5 in Exhibit C for the lump sum amount shown below.

Lump Sum: $_____ (Figures)

4. Cash Allowances if Approved by City:

a. Soils and Concrete Testing

Allowance $_____ (Figures)

b. Contingency
Allowance $_____ (Figures)

BID TOTAL, ITEMS 1 THROUGH 2, INCLUSIVE, THE AMOUNT OF:

$_____ (Figures)

_____

_____ (Words)

EXHIBIT C

ADDITIVE ALTERNATES

ADDITIVE ALTERNATE NO. 1 SHADE SAILS: $_____ (Figures)

_____ (Words)
Alternate No. 1 - shade sails shall include all work and materials associated with the above ground improvements for the shade sails structures, including, but not limited to support posts, sails, hardware & fasteners, and lighting. (shade sail foundations and electrical conduit shall be included in the base bid)

ADDITIVE ALTERNATE NO. 2 BENCH SWINGS: $_____ (Figures)

_____ (Words)
Alternate No. 2 - Bench swings shall include all work and materials associated with the arbor/trellis support structures, bench swings, and paving shown in details.

ADDITIVE ALTERNATE NO. 3 CLIMBING MOUND: $_____ (Figures)

_____ (Words)
Alternate No. 3 - Climbing mound shall include all work and materials associated with the climbing mound construction, including but not limited to the mound surface, synthetic turf & base, concrete curb/edge, concrete slide and climbing ropes.

ADDITIVE ALTERNATE NO. 4 MOGUL AREA: $_____ (Figures)

_____ (Words)
Alternate No. 4 - Mogul area shall include all work and materials associated with the construction and installation of the mogul area, including, but not limited to the mogul structure, synthetic turf & base, concrete curb / edging, and concrete benches.

ADDITIVE ALTERNATE NO. 5 SECOND STREET ENTRANCE @ NORTHWEST CORNER:
$_____ (Figures)

_____ (Words)

Alternate No. 5 – Second Street entrance shall include all work and materials associated with the construction and installation of the 2nd Street pedestrian plaza and stairway access, including, but not limited to paving, retaining walls, handrails/guardrails, and concrete stairs.

Proposal Price Certification

In compliance with the attached specification, the undersigned understands the City's minimum scope requirements.

The undersigned offers and agrees that if this proposal is accepted by the Mayor and City Council within one hundred twenty (120) days of the date of proposal opening, that the undersigned will furnish any or all of the deliverables and additional services offered, at the quoted price, to the designated point(s) within the time specified.

COMPANY _____

_____

ADDRESS _____

_____

AUTHORIZED SIGNATURE _____

PRINT / TYPE NAME _____

CONTACT'S PHONE NUMBER _____

CONTACT'S EMAIL ADDRESS _____

First Use Date 2001 Specifications: May 17, 2006
Revised: December 8, 2008
January 10, 2014

DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA

SUPPLEMENTAL SPECIFICATION

Section 107—Legal Regulations and Responsibility to the Public

Delete Subsection 107.21 and Substitute the following:

107.21—Contractor's Worksite Utility Coordination Supervisor

107.21 General Description

The Contractor shall designate, prior to beginning any work, a Worksite Utility Coordination Supervisor (WUCS) who shall be responsible for initiating and conducting utility coordination meetings and accurately recording and reporting the progress of utility relocations and adjustment work. Also, the WUCS shall prepare an Emergency Response Plan for the purpose of planning, training, and communicating among the agencies responding to the emergency. The WUCS shall be the primary point of contact between all of the Utility companies, the Contractor and the Department. The WUCS shall recommend the rate of reoccurrence for utility coordination meetings and the Engineer will have the final decision on the regularity for utility coordination meetings. In no case will utility coordination meetings occur less than monthly until controlling items of utility relocations and adjustment milestones are completed. The WUCS shall contact each of the utility companies for the purpose of obtaining information including, but not limited to, a Utility Adjustment Schedule for the controlling items of utility relocations and adjustments. The WUCS shall notify the appropriate utility company and/or utility subcontractors and the Department of the status of controlling items of relocations and adjustment milestones as they are completed. The WUCS shall furnish the Engineer, for approval, a Progress Schedule Chart, immediately following the receipt of the Notice to Proceed unless otherwise specified, which includes the utility companies controlling items of work and other information in accordance with Section 108.03 or elsewhere in the Contract documents.

A. Qualifications

The WUCS shall be an employee of the Prime Contractor, shall have at least one year experience directly related to highway and utility construction in a supervisory capacity and have a complete understanding of the Georgia Utilities Protection Center operations, and shall be knowledgeable of the High-voltage Safety Act and shall be trained on the Georgia Utility Facility Protection Act (GUFPA). The Department does not provide any training on GUFPA but will maintain a list of the Georgia Public Service Commission certified training programs developed by other agencies. Currently the following companies offer approved GUFPA training programs:

Associated Damage Consultants

Phone: 706.234.8218 or 706.853.1362

Georgia Utility Contractors Association

Phone: 404.362.9995

Georgia Utilities Protection Center

Phone: 678.291.0631 or 404.375.6209

H B Training & Consulting

Phone: 706.619.1669 or 877.442.4282 (Toll Free)

The Prime Contractor is responsible for obtaining the GUFPA training for their employees.

Questions concerning the Georgia Public Service Commission GUFPA training program should be directed to:

Georgia Public Service Commission

244 Washington St. SW

Atlanta, GA 30334-5701

404.463.9784

B. Ticket Status

During the utility coordination meetings the WUCS shall collect and maintain the Ticket Status information to determine the status of all locate requests within the project limits. This information will be used to assure those planning to use mechanized equipment to excavate or work within the project limits are prepared to begin work when they have reported or estimated beginning work. At points where the Contractor's or utility company's operations are adjacent to or conflict with overhead or underground utility facilities, or are adjacent to other property, damage to which might result in considerable expense, loss, or inconvenience, work shall not commence until all arrangements necessary for the protection thereof have been made.

C. Notice

The names of known utility companies and the location of known utility facilities will be shown on the Plans, or listed in the Subsurface Utility Engineering Investigation if performed or in the Special Provisions; and the WUCS shall give 24-hour notice to such utility companies before commencing work adjacent to said utility facilities which may result in damage thereto. The WUCS shall further notify utility companies of any changes in the Contractor's work schedules affecting required action by the utility company to protect or adjust their facilities. Notice to the utility companies by the Department of the Award of Contract, under Subsection 105.06, shall not be deemed to satisfy the notice required by this paragraph. Furthermore, this 24-hour notice shall not satisfy or fulfill the requirements of the Contractor as stated in Chapter 9 of Title 25 of the Official Code of Georgia Annotated, known as the "Georgia Utility Facility Protection Act".

D. Agenda

The WUCS shall cooperate with the companies of any underground or overhead utility facilities in their removal and relocations or adjustment work in order that these operations may progress in a reasonable manner, that duplication of their removal and relocations or adjustment work may be reduced to a minimum, and services rendered by those parties will not be unnecessarily interrupted. To promote this effort the WUCS shall prepare an agenda for the utility coordination meetings and circulate same in advance of the meeting to encourage input and participation from all of the utility companies. The agenda will be prepared by an examination of the project site and may include photographs of potential/actual utility conflicts.

E. Emergency Response Plan

The WUCS shall prepare an Emergency Response Plan within 30 days following the receipt of the Notice to Proceed. The WUCS shall clearly mark and highlight the gas, water and other pressurized pipeline shut-off valves and other utility services including overhead switch locations on the utility plans; and prepare a chart to indicate the location of each site (Street address or intersections), the utility company or operator of the facility with emergency contact information and the working condition of the device to facilitate prompt shut-off. The WUCS shall post the Emergency Response Plan in an area readily accessible to the Department. In the event of interruption to gas, water or other utility services as a result of accidental breakage or as a result of being exposed or unsupported, the WUCS shall promptly notify the appropriate emergency officials, the Georgia Utilities Protection Center and the appropriate utility facility company or operator, if known. Until such time as the damage has been repaired, no person shall engage in excavating or blasting activities that may cause further damage to the utility facility.

F. Submission

Provisions for reporting all utility coordination meetings, the progress of utility relocation and adjustment work milestones and ticket status information will be reported on a form developed by the WUCS and will be distributed by the WUCS to all of the utility companies as milestones are met and shall be included as part of the project records. These reports shall be delivered to the Engineer for review, on a monthly basis. The WUCS shall immediately report to the Engineer any delay between the utility relocation and adjustment work, the existing Utility Adjustment Schedule, or the proposed Utility Adjustment Schedule so that these differences can be reconciled.

G. Delays

Delays and interruptions to the controlling Item or Items of The Work caused by the adjustment or repair of water, gas, or other utility appurtenances and property will be considered for an extension of Contract Time as provided in Subsection 108.07.E unless such delays are due to the negligence of the Contractor.

H. Facilities Supported on Bridges

If the utility facilities are to be supported on bridges, the following provisions shall apply:

1. The Plans will show the location of the facility and the auxiliary items necessary to support the facility.

2. The Contractor constructing the bridge shall install anchor bolts, thimbles, inserts, or other auxiliary items attached to the bridge as a part of the support for the utility facility. The Utility Company shall furnish these auxiliary items, unless the Contract indicates these items are to be furnished by the Contractor as a part of the bridge construction.

3. The Utility or its subcontractor constructing the utility facility shall install hanger rods, pipe rollers, and other attachments necessary for the support of the utility facility as indicated on the Plans. The Utility Company shall furnish these attachments at no cost to the Department or the prime contractor unless otherwise specified. This work shall also include:

   a. Caulking the openings around the utility where it passes through endwalls to prevent the passage of undesirable materials.

   b. Painting the exposed portions of utility supports unless such supports are corrosion resistant. Painting shall be done in accordance with the applicable portions of Section 535, unless otherwise specified.

4. The sequence of bridge construction work may be set forth in the Plans and/or the Special Provisions and will show at what stage of the Work a utility company will be allowed to make the utility installation. Further, all or any portion of The Work under Subsection 107.21.H.3 may be included in the bridge Contract by the Plans and/or the Special Provisions.

5. Any damage to the bridge structure caused by the utility installation shall be repaired to the satisfaction of the Engineer at the expense of the Utility or its subcontractor installing the utility facility.

I. Clearances

The Plans provide for at least minimum clearance of utilities as required by the National Electrical Safety Code, U.S. Department of Commerce, and National Bureau of Standards. Any additional clearance the Contractor may desire or require in performing The Work shall be arranged by the Contractor with the utility company. The Department will pay no extra compensation for such additional clearances.

J. Utility Relocation Progress Schedule

The purpose of the Utility Adjustment Schedule is to provide the Contractor with the pertinent information, including any utility staging required, dependent activities, or joint-use coordination that is required for the creation of a feasible progress schedule. A suitable Utility Adjustment Schedule form is available from the Department for the WUCS to circulate to utility companies for any proposed project construction staging or should a utility company not duly file a Utility Adjustment Schedule to the Department during the preconstruction phase of the project. The WUCS shall submit a Utility Relocation Progress Schedule showing together the Progress Schedule Chart referenced in Section 108.03 and the proposed Utility Adjustment Schedules from all utility companies to the Engineer for review and approval. Copies of existing Utility Adjustment Schedules with utility companies having facilities on this project will be made available at the Georgia Department of Transportation, Office of Construction Bidding Administration, located at One Georgia Center, 600 West Peachtree Street, NW, Atlanta, GA 30308, for examination by the Contractor. The Utility Adjustment Schedules are available on-line at: http://www.dot.ga.gov/doingbusiness/contractors/Pages/default.aspx

K. Compensation

There will be no separate measurement or payment for this Work. The cost associated with this Work shall be included in the overall Bid submitted.

Tucker, DeKalb Co., GA
Railroad Ave. Culvert Cleaning
Abbeville Sub. Approx MP SG-560.68
OP_____

CSX Transportation, Inc.
Temporary Right of Entry Agreement

THIS AGREEMENT, made as of _____, 2024, by and between CSX TRANSPORTATION, INC., a Virginia corporation, whose mailing address is 500 Water Street, Jacksonville, Florida 32202, hereinafter called "**CSXT,**" and **Barge Design Solutions,** whose legal address is 2839 Paces Ferry Road SE, Suite 850, Atlanta, GA 30339, hereinafter called "**Licensee**," WITNESSETH:

WHEREAS, Licensee has submitted a written application to CSXT requesting permission to enter CSXT's property located within the Atlanta Zone, Abbeville Subdivision, near MP SG-560.68 on Railroad Ave. in Tucker, DeKalb County, GA (the "**Property**"), for the purpose of cleaning / clearing debris at the entrance to a box culvert located approximately 50 feet from the closest tracks and within the CSX right of way, (the "**Project**").

WHEREAS, CSXT is willing to grant to Licensee the limited right and permission to enter upon the Property for the limited purpose of performing the Project.

NOW THEREFORE, CSXT hereby grants to Licensee the right and permission to enter upon the Property for the purpose of performing said Project, subject to the terms and conditions set forth below:

1. **PROJECT**: The Project shall be performed at the entire cost and expense of Licensee, in accordance with good and sound engineering practices, to the satisfaction of CSXT's Regional Engineer or his or her duly authorized representative ("Regional Engineer") and in a manner to avoid accidents, damages, unnecessary delays to or interference with train traffic of CSXT. Prior to entry, Licensee shall notify the Regional Engineer's representative and arrange for flagging protection in accordance to Sections 5 and 6 of this Agreement. Licensee shall not dig in the ballast line or within the tracks loading influence area, or otherwise disturb the track structure. Licensee and Licensee's employees, agents, contractors ("Contractors") and other representatives (collectively, "Agents") shall maintain in their possession a copy of this Agreement at all times during their occupation of the Property. Licensee further agrees that, prior to the commencement of Project work by any third party Contractor, such Contractor shall execute and deliver to CSXT Attachment B to this Agreement to acknowledge Contractor's agreement to observe and abide by the terms and conditions of this Agreement.

2. **INDEMNITY:**

2.1 Licensee and its Contractors hereby assume risk of and shall indemnify, defend, protect and save CSXT and CSXT's Affiliates harmless with respect to any and all attorneys' fees, liability, claims, demands, payments, suits, actions, recoveries, penalties, costs, legal expenses, judgments, settlements, and damages of every nature, degree, and kind (including direct, indirect, consequential, incidental, and punitive damages) for:

2.1.1 personal injury, including, but not limited to bodily injury to or death of any person or persons whomsoever, including the agents, servants, Affiliates or employees of the parties or the Contractors;

2.1.2 the loss or damage to any property whatsoever, including property owned or in the care, custody or control of the parties hereto or their respective Affiliates;

2.1.3 any environmental damage and any related remediation brought or recovered against CSXT or any of its Affiliates; and

2.1.4 any and all other losses or damages; arising directly or indirectly from the presence of Licensee or its Agents on or about the Property, whether or not attributable in whole or part to the negligence, gross negligence, or intentional misconduct of CSXT or its Affiliates.

2.2 The parties waive any and all right or opportunity to contest the enforceability of this Section and agree that, in the event this Section, or any part of this Section, is found unenforceable by the final, unappealable judgment of a court of competent jurisdiction, this Section shall be construed so as to be enforceable to the maximum extent permitted by applicable law. In the event that such court of competent jurisdiction finds that Florida statutory construction contract indemnity monetary limits apply to this Agreement with respect to Licensee's/Contractors' indemnification of CSXT and its Affiliates for liability caused in whole or in part by any act, omission or default by CSXT or its Affiliates, the parties hereto agree that such limit shall be equal to the limits (exclusive of deductibles) of the applicable insurance required by Sections 3 and 4 of this Agreement. The parties acknowledge and agree that this monetary limit, if required, bears a commercially reasonable relationship to this Agreement, in so far as, among other factors, the parties have taken into account the availability and cost of insurance and other risk transference devices, the scope of the Project, the risks associated with the Project, and the compensation and any other benefits exchanged between the parties in connection with this Agreement.

2.2.1 Licensee shall comply, and shall require its Contractors to comply, with any federal, state, or local laws, statutes, codes, ordinances, rules, and regulations applicable to its presence or performance of any activity on the Property. Licensee and its Contractors shall indemnify, defend, and hold CSXT and its Affiliates harmless with respect to any fines, penalties, liabilities, or other consequences for its failure to so comply.

2.2.2 For the purpose of this Agreement, the term "Affiliates" includes all entities, directly or indirectly owned or controlled by, or under common control of a party or its respective officers, directors, employees and agents, and in the case of CSXT, includes CSX Corporation, CSXT and their Affiliates and their respective officers, directors, employees and agents.

2.2.3 The provisions of this Section shall survive the termination or expiration of this Agreement.

3. **GENERAL LIABILITY INSURANCE**: Licensee shall or shall require its Contractor to procure and maintain insurance in compliance with CSXT's insurance requirements attached to this Agreement as Attachment A. Neither Agency nor Contractor shall commence work on the Project until such policy or policies have been submitted to and approved by CSXT's Risk Management Department.

4. **RAILROAD PROTECTIVE LIABILITY INSURANCE:** Licensee shall or shall require its Contractor to procure and maintain Railroad Protective Liability insurance in compliance with CSXT's requirements attached to this Agreement as Attachment A.

5. **PRIOR NOTIFICATION: Licensee or Licensee's Agents shall notify CSXT's** GEC working on the project at least 30 days prior to requiring entry on the Property and shall abide by the instructions of the GEC. The GEC – STV Incorporated can be reached by contacting Janae Hudgins at Janae.Hudgins@stvinc.com or 904-265-7721.

6. **CLEARANCES**: Neither Licensee nor Agents shall perform any Project or place or operate any equipment of Licensee or Agents at a distance closer than fifty (50) feet from the center of any track, without the prior approval of the Regional Engineer. The Regional Engineer may require protective services or such other services as deemed necessary or appropriate. Equipment shall be moved across CSXT's track(s) only at a public crossing unless prior arrangements have been made with the Regional Engineer and a Private Crossing Agreement is fully executed and in place. Licensee and Agents shall take all precautions necessary to avoid interference with or damage to CSXT's property and signal and communication facilities during their performance of the Project.

7. **PROTECTIVE SERVICES**: If protective services, such as flagging protection, are required by CSXT, Licensee shall make arrangements with the Roadmaster to furnish such personnel, flagman or watchman, that in the Roadmaster's opinion may be necessary to protect the facilities and traffic of CSXT during the performance of the Project. Licensee shall pay for the cost of such services, including all applicable surcharges and additives. These services are estimated to be **$0** as supported by the attached estimate.

8. **PAYMENT FOR PROTECTIVE SERVICES**: Payment shall be made by Licensee in accordance with the following designated option:

(X) **Option 1**: Licensee shall make an advance deposit of funds based on an estimate of the cost of protective or other services as determined by CSXT. The cost for CSXT's services shall then be assessed by CSXT against this advance deposit. Upon completion of the Project, any unused funding will be returned to Licensee. Notwithstanding the foregoing, in the event Licensee performs any Project work without permission or without protective services (such as flagging protection) as may be required by CSXT, no portion of Licensee's advance deposit will be refunded. If CSXT's costs exceed the advance deposit(s), a request will be made to Licensee for additional funds or an invoice will be issued to Licensee for final payment. Licensee shall remit payment to CSXT within thirty (30) days of receipt of either a request for additional funds or an invoice.

( ) **Option 2**: Licensee shall promptly reimburse CSXT for the cost of protective or other services on an as-incurred basis, including all applicable surcharges, upon receipt of bill(s) therefor.

9. **ENVIRONMENTAL**: **This Agreement does not include and expressly excludes the performance of any site investigation activities designed to determine environmental conditions on, about or beneath the Property**. Precluded activities include performing soil borings for purposes other than geotechnical investigation, obtaining soil, sediment, groundwater and surface water samples, and conducting field or laboratory analyses of any soil, sediment, groundwater or surface water samples obtained from CSXT property to identify chemical composition or environmental condition. *If any type of environmental investigation is desired, a separate right of entry agreement issued through CSXT's Environmental Department must be secured.*

10. **CLAIMS:** Licensee shall, or shall require Agents, to promptly notify the Regional Engineer of any loss, damage, injury or death arising out of or in connection with the Project.

11. **REMEDIATION**: It is understood and agreed that, upon completion of the Project, the Property shall be left in a condition satisfactory to Regional Engineer or his or her duly authorized representative.

12. **SAFETY:**

12.1 All personnel entering the Property must comply with CSXT safety rules and requirements to include, without exception, the wearing of hard hats and approved safety shoes and safety glasses with side shields. Anyone not in compliance with these rules and regulations will be asked to leave the Property.

12.2 Before performing any work authorized by this Agreement, Licensee, at its sole cost and expense, shall obtain all necessary permit(s) (including but not limited to zoning, building, construction, health, safety or environmental matters), letter(s) or certificate(s) of approval. Licensee expressly agrees and warrants that it shall conform and limit its activities to the terms of such permit(s), approval(s) and authorization(s), and shall comply with all applicable ordinances, rules, regulations, requirements and laws of any governmental authority (state, federal or local) having jurisdiction over Licensee's activities, including the location, contact, excavation and protection regulations of the Occupational Safety and Health Act (OSHA) (29 CFR 1926.651(b), et al.), and State "One Call" -"Call Before You Dig" requirements.

13. **TERM:** This Right-of-Entry Agreement and the permission conferred and the license granted by it does not constitute a grant of permanent easement and shall terminate upon completion of the Project or at midnight, **March 31, 2027,** whichever occurs first, unless extended in writing by CSXT. In the event Licensee fails to comply with terms and provisions of this Agreement, Licensee agrees to pay and agrees that CSXT shall be entitled to recover costs and expenses incurred by CSXT, including legal fees and expenses, to enforce the terms of this Agreement.

14. **SEVERABILITY**: The parties agree that if any part, term or provision of the Agreement is held to be illegal, unenforceable or in conflict with any applicable federal, state, or local law or regulation, such part, term or provision shall be severable, with the remainder of the Agreement remaining valid and enforceable. If any provision or any part of a provision of the Agreement shall be finally determined to be superseded, invalid, illegal, or otherwise unenforceable pursuant to any applicable law, ordinance, rule or regulation, such determination shall not impair or otherwise affect the validity, legality, or enforceability of the remaining provision or parts of the provision of the Agreement, which shall remain in full force and effect as if the unenforceable provision or part were deleted.

15. **ENTIRE AGREEMENT:** This Agreement embodies the entire understanding of the parties, may not be waived or modified except in a writing signed by authorized representatives of both parties, and supersedes all prior or contemporaneous written or oral understandings, agreements or negotiations regarding its subject matter.

16. **NOTICES:** All notices, consents and approvals required or permitted by this agreement shall be in writing and shall be deemed delivered; upon personal delivery, upon the expiration of three (3) business days following mailing by U.S. first class mail, or upon the next business day following mailing by a nationally recognized overnight carrier, to the Licensee at the address above, and to Licensor at the address shown on Page 1, or at such other addresses as either party may designate by delivery of prior notice to the other party .

17. **TERMINATION:** CSXT shall have the right at any time and at its sole discretion to terminate this Agreement upon notice to Licensee.

18. **WAIVER:** If either party fails to enforce its respective rights under this Agreement, or fails to insist upon the performance of the other party's obligations hereunder, such failure shall not be construed as a permanent waiver of any rights or obligations in this Agreement.

19. **GOVERNING LAW; VENUE:** This Agreement shall be governed by and construed under the laws of the State of Florida, without regard to the choice of law provisions thereof. Venue for any action arising from, or brought to enforce, this Agreement, shall vest exclusively in the state or federal courts located in Duval County, Florida, and the parties agree to submit to the personal jurisdiction of any state or federal court located in Duval County, Florida.

20. **NO ASSIGNMENT:** Notwithstanding anything to the contrary contained in this Agreement, Licensee shall not permit Agents to enter the Property without first requiring Agents to agree in writing to comply with all of the terms of this Agreement. Notwithstanding the foregoing, Licensee shall continue to be responsible for insuring that Agents comply with all of the terms and conditions of this Agreement and shall indemnify and hold CSXT harmless for any damages described in Section 2 above caused in whole or in part by such subcontractor. Assignment of this Agreement to any party other than Agents in accordance with this Section shall not be permitted except upon the prior written consent of CSXT, which consent may be granted or withheld at CSXT's sole discretion. This Agreement shall be binding upon the parties and their respective successors and assigns.

[*Signatures appear on following page*]

BY SIGNING THIS AGREEMENT, I certify that there have been no changes made to the content of this Agreement since its approval by the CSXT Legal Department on May 10, 2021.

IN WITNESS WHEREOF, the parties hereto have caused this Agreement to be executed as of the day and year first above written.

CSX TRANSPORTATION, INC.

By: _____

Name: Todd Allton
Title: Project Manager – Public Projects

Barge Design Solutions:

By: _____

Print/Type Name:_____
Print/Type Title:_____
Who, by the execution hereof, affirms that he/she has the authority to do so and to bind **Barge Design Solutions** to the terms and conditions of this Agreement.

ATTACHMENT "A"

INSURANCE REQUIREMENTS

I. Insurance Policies:

Agency and Contractor, if and to the extent that either is performing work on or about CSXT's property, shall procure and maintain the following insurance policies:

1. Commercial General Liability coverage at their sole cost and expense with limits of not less than $5,000,000 in combined single limits for bodily injury and/or property damage per occurrence, and such policies shall name CSXT as an additional named insured. The policy shall include endorsement ISO CG 24 17 evidencing that coverage is provided for work within 50 feet of a railroad. If such endorsement is not included, railroad protective liability insurance must be provided as described in item 4 below.

2. Statutory Worker's Compensation and Employers Liability Insurance with limits of not less than $1,000,000, which insurance must contain a waiver of subrogation against CSXT and its affiliates (if permitted by state law).

3. Commercial automobile liability insurance with limits of not less than $1,000,000 combined single limit for bodily injury and/or property damage per occurrence, and such policies shall name CSXT as an additional named insured. The policy shall include endorsement ISO CA 20 70 evidencing that coverage is provided for work within 50 feet of a railroad. If such endorsement is not included, railroad protective liability insurance must be provided as described in item 4 below.

4. Railroad protective liability insurance with limits of not less than $5,000,000 combined single limit for bodily injury and/or property damage per occurrence and an aggregate annual limit of $10,000,000, which insurance shall satisfy the following additional requirements:

   a. The Railroad Protective Insurance Policy must be on the ISO/RIMA Form of Railroad Protective Insurance - Insurance Services Office (ISO) Form CG 00 35.

   b. CSX Transportation must be the named insured on the Railroad Protective Insurance Policy.

   c. Name and Address of Contractor and Agency must appear on the Declarations page.

   d. Description of operations must appear on the Declarations page and must match the Project description.

   e. Authorized endorsements must include the Pollution Exclusion Amendment - CG 28 31, unless using form CG 00 35 version 96 and later.

   f. Authorized endorsements may include:

      (i). Broad Form Nuclear Exclusion - IL 00 21
      (ii) 30-day Advance Notice of Non-renewal or cancellation
      (iii) Required State Cancellation Endorsement
      (iv) Quick Reference or Index - CL/IL 240

   g. Authorized endorsements may not include:

      (i) A Pollution Exclusion Endorsement except CG 28 31
      (ii) A Punitive or Exemplary Damages Exclusion

(iii) A "Common Policy Conditions" Endorsement
(iv) Any endorsement that is not named in Section 4 (e) or (f) above.
(v) Policies that contain any type of deductible

5. All insurance companies must be A. M. Best rated A- and Class VII or better.

6. The CSX OP number or CSX contract number, as applicable, must appear on each Declarations page and/or certificates of insurance.

7. Such additional or different insurance as CSXT may require.

II. Additional Terms

1. Contractor must submit the original Railroad Protective Liability policy, Certificates of Insurance and all notices and correspondence regarding the insurance policies to:

Insurance Department
CSX Transportation, Inc.
500 Water Street, 14th Floor
Jacksonville, FL 32202

OR

insurancedocuments@csx.com and Janae.Hudgins@stvinc.com

2. Neither Agency nor Contractor may begin work on the Project until it has received CSXT's written approval of the required insurance.

ESTIMATE

All administrateve costs for this agreement to be paid for under a separate Preliminary Engineering Agreement with the City of Tucker.

Building and Permitting
1975 Lakeside Parkway
Suite 350
Tucker, GA 30084
Phone: 678-597-9040 Email:
permits@tuckerga.gov
Website: www.tuckerga.gov

Subcontractor Affidavit

REQUIREMENTS:

1. This form must be completed, signed, and submitted to the Building Permits Division prior to construction.
2. A copy of the license holder's ID, business license and State of Georgia license must be submitted.
3. No inspections are allowed until the appropriate Subcontractor Affidavit form is submitted to the Building Permits Division

Name of License Holder: _____

Company Name: _____ Address: _____

State License Number: _____ Expiration Date: _____

Business License Number: _____ Jurisdiction: _____

Email Address: _____ Phone Number: _____

Select the scope of work the license holder is responsible for:

☐ Electrical ☐ Plumbing ☐ HVAC/Mechanical ☐ Septic Tank Only
☐ Kitchen Hood ☐ Water Service Only ☐ Gas Piping ☐ Septic Line Connection
☐ Refrigeration System ☐ Sewer Line Connection ☐ Sewer Lateral Only ☐ Mobile Home Installation
☐ Other _____

License holder declares responsibility for scope of work indicated for the following permits:

1. Building Permit Number: _____ General Contractor: _____

Job Site Address: _____

This is to certify that I am responsible for the scope of work indicated above. In the event of any change in my status on this installation, I understand that I will be held responsible for the job until the Community Development Department has been notified, in writing, of any change.

_____ _____
Subcontractor Signature Date

_____
Notary Signature

State of Georgia
Sworn and Subscribed before me
This _____ day of _____ 20_____ Notary Seal

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SECTION 013300 – SUBMITTAL-RFI PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.
3. RFIs.

1.2 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.3 SUBMITTAL SCHEDULE

A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.

1.4 SUBMITTAL FORMATS

A. Submittal Information: Include the following information in each submittal:

1. Project name.
2. Date.
3. Name of Architect.
4. Name of Construction Manager.
5. Name of Contractor.
6. Name of firm or entity that prepared submittal.
7. Names of subcontractor, manufacturer, and supplier.

8. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier; and alphanumeric suffix for resubmittals.
9. Category and type of submittal.
10. Submittal purpose and description.
11. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
12. Drawing number and detail references, as appropriate.
13. Indication of full or partial submittal.
14. Location(s) where product is to be installed, as appropriate.
15. Other necessary identification.
16. Remarks.
17. Signature of transmitter.

B. Options: Identify options requiring selection by Architect.

C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

D. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

E. Submittals for Utilizing Web-Based Project Management Software: Prepare submittals as PDF files, or other format indicated by Project management software.

1.5 SUBMITTAL PROCEDURES

A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Email: Prepare submittals as PDF package, and transmit to Architect by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Architect.
2. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project management software website. Enter required data in web-based software site to fully identify submittal.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.

3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. Resubmittal Review: Allow 15 days for review of each resubmittal.

D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

1.6 SUBMITTAL REQUIREMENTS

A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:

    a. Manufacturer's catalog cuts.
    b. Manufacturer's product specifications.
    c. Standard color charts.
    d. Statement of compliance with specified referenced standards.
    e. Testing by recognized testing agency.
    f. Application of testing agency labels and seals.
    g. Notation of coordination requirements.
    h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:

    a. Wiring diagrams that show factory-installed wiring.
    b. Printed performance curves.
    c. Operational range diagrams.
    d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before Shop Drawings, and before or concurrent with Samples.

B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data unless submittal based on Architect's digital data drawing files is otherwise permitted.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

   a. Identification of products.
   b. Schedules.
   c. Compliance with specified standards.
   d. Notation of coordination requirements.
   e. Notation of dimensions established by field measurement.
   f. Relationship and attachment to adjoining construction clearly indicated.
   g. Seal and signature of professional engineer if specified.

C. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other materials.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Identification: Permanently attach label on unexposed side of Samples that includes the following:

   a. Project name and submittal number.
   b. Generic description of Sample.
   c. Product name and name of manufacturer.
   d. Sample source.
   e. Number and title of applicable Specification Section.
   f. Specification paragraph number and generic name of each item.

3. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics, and identification information for record.
4. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
5. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

   a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
   b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

6. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.

    a. Number of Samples: Submit three full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.

7. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

    a. Number of Samples: Submit three sets of Samples. Architect will retain one Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record Sample.

        1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
        2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.

G. Certificates:

1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.

2. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
4. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
5. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

H. Test and Research Reports:

1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

    a. Name of evaluation organization.
    b. Date of evaluation.
    c. Time period when report is in effect.
    d. Product and manufacturers' names.
    e. Description of product.
    f. Test procedures and results.
    g. Limitations of use.

1.7 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

1.8 CONTRACTOR'S REVIEW

A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

1.9 ARCHITECT'S REVIEW

A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return it.

1. PDF Submittals: Architect will indicate, via markup on each submittal, the appropriate action, as follows:

Comment	Meaning
Reviewed/No Exceptions Taken	Acceptance for construction
Rejected	Not acceptable

Comment	Meaning
Reviewed/Exceptions Noted	Incorporate corrections/Process
Revise and Resubmit	Revise in accordance with corrections or comments and resubmit.
Not Subject to Review	Submittal is not required and has not been reviewed.

B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

E. Architect will return without review submittals received from sources other than Contractor.

F. Submittals not required by the Contract Documents will be returned by Architect without action.

1.10 REQUEST FOR INFORMATION (RFI)

A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Owner name.
2. Owner's Project number.
3. Name of Architect.
4. Architect's Project number.
5. Date.
6. Name of Contractor.
7. RFI number, numbered sequentially.
8. RFI subject.

9. Specification Section number and title and related paragraphs, as appropriate.
10. Drawing number and detail references, as appropriate.
11. Field dimensions and conditions, as appropriate.
12. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
13. Contractor's signature.
14. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.

D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven (7) days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.

1. The following Contractor-generated RFIs will be returned without action:

    a. Requests for approval of submittals.
    b. Requests for approval of substitutions.
    c. Requests for approval of Contractor's means and methods.
    d. Requests for coordination information already indicated in the Contract Documents.
    e. Requests for adjustments in the Contract Time or the Contract Sum.
    f. Requests for interpretation of Architect's actions on submittals.
    g. Incomplete RFIs or inaccurately prepared RFIs.

2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect of additional information.
3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal.

    a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within five days of receipt of the RFI response.

E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Software log with not less than the following:

1. Project name.
2. Name and address of Contractor.
3. Name and address of Architect.
4. RFI number including RFIs that were returned without action or withdrawn.
5. RFI description.
6. Date the RFI was submitted.
7. Date Architect's response was received.

F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within three days if Contractor disagrees with response.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013300

SECTION 013330 - STRUCTURAL SUBMITTALS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Structural submittals include shop drawings, design calculations, diagrams, illustrations, schedules, performance charts, nomenclature charts, samples, brochures and other data prepared by the Contractor or any subcontractor, manufacturer, supplier, fabricator, or distributor and which illustrate some portion of the Project.

B. Submittals by the Contractor are not a part of the Contract Documents.

1.2 RELATED SECTIONS

A. Section 013300 – Submittals

1.3 SUBMITTAL PROCEDURES

A. Prior to the initial submittal, Contractor shall submit to the Design Professional a completed Submittal Information and Schedules form given in Appendix I.

B. Submittals shall be accompanied by a transmittal letter with the following information:

1. Project name.
2. Contractor's name.
3. Date submitted.
4. Description of items submitted; identify work and product by Specification Section.
5. Number of drawings and other pertinent data.

C. Provide blank space on each submittal for the Design Professional's review stamp.

D. The type and number of submittals for each item shall be in accordance with Section 013000.

E. Contractor shall direct specific attention on the submittal to any deviation from the Contract Documents.

1.4 CONTRACTOR RESPONSIBILITY

A. Contractor shall make all submittals in advance of installation or construction to allow the Design Professional sufficient time for review.

B. Contractor shall stamp and sign each sheet of shop drawings and product data, and sign or initial each sample to certify compliance with requirements of Contract Documents. SUBMITTALS RECEIVED WITHOUT THE CONTRACTOR'S STAMP OF REVIEW WILL BE RETURNED TO THE CONTRACTOR FOR REVIEW AND RESUBMITTAL.

C. Contractor shall understand that the submittal of the required documents does not constitute compliance with the requirements of the Contract Documents; only submittals reviewed by the Design Professional constitute compliance.

D. It is the Contractor's responsibility to furnish equipment, materials, and labor for the Project which meets the requirements of the codes and authorities quoted as well as the Contract Documents. Proprietary items specified herein only establish a minimum functional and aesthetic standard and it is incumbent upon the Contractor to ascertain conformance of these proprietary items or any proposed substitution with the codes and authorities.

E. By reviewing, approving and submitting shop drawings, product data, or samples, Contractor thereby represents that he has determined and verified all field measurements, field construction criteria, materials, member sizes catalog numbers, and similar data and that he has checked and coordinated shop drawings with the requirements of the Project and of the Contract Documents.

F. Work requiring shop drawings, whether called for by the Contract Documents or requested by the Contractor, shall not commence until the submission has been reviewed by the Design Professional. Work may commence if the Contractor verifies the accuracy of the Design Professional's corrections and notations and complies with them without exception and without requesting change in Contract Sum or Contract Time.

1.5 DESIGN PROFESSIONAL REVIEW

A. Design Professional will review submittals with reasonable promptness.

B. Design Professional's review or corrections refer only to the general arrangement and conformance of the subject of the submittals with the design concept of the project and with the information given in the Contract Documents. Under no conditions should the Contractor consider the review to include the dimensions, quantities, and details of the items nor the approval of an assembly in which the item functions.

C. Design Professional's review shall not relieve the Contractor from responsibility for errors or omissions in the submittals.

D. Design Professional's review of submittals shall not relieve the Contractor of responsibility for any deviation from the requirements of the Contract Documents

unless the Contractor has directed specific attention to the deviation at the time of submission and the Design Professional has given written approval to the specific deviation.

E. Design Professional's review of submittals shall not be construed as authorizing any change in the Contract Sum or Contract Time.

1.6 SHOP DRAWINGS

A. Present in a clear and thorough manner. Title each drawing with Project name and number; identify each element of drawings by reference to sheet number and detail of Contract Documents.

B. Reproduction of Structural Drawings for shop drawings is not permitted. Electronic drawing files will not be provided to the Contractor.

C. Identify field dimensions; show relationship to adjacent or critical features of Work or products.

D. A copy of the marked structural shop drawings with the Design Professional's review stamp is to be maintained at the job site.

1.7 PRODUCT DATA

A. Submit only pages which are pertinent; mark each copy of standard printed data to identify pertinent products, referenced to Specification Section and Article number. Show reference standards, performance characteristics, and capacities; wiring and piping diagrams and controls; component parts; finishes; dimensions; and required clearances.

B. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete information which is not applicable.

C. Provide manufacturer's preparation, assembly, and installation instructions.

1.8 SAMPLES

A. Submit full range of manufacturer's standard finishes except where more restrictive requirements are specified, indicating colors, textures, and patterns.

B. Submit samples to illustrate functional characteristics of products, including parts and attachments as required by Design Professional.

C. Approved samples which are of proper size may be incorporated in Work.

D. Label each sample with identification.

E. Field Finishes: Provide full samples at Project, at location acceptable to Design Professional, as required by individual Specification Section. Install each sample complete and finished. Acceptable finishes in place may be retained in completed work.

1.9 RESUBMITTALS

A. When submittals are returned to the Contractor with the Design Professional's corrections the Contractor shall make the required corrections. Upon request, resubmit one corrected set.

B. Contractor shall direct specific attention on the resubmittal to all revisions including those requested by the Design Professional on previous submission.

1.10 DISTRIBUTION

A. Distribute reproductions of shop drawings, copies of product data, and samples which bear the Design Professional's review stamp to job site file, Record Documents file, subcontractors, suppliers, other affected contractors, and other entities requiring information.

B. Work shall be in accordance with and performed from the reviewed drawings.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013330

APPENDIX I
SUBMITTAL INFORMATION AND SCHEDULES

PROJECT _____
CONTRACTOR _____
CONTRACTOR'S ADDRESS _____
PROJ. MANAGER _____
PHONE _____
FAX _____
SUPERINTENDENT _____
PHONE _____
FAX _____
MOBILIZATION DATE _____

PROJECTED SUBMITTAL DATES

FOUNDATION, CONCRETE & REINFORCING		STRUCTURAL STEEL		MASONRY	
SUBMITTAL	DATE	SUBMITTAL	DATE	SUBMITTAL	DATE
Site Preparation & Equipment Information		Fabricator / Erector Qualifications		Grout & Mortar Mix	
Concrete Mix Design		Anchor Bolt & Embedded Items		Block Prism & Comp. Strength	
Foundation Reinforcing		Erection & Detail Drawings		Reinforcing	
Structural Frame Reinforcing				Written Procedures	
Miscellaneous Frame Reinforcing		Joists			
Post-Tensioning		Deck		WOOD	DATE
Precast		Cooling Tower, Elevator & Stair Drawings		Trusses	

REMARKS: _____

COMPLETED BY _____ DATE _____

END OF APPENDIX I

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SECTION 014525 - STRUCTURAL TESTING/INSPECTION AGENCY SERVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Section summarizes the responsibility of the Contractor and the Structural Testing/Inspection Agency in the performance of the testing/inspection specified in the Contract Documents.

B. Neither the observation of the Design Professional in the administration of the contract, nor tests/inspections by the Testing/Inspection Agency, nor approvals by persons other than the Design Professional shall relieve the Contractor from his obligation to perform the work in accordance with the Contract Documents.

1.2 RELATED SECTIONS

A. Section 013330 - Structural Submittals.

B. Section 014000 - Quality Control Services.

1.3 REFERENCES

A. ASTM D3740 - Practice for Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

B. ASTM E329 - Recommended Practice for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction.

C. American Council of Independent Laboratories - Recommended Requirements for Independent Laboratories Qualifications.

1.4 SELECTION AND PAYMENT

A. Owner will employ and pay for the structural testing/inspection services that are required by the Contract Documents.

B. Contractor shall pay for any additional structural testing/inspection required for work or materials not complying with Contract Documents due to negligence or nonconformance.

C. Contractor shall pay for any additional structural testing/inspection required for his convenience.

D. Qualifications: Minimum Special Inspector qualifications shall be per Table 1704.2 of 2022 Georgia State Amendments to the International Building Code (2018 Edition).

1.5 STRUCTURAL TESTING/INSPECTION REQUIREMENT SUMMARY

A. Specific structural testing/inspection requirements are given in the following specification sections:

Specification 03 1000	-	Concrete Formwork Inspection
Specification 03 2000	-	Concrete Reinforcement Inspection
Specification 03 3000	-	Concrete Testing/Inspection
Specification 03 6200	-	Non-Shrink Grout Inspection
Specification 04 2200	-	Masonry Testing/Inspection
Specification 05 1000	-	Structural Steel Inspection
Specification 31 2301	-	Excavating, Backfilling, and Compacting For Structures

1.6 STATEMENT OF SPECIAL INSPECTIONS

A. Provide testing/inspection required to meet the provisions of the Schedule of Special Inspection Services below.

PART 2 - MATERIALS (Not Used)

PART 3 - EXECUTION

3.1 STRUCTURAL PRECONSTRUCTION MEETING

A. A structural preconstruction meeting may be conducted at the construction site by the Design Professional to discuss quality issues. The parties involved may be the Design Professional, Contractor, Structural Testing/Inspection Agency, appropriate subcontractors, suppliers, and detailers.

3.2 STRUCTURAL TESTING/INSPECTION AGENCY'S RESPONSIBILITIES

A. Cooperate with the Contractor and provide timely service.

B. Upon arriving at the construction site, sign in and notify the Contractor of presence.

C. Select the representative samples that are to be tested/ inspected.

D. Perform tests/ inspections as outlined in Contract Documents, the applicable codes, and as directed by the Design Professional.

E. Report work and materials not complying with Contract Documents immediately to the Contractor and Design Professional.

F. Leave copies of field notes with the Contractor prior to leaving the construction site. Field notes shall include the message given to the Contractor, date, time of message, name of Contractor's representative informed, type and location of work or materials tested/inspected, whether the work or materials complies with Contract Documents and name of the Structural Testing/Inspection Agency's representative.

G. Report and distribute results of tests/inspections promptly in the form of written reports as directed by the Design Professional.

H. Structural Testing/Inspection Agency shall not alter requirements of Contract Documents, approve or reject any portion of the work, or perform duties of the Contractor.

3.3 CONTRACTOR'S RESPONSIBILITIES

A. Provide copy of Contract Documents to the Structural Testing/Inspection Agency.

B. Arrange the preconstruction meeting to discuss quality issues.

C. Notify the Structural Testing/Inspection Agency sufficiently in advance of operations to allow assignment of personnel and scheduling of tests.

D. Cooperate with Structural Testing/Inspection Agency and provide access to work.

E. Provide samples of materials to be tested in required quantities.

F. Furnish copies of mill test reports when requested.

G. Provide storage space for Structural Testing/Inspection Agency's exclusive use, such as for storing and curing concrete testing samples.

H. Provide labor to assist the Structural Testing/Inspection Agency in performing tests/inspections.

3.4 OPTIONS

A. If the Structural Testing/Inspection Agency is located at such a distance from the project that travel expenses will be a consideration, or if the amount of sampling performed is minor, and by mutual agreement of the Design Professional and Contractor, the Contractor may be requested to take samples and forward them to the Structural Testing/Inspection Agency for testing/inspection.

END OF SECTION 014525

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SECTION 020100 - SITEWORK GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Site work includes the work shown and reasonably inferred from the drawings, technical specifications, and contract documents. Provide materials, labor, equipment and supervision required to perform the work complete.

B. The scope of site work includes, but is not limited to the following:

1. Construction staking and other construction engineering required to control the work.
2. Erosion and sedimentation control construction.
3. Temporary groundwater control.
4. Site preparation, including stripping and undercutting unsuitable subgrade soils, demolition, and removal from the project lands of materials not to be used for construction.
5. Site grading, including excavation, filling, compaction, and preparation of subgrades for paving. Site grading includes importing material, stockpiling and hauling from stockpiles, and other work necessary to construct embankments and excavations as shown and specified.
6. Construction of curbs.
7. Construction of paving.
8. Installation of soil amendments and landscape.
9. Installation of granite walls and guardrails.
10. Installation and coordination of temporary warning signs, directional signs, barricades and fences required to direct, control and protect the public throughout the construction period.
11. Installation of site amenities.
12. Installation of lighting.
13. Installation of special features indicated on the drawings.

C. Existing Site Conditions

1. As required by General Conditions Article 7 and Article 8, the Contractor shall examine the existing conditions of the Work site and verify locations shown on the Drawings before starting any work in that general area.
2. The existing conditions shown on the Drawings is based on a combination of field survey data and design drawings of work which was intended to be constructed prior to the Work of this Project. Not all of the information shown has been field verified, including existing ground topography, existing constructed facilities and appurtenances, and underground and overhead utility systems, including storm drainage systems, lighting systems, power systems, gas systems, communication systems, water systems and sanitary sewer systems.

3. Should existing conditions not be as shown on the Drawings, the Contractor shall notify the Engineer as required by the General Conditions.

1.2 SAFETY

A. Safety & Protection: Initiate, maintain, and supervise safety precautions and programs in connection with the Work. Take necessary precautions for the safety of, and provide the necessary protection to prevent damage, injury or loss to employees on the job and other persons or organizations.

B. Safe trench construction is mandatory. Lay back slopes or shore as necessary.

C. Control traffic during operations on existing streets.

D. Erect and maintain barricades, fences, and other physical blockages sufficient to exclude the public from construction areas.

1.3 PROTECTION OF ADJACENT LANDS

A. Limit construction to areas so indicated on the drawings and designated by the Owner. Protect areas beyond the construction which are subject to the effect or byproduct of the construction effort.

B. Make special effort to prevent soil erosion and sediment transport onto adjacent lands. Restore disturbance to areas outside the designated construction limits to a satisfactory condition, as determined by the Owner or governing authority, at no cost to the Owner.

C. Take precautionary measures to prevent damage to the adjoining public street system. Clean mud or debris deposited as a result of this construction.

D. Perform construction on the right-of-way or on other properties not in possession of the Owner in strict accordance with the terms of the permits or easements. Obtain copies of permit and easement conditions affecting the work.

1.4 CONSTRUCTION ENGINEERING

A. Provide construction staking, dimensional control, and related construction engineering for phases of the Work.

1.5 GEOTECHNICAL ENGINEERING

A. Geotechnical quality control services will be performed by a geotechnical engineering firm (referred to as the Geotechnical Engineer) selected and hired by the Owner.

B. Provide in cooperation with the Geotechnical Engineer, as a minimum, monitoring and testing services of earthwork, drainage, utility construction, site preparation and demucking, underdrain construction, and pavement construction. Report results of tests verbally on completion of the work and provide daily written reports at the job site.

1. Fill Placement: Monitor placement of fill for suitability of fill materials, uniformity of compaction operations, and compliance with aspects of these Specifications. Test soil fill for compliance with compaction requirements. Monitor rock fill for appropriate placement procedures, particle size, and lift thickness.
2. Stripping and Demucking: Evaluate subgrades upon which fill is to be placed prior to fill placement. Monitor conditions and make appropriate recommendations. In the event of unstable subgrades, soil bridging, or provide stabilization stone as required. Discuss with the Owner, who will then authorize the procedure to be used.
3. Underdrains: Monitor underdrain construction for compliance with the plans and specifications. If unforeseen conditions which impact the design and construction of underdrains are encountered, make appropriate recommendations to the Owner.
4. Underground Utilities: Monitor installation of underground utilities and structures for compliance to specifications for materials, procedures, and workmanship. Evaluate the suitability of the subgrade upon which the pipes are to be constructed. Issue appropriate recommendations if unsuitable conditions are detected.
5. Backfilling: Monitor backfills and test to evaluate compliance with the specifications.
6. Retaining Walls: Provide monitoring and testing services during construction of retaining walls. The actual scope of these services will be dependent upon the type of wall used. Comply with the practice recommended by the designer of the wall system.
7. Pavements: Monitor preparation and proofrolling of the soil subgrade upon which pavements are to be constructed. When unstable soils are encountered, recommend appropriate remedial action to the Owner, who will then direct the Contractor as to the course of action. Monitor construction of the pavement system. Test thickness, gradations, and compactions of base course and surface course.

1.6 RESPONSIBILITY OF THE CONTRACTOR

A. The Contractor is responsible for compliance with the Contract Documents. Monitoring and testing by the Geotechnical Engineer does not infer acceptance of responsibility by the Geotechnical Engineer, the Design Professional, or the Owner. When monitoring and testing indicates that construction does not meet Specification requirements, rework to obtain compliance.

1.7 AS-BUILT PLANS

A. Maintain "Contractor's mark-up as-built" plans of construction. Certify the accuracy and completeness of these plans and deliver to the Owner.

B. Prepare as-built plans of construction to be dedicated to Governmental entities and deliver in a form that is acceptable to the receiving agency.

C. As-built topographic maps of detention structures may be required by governmental jurisdictions. If required, provide a topographic survey sufficient to confirm structure volume as well as dimensions and deviations of outlet structures.

D. Retain a registered surveyor to certify as-built surveys required by governmental jurisdictions.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 020100

SECTION 024119 – SELECTIVE STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.

1.2 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Detach items from existing construction and deliver them to Owner.

C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.3 MATERIALS OWNERSHIP

A. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to Owner that may be encountered during selective demolition remain Owner's property. Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to Owner.

1.4 SUBMITTALS

A. Qualification Data: For demolition firm.

B. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Locations of proposed dust- and noise-control temporary partitions and means of egress.
5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
6. Means of protection for items to remain and items in path of waste removal from building.

C. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged.

D. Pre-demolition Photographs or Videotapes: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by selective demolition operations. Submit before Work begins.

E. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1. Comply with submittal requirements.

1.5 QUALITY ASSURANCE

A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.

B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

C. Standards: Comply with ANSI A10.6 and NFPA 241.

D. Pre-demolition Conference: Conduct conference at Project site to comply with City and state regulations and requirements. Review methods and procedures related to selective demolition including, but not limited to, the following:

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.6 PROJECT CONDITIONS

A. Conduct selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Storage or sale of removed items or materials on-site is not permitted.

E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

1.7 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped.

B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

E. Engage a professional engineer to survey condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective demolition operations.

F. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or preconstruction videotapes.

1. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

G. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.

B. Service/System Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
2. Arrange to shut off indicated utilities with utility companies.
3. If services/systems are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
4. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.

5. Where entire wall is to be removed, existing services/systems may be removed with removal of the wall.

3.3 PREPARATION

A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.

3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.

C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
5. Maintain adequate ventilation when using cutting torches.
6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
9. Dispose of demolished items and materials promptly.

B. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.

5. Protect items from damage during transport and storage.

C. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in small sections. Cut concrete to a depth of at least 3/4 inch at junctures with construction to remain, using power-driven saw. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete indicated for selective demolition. Neatly trim openings to dimensions indicated.

B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals, using power-driven saw, then remove concrete between saw cuts.

C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.

D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow demolished materials to accumulate on-site. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
2. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.7 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

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SECTION 031000 - CONCRETE FORMWORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Section includes the design and erection of formwork, shoring and reshoring for cast-in-place concrete and accessories.

1.2 REFERENCES

A. ACI CODE-318 – building Code Requirements for Structural Concrete and Commentary 2019 (Reapproved 2022)

B. ACI PRC-347 – Guide to Formwork for Concrete 2014 (Reapproved 2021).

C. ACI SPEC-117 – Specification for Tolerances for Concrete Construction and Materials 2010 (Reapproved 2015)

D. ACI SPEC-301 – Specifications for Concrete Construction 2020.

1.3 SUBMITTALS

A. Product Data: For each of the following:

1. Exposed surface form-facing material.
2. Concealed surface form-facing material.
3. Forms for cylindrical columns.
4. Form liners.
5. Form ties.
6. Isolation joint filler.
7. Waterstops.
8. Form-release agent.

B. Shop Drawings: Prepared by, and signed and sealed by, a qualified professional engineer responsible for their preparation, detailing fabrication, assembly and support of forms.

1. For exposed vertical concrete walls, indicate dimensions and form tie locations.
2. Indicate dimension and locations of construction and movement joints required to construct the structure in accordance with ACI 301.

    a. Location of construction joints is subject to approval of the Architect.

3. Indicate location of waterstops.
4. Indicate form liner layout and form line termination details.
5. Indicate proposed schedule and sequence of stripping of forms, shoring removal and reshoring installation and removal.

C. Samples: Submit two, 12 inch long samples of waterstops and construction joint devices.

D. Designer's Qualification Statement.

E. Design Data: As required by authorities having jurisdiction.

1.4 QUALITY ASSURANCE

A. Designer Qualifications: Design formwork under direct supervision of a Professional Structural Engineer experienced in design of concrete formwork and licensed in the State in which the Project is located.

1.5 MOCK-UPS

A. Construct a mock-up of formwork for pattern, 4 feet long by 4 feet wide.

1. Provide concrete in accordance with provisions of Section 033000.
2. Cure concrete in accordance with provisions of Section 033000.

B. Locate mock-up where directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Concrete Formwork: Design, engineer, erect, shore and brace, and maintain formwork, shores, and reshores in accordance with ACI 301, ACI CODE-318 and ACI PRC-347 to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.

1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."
2. Design formwork to limit deflection of form-facing material to l/360 of center-to-center spacing of supports.

2.2 FORM-FACING MATERIALS

A. As-Cast Surface Form-Facing Material:

1. Provide continuous, true, and smooth concrete surfaces.
2. Furnish in largest practicable sizes to minimize number of joints.
3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete, and as follows:

    a. Plywood, metal, or other approved panel materials.
    b. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

        1) APA HDO (high-density overlay).
        2) APA MDO (medium-density overlay); mill-release agent treated and edge sealed.
        3) APA Structural 1 Plyform, B-B or better; mill oiled and edge sealed.
        4) APA Plyform Class I, B-B or better; mill oiled and edge sealed.

B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.

1. Provide lumber dressed on at least two edges and one side for tight fit.

2.3 FORMWORK ACCESSORIES

A. Form Ties: Removable type, galvanized metal, fixed length, cone type, with waterproofing, free of defects that could leave holes larger than 1 inch in concrete surface.

B. Form Release Agent: Capable of releasing forms from hardened concrete without staining or discoloring concrete or forming bugholes and other surface defects, compatible with concrete and form materials, and not requiring removal for satisfactory bonding of coatings to be applied.

1. Composition: Colorless, reactive, water-based compound.

    a. Products:

        1) Kaufman Products Inc; FormKote
        2) Emulsion: www.kaufmanproducts.net/#sle.
        3) Nox-Crete Inc; BIO-NOX: www.nox-crete.com/#sle.
        4) SpecChem, LLC; Bio Strip WB (water-based): www.specchemllc.com/#sle.
        5) W. R. Meadows, Inc; Duogard II (water-based): www.wrmeadows.com/#sle.

C. Embedded Anchor Shapes, Plates, Angles and Bars: As specified in section 051200.

2.4 FORM RELEASE AGENT

A. Form release agent shall not bond with, stain, nor adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
2. Form release agent for form liners shall be acceptable to form liner manufacturer.

2.5 FORM TIES

A. Factory-fabricated, removable or snap-off, glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that leave no corrodible metal closer than 1 inch (25 mm) to the plane of exposed concrete surface.
2. Furnish ties that, when removed, leave holes no larger than 1 inch (25 mm) in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.6 WATERSTOPS

A. Waterstops at construction joints and control joints indicated by the Drawings shall be sized to suit the joints.

B. Waterstops shall be flat dumbbell type or centerbulb type at control joints and construction joints where shown on drawings.

C. Waterstops shall be preformed plastic adhesive waterstops at cold joints in concrete where shown on the drawings. Provide triangular shapes at walls with 8-inch thickness.

2.7 DOVETAIL ANCHORS

A. Dovetail anchors shall consist of 24 gage galvanized steel dovetail anchoring slots with filler strips and 16 gage galvanized dovetail anchors, unless otherwise noted on Drawings.

2.8 ISOLATION JOINT FILLER

A. Asphalt impregnated premolded fiberboard isolation joint filler shall conform with ASTM D1751 and be 1/2-inch thick by full thickness of slab or joint, unless indicated otherwise on the Drawings.

2.9 CONSTRUCTION JOINTS

A. Provide key type steel forms by Vulcan screed joints, Burke Keyed Kold joint form or Form-A-Key.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions agree with drawings.

3.2 INSTALLATION OF FORMWORK

A. Comply with ACI 301.

B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 and to comply with the Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete" for as-cast finishes

C. Limit concrete surface irregularities as follows:

1. Surface Finish-1.0: ACI 117 Class C, 1/2 inch (12 mm).

a. To be used on concrete surfaces not exposed to view.

2. Surface Finish-2.0: ACI 117 Class B, 1/4 inch (6 mm).

a. To be used on concrete surfaces exposed to view.

D. Construct forms tight enough to prevent loss of concrete mortar.

1. Minimize joints.
2. Exposed Concrete: Symmetrically align joints in forms.

E. Construct removable forms for easy removal without hammering or prying against concrete surfaces.

1. Provide crush or wrecking plates where stripping may damage cast concrete surfaces.
2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
3. Install keyways, reglets, recesses, and other accessories, for easy removal.

F. Do not use rust-stained, steel, form-facing material.

G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.

1. Provide and secure units to support screed strips.
2. Use strike-off templates or compacting-type screeds.

H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.

1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
2. Locate temporary openings in forms at inconspicuous locations.

I. Chamfer exterior corners and edges of permanently exposed concrete. Provide 3/4-inch chamfer at all corners.

J. At construction joints, overlap forms onto previously placed concrete not less than 12 inches.

K. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.

1. Determine sizes and locations from trades providing such items.
2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.

L. Construction and Movement Joints:

1. Construct joints true to line with faces perpendicular to surface plane of concrete.
2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Design Professional.
3. Place joints perpendicular to main reinforcement.
4. Locate joints for beams, slabs, joists, and girders in the middle third of spans.

    a. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.

5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
6. Space vertical joints in walls per Specification 033000 Cast-In-Place Concrete.

    a. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.

7. Provide construction joints in accordance with ACI 318.
8. Provide 1 1/2-inch-deep key type construction joints at end of each placement for slabs, beams, walls, and footings. Bevel forms for easy removal.
9. Remove loose particles and latency from surface prior to placing the next lift. Chip the surface to a depth sufficient to expose sound concrete.

M. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.

1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.

N. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

O. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

P. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement. Do not allow excess form release agent to accumulate in forms or come in contact with concrete surfaces against which fresh concrete will be placed.

3.3 CAMBER

A. Camber formwork for slabs and beams to compensate for anticipated deflections in formwork prior to hardening of concrete to maintain tolerances specified by ACI 117.

B. Set screeds to a like camber to maintain specified concrete thickness.

3.4 FOUNDATION ELEMENTS

A. Form foundation elements if soil or other conditions are such that earth trench forms are unsuitable.

B. Sides of exterior grade beams, foundation walls, and turned-down slabs shall be formed.

C. Maintain minimum coverage of reinforcing steel as indicated on Structural Drawings.

3.5 INSTALLATION OF WATERSTOPS

A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm.

1. Install in longest lengths practicable.
2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
3. Allow clearance between waterstop and reinforcing steel of not less than 2 times the largest concrete aggregate size specified in Section 033000 "Cast-In-Place Concrete."
4. Secure waterstops in correct position at 12 inches (305 mm) on center.

5. Field fabricate joints in accordance with manufacturer's instructions using heat welding.

    a. Miter corners, intersections, and directional changes in waterstops.
    b. Align center bulbs.

6. Clean waterstops immediately prior to placement of concrete.
7. Support and protect exposed waterstops during progress of the Work.

B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated on Drawings, according to manufacturer's written instructions, by adhesive bonding, mechanically fastening, and firmly pressing into place.

1. Install in longest lengths practicable.
2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
3. Protect exposed waterstops during progress of the Work.

3.6 INSTALLATION OF EMBEDDED ITEMS

A. Set and secure embedded plates, bearing plates, and anchor bolts in accordance with approved setting drawings and in such a manner to prevent displacement during placement of concrete.

B. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.

C. Install and secure in position required inserts, hangers, sleeves, anchors, and nailers.

D. Install continuous vertical dovetail anchoring slots with filler strips at intersections of concrete and masonry walls unless indicated otherwise by the Drawings.

E. Clean embedded items immediately prior to concrete placement.

3.7 VAPOR BARRIER

A. Where indicated on Drawings, place vapor barrier over sewer, piping, and granular subbase, but below conduits and ducts, and behind insulation and expansion joints at sidewalls.

B. Lap vapor barrier six inches minimum at splices.

C. Do not puncture vapor barrier.

3.8 REMOVING AND REUSING FORMS

A. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than

50 deg F (10 deg C) for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work.

1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed surfaces.
2. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.

1. Align and secure joints to avoid offsets.
2. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.9 SHORING AND RESHORING INSTALLATION

A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.

1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.10 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a [special inspector] [and] [qualified testing and inspecting agency] to perform field tests and inspections and prepare test reports.

B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

C. Inspections:

1. Inspect formwork for shape, location, and dimensions of the concrete member being formed.
2. Inspect insulating concrete forms for shape, location, and dimensions of the concrete member being formed.

END OF SECTION 031000

SECTION 031100 - CONCRETE FORMWORK - SITE

PART 1 - GENERAL

1.1 SUMMARY OF WORK

A. This Section specifies concrete formwork, accessories, form coating, erection, stripping and reshoring and erection tolerances.

1.2 SUBMITTALS

A. Manufacturer's Literature: Submit copies of manufacturer's product specifications and installation instructions for manufactured products, including form sealer and release agent.

B. Shop Drawings for formwork where concrete is exposed to view that show form construction including jointing, special form joint or reveals, location and pattern of form tie placement and other items that become a feature of the wall.

C. Submit manufacturer's data for carton void forms.

1.3 QUALITY ASSURANCE

A. Industry Standards

1. American Concrete Institute, ACI-301, Specifications for Structural Concrete.
2. American Concrete Institute, ACI-318, Building Code Requirements for Reinforced Concrete.
3. American Concrete Institute, ACI-347, Recommended Practice for Concrete Formwork.
4. American Concrete Institute, ACI-SP-15, Field Reference Manual.
5. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
6. ASTM E154 - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.
7. Southern Pine Inspection Bureau (SPIB) Grading Rules.
8. Western Wood Products Association (WWPA) Grading Rules.
9. American Plywood Association (APA) Grading Rules.

B. Allowable Tolerances: Construct formwork within tolerance requirements of ACI 117, ACI 301, ACI 318 and ACI 347- or as approved by Owner’s Representative. Maximum deflection of form facing material between supports shall be limited to 0.0025 x span.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

A. Forms for Exposed Finish Concrete: Plywood, metal, metal-framed plywood faced; or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings.

B. Forms for Unexposed Finish Concrete: Plywood timber, metal or other acceptable material. Provide lumber dressed on at least 2 edges and one side for tight fit.

C. Forms for Textured Finish Concrete: Units of face design, size arrangement, and configuration to match Landscape Architect's control sample. Provide solid backing and firm supports to ensure stability of textured form liners.

D. Forms for Cylindrical Columns: Metal, fiberglass-reinforced plastic, or paper or fiber tubes. Provide paper or fiber tubes of laminated plies with water-resistant adhesive and wax-impregnated exterior for weather and moisture protection. Provide units with sufficient wall thickness to resist wet concrete loads without deformation.

E. Form Coatings; Sealers and Release Agents: Provide commercial formulated form-coating compounds that will not bond with, stain or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces. Use single source for all forms.

F. Form Ties: Factory-fabricated, adjustable-length, removable or snap-off metal form ties, designed to prevent form deflection and to prevent spalling concrete upon removal. Provide units that will leave no metal closer than 1 1/2 inches to exposed surface. Spreader cones on ties shall not exceed 1 inch in diameter.

G. Earth Forms: Forms for footings may be cut into earth provided that earth is dry, stable, level and sound.

H. Vapor barrier shall consist of polyethylene sheet, not less than six mils thick.

PART 3 - EXECUTION

3.1 FORMWORK CONSTRUCTION

A. General: Design, erect, support, brace and maintain formwork to support vertical and lateral loads that might be applied until concrete structure can support such loads. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation and position. Maintain formwork construction tolerances complying with ACI 301, ACI 318 and ACI 347.

B. Construct forms to sizes, shapes, lines, and dimensions shown and to obtain accurate alignment, location, grades, level, and plumb work in finished structures. Provide for openings, offsets, keyways, rustications, chamfers, and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide backup at joints to prevent leakage of cement paste.

C. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for easy removal.

D. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection and for placement of concrete. Locate temporary openings in forms at inconspicuous locations.

E. Chamfer exposed corners and edges 3/4” or as indicated, using wood, metal, PVC or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

F. Forms coated to prevent bond with concrete shall be done in accordance with manufacturer's instructions. Materials which will stain or discolor the concrete shall not be applied to the form surfaces.

G. Cleaning and Tightening Thoroughly clean forms and adjacent surfaces to recure concrete. Remove chips, wood, sawdust, dirt or other debris just before concrete is placed. Retighten forms and bracing before concrete placement as required to prevent mortar leaks and maintain proper alignment.

H. Where indicated on Drawings, place vapor barrier over sewer, piping, and granular sub-base, but below conduits and ducts, and behind insulation and expansion joints at sidewalls. Lap vapor barrier six inches minimum at splices. Do not puncture vapor barrier.

3.2 REMOVAL OF FORMS

A. General: Formwork not supporting weight of concrete, such as sides of walls, and slabs may be removed after cumulatively curing at not less than 50 degrees for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form-removal operations, and provided curing and protection operations are maintained.

B. Contractor shall assume full responsibility for removal of formwork and forms shall be removed in such a manner as to insure complete safety of structure.

3.3 CLEANING

A. Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt or other debris just before concrete is placed.

END OF SECTION 031100

SECTION 032000 - CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.1 RELATED SECTIONS

A. Section 013330 - Structural Submittals.

B. Section 014525 - Structural Testing/Inspection Agency Services.

C. Section 031000 – Concrete Formwork.

D. Section 033000 – Cast-In-Place Concrete.

1.2 REFERENCES

A. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.

B. ACI 301 - Standard Specifications for Structural Concrete.

C. ACI 318- Building Code Requirements for Structural Concrete.

D. ASTM A1064- Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete Reinforcement.

E. ASTM A615- Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

F. ASTM A706- Standard Specification for Low-Alloy Steel Deformed Bars for Concrete Reinforcement.

G. AWS D1.4- Structural Weld Code - Reinforcing Steel.

H. CRSI - Manual of Practice, and Documents 63 and 65.

1.3 SUBMITTALS

A. Shop drawings:

1. Notify Design Professional prior to detailing reinforcing steel shop drawings.
2. Include placing drawings that detail fabrication, bending, and placement. Provide elevations of all wall reinforcement.

3. Include locations of proposed construction joints for approval by EOR. Contractor to submit sequence of placing concrete.
4. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement. Reinforcement detailing of standard hooks, splices and development lengths shall conform to ACI 318 unless noted otherwise on drawings.
5. Include proposed field bending or cutting locations and cutting methods for approval by EOR.
6. Written description of reinforcement without adequate sections, elevations, and details is not acceptable.
7. All revisions to shop drawings shall be clouded.
8. Reproduction of Structural Drawings for shop drawings is not permitted. Electronic drawing files will not be provided to the Contractor.

B. Submit a certification from each manufacturer or supplier stating that materials meet the requirements of the ASTM and ACI standards referenced.

C. Submit mill test reports.

D. Submit manufacturer's data for tensile and compressive splicers.

E. Submit manufacturer's data including installation recommendations for dowel adhesive.

1.4 QUALITY ASSURANCE

A. Coordinate and schedule in a timely manner with the Structural Testing/Inspection Agency the following quality related items:

1. Verify reinforcing steel for quantity, size, location, and support.
2. Verify proper reinforcing steel concrete coverage.
3. Inspect mechanical splice couplers and reinforcement welding.

B. Structural Testing/Inspection Agency shall provide special inspections as required by Chapter 17 of the building code and as required by Specification 014525.

C. The Structural Testing/Inspection Agency shall be qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

1.5 STORAGE AND PROTECTING

A. Store reinforcing steel above ground so that it remains clean. Maintain steel surfaces free from materials and coatings which might impair bond.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Deformed reinforcing steel shall conform to ASTM A615, refer to Structural Drawings for grade (Grade 60 minimum).

B. Welded steel wire fabric shall conform to ASTM A1064.

2.2 ACCESSORY MATERIALS

A. Annealed steel tie wire shall be 16-1/2 gage minimum.

B. Bar supports shall be plastic-tipped steel Class I bar supports conforming to CRSI Specifications. Concrete brick may be used to support reinforcement to obtain proper clearance from earth.

2.3 SPLICERS

A. Tensile splicers shall be capable of developing 125% of the reinforcing steel ASTM specified minimum yield strength.

B. Compression splicers shall be the mechanical type such that the compression stress is transmitted by end bearing held in concentric contact.

2.4 DOWEL ADHESIVE

A. Adhesive for reinforcing dowels in existing concrete shall conform to ASTM C881-13, Type IV, Grade 3, CLASS A, B, & C except gel times and epoxy content. Adhesive shall consist of a two component adhesive system contained in side by side packaging connected to a mixing nozzle which thoroughly mixes the components as it is injected into the hole. Adhesive shall have passed ICC Evaluation Services, Inc. Acceptance Criteria 308 for long term creep and be specifically approved for use in cracked concrete.

PART 3 - EXECUTION

3.1 FABRICATION

A. Fabricate steel in accordance with ACI 318 and CRSI standards.

B. Bend bars cold. Do not heat or flame cut bars. No field bending of bars partially embedded in concrete is permitted, unless specifically approved Design Professional and checked by Testing and Inspection Agency for cracks.

C. Weld only as indicated. Perform welding in accordance with AWS D1.4.

D. Tag reinforcing steel for easy identification.

3.2 INSTALLATION

A. Before placing concrete, clean reinforcement of foreign particles and coatings.

B. Place, support on chairs, and secure reinforcement against displacement in accordance with ACI 318 and CRSI standards. Do not deviate from alignment or measurement. Maximum support spacing shall not exceed 48 inches.

C. Place concrete beam reinforcement support parallel to main reinforcement.

D. Install welded-wire reinforcement in longest practicable lengths.

1. Locate welded wire fabric in the top third of slabs unless otherwise noted in drawings. WWF shall be supported on chairs.
2. Overlap mesh one lap plus two inches at side and end joints. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wires.
3. Support spacing of welded wire reinforcement shall not exceed 24 inches, unless noted otherwise on plans.

E. Furnish and install dowels or mechanical splices at intersections of walls, columns and piers to permit continuous reinforcement or development lengths at such intersections.

F. Maintain cover and tolerances in accordance with ACI and CRSI Specifications, unless indicated otherwise on Structural Drawings.

G. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.

H. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

3.3 INSTALLATION TOLERANCES

A. Comply with ACI 117 for installation tolerances.

3.4 SPLICES

A. Do not splice reinforcement except as indicated on Structural Drawings.

B. Stagger splices in accordance with ACI 318.

C. Tension couplers may be used and installed in accordance with manufacturer's specifications.

3.5 DOWELS IN EXISTING CONCRETE

A. Install dowels and dowel adhesive in accordance with manufacturer’s recommendations.

B. Minimum embedment length shall be 12 bar diameters, unless noted otherwise.

END OF SECTION 032000

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SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Section includes cast-in-place concrete work indicated in the Contract Documents or otherwise required for proper completion of the work.

1.2 RELATED SECTIONS

A. Section 013300 - Structural Submittals.

B. Section 014525 - Structural Testing/Inspection Agency Services.

C. Section 031000 - Concrete Formwork.

D. Section 032000 - Concrete Reinforcement.

E. Section 036200 - Non-Shrink Grout.

1.3 REFERENCES

A. ACI 301 - Specifications for Structural Concrete for Buildings.

B. ACI 318 - Building Code Requirements for Structural Concrete.

C. ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.

D. ASTM C33 - Standard Specification for Concrete Aggregates.

E. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

F. ASTM C94 - Standard Specification for Ready-Mixed Concrete.

G. ASTM C138 - Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.

H. ASTM C143 - Standard Test Method for Slump of Hydraulic Cement Concrete.

I. ASTM C150 - Standard Specification for Portland Cement.

J. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.

K. ASTM C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.

L. ASTM C230 - Standard Specification for Flow Table or Use in Tests of Hydraulic Cement.

M. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.

N. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.

O. ASTM C618 - Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.

P. ASTM E1155 - Standard Test Method for Determining Floor Flatness and Levelness Using the F-Number System.

Q. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.

1.4 NOTICE

A. Notify Design Professional and Structural Testing/Inspection Agency not less than 48 hours prior to placing concrete.

1.5 QUALITY ASSURANCE

A. Structural Testing/Inspection Agency shall perform the following quality related items:

1. Examine concrete in truck to verify that concrete appears properly mixed.
2. Perform a slump test as deemed necessary for each concrete load. Record if water or admixtures are added to the concrete at the job site. Perform additional slump tests after job site adjustments.
3. Concrete testing: Obtain one composite sample for each day’s pour of each concrete mixture exceeding 5 cu yd. plus one sample for each additional 100 cu. yd.
    a. At a minimum, obtain 5 compressive strength tests for each concrete mixture per ACI 318.
4. Per composite sample taken, mold four standard cured specimens per set for compressive strength testing. For each set molded, record:
    a. Slump
    b. Air content
    c. Unit weight
    d. Temperature, ambient and concrete
    e. Location of placement
    f. Any pertinent information, such as addition of water, addition of admixtures, etc.

5. Test concrete slabs for specified flatness and levelness in accordance with ASTM E1155. As a minimum, test three placements: the first placement and two additional placements as directed by the Design Professional. If the tested placement does not meet the specified overall values, test the next placement.

B. The ready-mixed concrete plant shall be certified for conformance with the requirements of the National Ready Mix Concrete Association.

C. The Structural Testing / Inspection Agency shall provide special inspections as required by Chapter 17 of the building code as required in Specification 014525.

1.6 CONCRETE MIX DESIGN

A. Establish concrete mix design proportions in accordance with ACI 318, Chapter 19 and 26 for each concrete strength noted on the contract drawings.

B. Submit concrete mix designs. Include the following:

1. Type and quantities of materials.
2. Slump.
3. Air content.
4. Fresh unit weight.
5. Aggregates sieve analysis.
6. Design compressive strength.
7. Location of placement in structure.
8. Method of placement.
9. Method of curing.
10. Seven-day and 28-day compressive strengths.

1.7 SLUMP

A. Design concrete with a maximum slump of five inches.

B. If a slump greater than five inches is desired it shall be achieved with a high-range water reducer. Design the concrete mix with a high range water reducer slump of two and one-half inches plus or minus one and one-half inches. The maximum slump after high-range water reducers are added shall be eight inches.

1.8 FRESH UNIT WEIGHT

A. Normal weight concrete shall have a fresh unit weight of 140 to 152 pcf.

1.9 AIR CONTENT

A. No entrained air content is required in concrete placed in the foundation.

B. Provide entrained air content per the table below and exposure category specified on structural drawings. Tolerance on air content as delivered shall be +/-1.5 percent.

Nominal maximum aggregate size, in.*	Air Content, percent	
	Exposure Class F1	Exposure Classes F2 and F3
3/8	6	7.5
1/2	5.5	7
3/4	5	6
1	4.5	6
1-1/2	4.5	5.5
* See ASTM C33 for tolerance on oversize for various nominal maximum size designations.		

1.10 WATER/CEMENT RATIO

A. Concrete elements shall have a maximum water cement ratio of 0.5, unless noted otherwise.

B. Air entrained concrete elements shall have a maximum water cement ratio of 0.45.

C. Concrete elements within an aggressive environment (Exposure Class F2) shall have a maximum water/cement ratio of 0.45.

1.11 SUBMITTALS

A. Submit a concrete mix design as specified above for each type of concrete included in the work.

B. Submit a certification from each manufacturer or supplier stating that materials meet the requirements of the ASTM and ACI standards referenced.

C. Submit manufacturer's data including Product Data and installation instructions for the following items. Manufacturer’s Data shall include the name of the manufacturer and date of the publication. All manufacturers’ data shall be maintained at the project site by the contractor.

1. Admixtures
2. Curing materials
3. Joint sealing materials
4. Expansion joint filler
5. Patching compounds

6. Bonding agents

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials designated by specific manufacturer's trade names are approved, subject to compliance with the quality and performance indicated by the manufacturer. Instructions and specifications, published by the manufacturer of such materials are included in and are a part of these specifications. Upon request, provide certification from manufacturer or supplier that materials designated by reference to ASTM and ACI standards meet the requirements of these standards.

2.2 CONCRETE STRENGTH

A. Provide concrete strengths indicated on the Structural Drawings.

2.3 CEMENT

A. Portland cement shall conform to ASTM C150, Type I, unless noted otherwise. Use one brand only.

2.4 AGGREGATE

A. Fine aggregate shall conform to ASTM C33.

B. Coarse aggregate of gravel or crushed stone shall conform to ASTM C33, Class 3M. Size coarse aggregate in accordance with ACI 318.

2.5 WATER

A. Water shall be potable and free of deleterious substances in accordance with ACI 318.

2.6 AIR ENTRAINING AGENT

A. Air entraining agent shall conform to ASTM C260.

2.7 WATER REDUCER

A. Water reducing agent shall conform to ASTM C494.

2.8 HIGH-RANGE WATER REDUCER

A. High-range water reducers (superplasticizers) shall conform to ASTM C494.

2.9 CHLORIDE

A. Use no chlorides of any form in concrete.

2.10 CURING MATERIALS

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

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.

C. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.

1. Color:
   a. Ambient Temperature Below 50 deg F (10 deg C): Black.
   b. Ambient Temperature between 50 deg F (10 deg C) and 85 deg F (29 deg C): Any color.
   c. Ambient Temperature Above 85 deg F (29 deg C): White.

D. Curing Paper: Eight-feet- (2438-mm-) wide paper, consisting of two layers of fibered kraft paper laminated with double coating of asphalt.

E. Water: Potable or complying with ASTM C1602/C1602M.

F. Clear, Waterborne, Membrane-Forming, Dissipating Curing Compound: ASTM C309, Type 1, Class B.

G. Clear, Waterborne, Membrane-Forming, Nondissipating Curing Compound: ASTM C309, Type 1, Class B, certified by curing compound manufacturer to not interfere with bonding of floor covering].

H. Clear, Waterborne, Membrane-Forming, Curing Compound: ASTM C309, Type 1, Class B, 18 to 25 percent solids, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering].

I. Clear, Solvent-Borne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.

J. Clear, Waterborne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.

2.11 FLY ASH

A. Fly ash shall be Class F fly ash with a loss on ignition of less than five percent or Class C fly ash with a loss on ignition of less than one percent in accordance with ASTM C618.

2.12 ACCELERATORS

A. Non-chloride accelerators shall conform to ASTM C494.

2.13 RETARDERS

A. Retarders shall conform to ASTM C494.

PART 3 - EXECUTION

3.1 HIGH-RANGE WATER REDUCERS

A. High-range water reducers are to be added at dosage recommended by the manufacturer. The slump of the concrete shall be one to four inches at the time the high-range water reducers are added. Do not permit fresh concrete containing superplasticizers to come in contact with fresh concrete not containing superplasticizers.

3.2 ADDITION OF WATER AT JOB SITE

A. Provide batch tickets indicating the amount of mix water withheld at the batch plant for each load of concrete delivered. Water may be added to the batch only if neither the maximum permissible water/cement ratio nor the maximum slump is exceeded.

B. Water shall not be added to the batch after the required on-site testing has been performed.

3.3 PLACEMENT OF CONCRETE

A. Deposit concrete as near as practical to final position to prevent segregation of concrete.

B. Do not use aluminum equipment in placing and finishing concrete.

C. Place thickened slabs for partitions integral with floor slabs.

D. Prepare place of deposit, mix, convey, place, and cure concrete in accordance with ACI 301 and ACI 318. Wet forms before placing concrete.

E. Concrete Placement

1. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
    a. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
    b. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.
2. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.
3. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect in writing, but not to exceed the amount indicated on the concrete delivery ticket.
    a. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
4. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301 (ACI 301M), but not to exceed the amount indicated on the concrete delivery ticket.
    a. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
5. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.
    a. If a section cannot be placed continuously, provide construction joints as indicated.
    b. Deposit concrete to avoid segregation.
    c. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
    d. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301 (ACI 301M).
        1. Do not use vibrators to transport concrete inside forms
        2. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer.
        3. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
        4. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
6. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
    a. Do not place concrete floors and slabs in a checkerboard sequence.

b. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
c. Maintain reinforcement in position on chairs during concrete placement.
d. Screed slab surfaces with a straightedge and strike off to correct elevations.
e. Level concrete, cut high areas, and fill low areas.
f. Slope surfaces uniformly to drains where required.
g. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
h. Do not further disturb slab surfaces before starting finishing operations.

3.4 TIME LIMIT

A. Deposit concrete within one and one-half hours after batching.

3.5 FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:

1. ACI 301 Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.
   a. Patch voids larger than 1-1/2 inches (38 mm) wide or 1/2 inch (13 mm) deep.
   b. Remove projections larger than 1/2 inch (25 mm).
   c. Tie holes do not require patching.
   d. Surface Tolerance: ACI 117 Class C.
   e. Apply to concrete surfaces not exposed to public view.
2. ACI 301 Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.
   a. Patch voids larger than 3/4 inch (19 mm) wide or 1/2 inch (13 mm) deep.
   b. Remove projections larger than 1/4 inch (6 mm).
   c. Patch tie holes.
   d. Surface Tolerance: ACI 117 Class B.
   e. Locations: Apply to concrete surfaces [exposed to public view,] [to receive a rubbed finish,] [or to be covered with a coating or covering material applied directly to concrete] <Insert locations>.
3. ACI 301 Surface Finish SF-3.0:
   a. Patch voids larger than 3/4 inch (19 mm) wide or 1/2 inch (13 mm) deep.
   b. Remove projections larger than 1/8 inch (3 mm).
   c. Patch tie holes.
   d. Surface Tolerance: ACI 117 Class A.

e. Locations: Apply to concrete surfaces [exposed to public view,] [to receive a rubbed finish,] [or to be covered with a coating or covering material applied directly to concrete] <Insert locations>.

3.6 CURING

A. Begin curing procedures immediately following the commencement of the finishing operation.

B. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

1. Maintain moisture loss no more than 0.2 lb/sq. ft. x h (1 kg/sq. m x h), calculated in accordance with ACI 305.1,) before and during finishing operations.

C. Curing Formed Surfaces: Comply with ACI 308.1 as follows:

1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
2. Cure concrete containing color pigments in accordance with color pigment manufacturer's instructions.
3. If forms remain during curing period, moist cure after loosening forms.
4. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:
   a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
   b. Continuous Sprinkling: Maintain concrete surface continuously wet.
   c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
   d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
   e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
      1. Recoat areas subject to heavy rainfall within three hours after initial application.
      2. Maintain continuity of coating and repair damage during curing period.

D. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:

1. Begin curing immediately after finishing concrete.
2. Interior Concrete Floors:
   a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:

1. Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
   i. Lap edges and ends of absorptive cover not less than 12-inches (300-mm).
   ii. Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive.
   i. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
   ii. Cure for not less than seven days.
3. Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
   i. Water.
   ii. Continuous water-fog spray

b. Floors to Receive Penetrating Liquid Floor Treatments: Contractor has option of the following:
1. Absorptive cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
   i. Lap edges and ends of absorptive cover not less than 12 inches.
   ii. Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive.
   i. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
   ii. Cure for not less than seven days.
3. Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
   i. Water.
   ii. Continuous water-fog spray.

c. Floors to Receive Polished Finish: Contractor has option of the following:
1. Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.

i. Lap edges and ends of absorptive cover not less than 12 inches.
ii. Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

2. Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
i. Water.
ii. Continuous water-fog spray.

d. Floors to Receive Curing Compound:
1. Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
2. Recoat areas subjected to heavy rainfall within three hours after initial application.
3. Maintain continuity of coating, and repair damage during curing period.
4. Removal: After curing period has elapsed remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacture unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.

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

3.7 ENVIRONMENTAL PROVISIONS

A. Hot weather concrete

1. Procedure applies when concrete mix starts to exceed 77 degrees Fahrenheit.
2. Forms, reinforcing steel and subgrade shall be fogged or sprinkled with cool water. prior to concrete in placement.
3. Expedite all elements of the concrete placement.
4. Moist curing shall commence as soon as the surfaces are finished and shall continue for at least seven days.

B. Cold weather concrete

1. Procedure applies when a period of more than 3 successive days the average daily air temperature drops below 40 degrees Fahrenheit and stays below 50 degrees for more than one half of any 24-hour period.
2. Provide wind break or heated enclosure to protect freshly placed concrete.
3. During curing protect concrete with polyethylene sheets or insulating blankets for at least seven days.
4. In no instance shall the concrete temperature drop below 50 degrees Fahrenheit prior to stripping forms and reshoring the structure.

C. Protect concrete from drying and excessive temperature for the first seven days.

D. Protect fresh concrete from wind.

3.8 CONTRACTION JOINTS

A. Obtain Design Professional 's approval for location of contraction joints.

B. Do not place contraction joints in framed floors, composite slabs, or shear walls.

C. Place contraction joints in slabs-on-grade with a maximum spacing of 36 times the slab thickness to form a regular grid. The long dimension of the grid shall not exceed 1.5 times the short dimension of the grid. Contraction joints may be saw cut after placement of concrete. Cut joints into concrete when cutting action does not tear, abrade or otherwise damage surface and before concrete develops random cracks. Sawing should be completed within the first six to 18 hours and never delayed more than 24 hours. Saw cuts shall be a depth equal to one-fourth the slab thickness by one-eighth inch wide. Alternately, in areas to receive carpeting or wood flooring contraction joints may be provided by preformed plastic strip inserts.

D. Provide contraction joints in concrete foundation or retaining walls at a maximum spacing of 20-foot but not more than 1.5 or less than 0.7 times the wall height. Space contraction joints equally between column interruptions in the wall surface such as pedestals, corners, or construction joints. Coordinate location with Architect. Contraction joints shall be formed as a V-groove on both faces of the wall, 3/4-inch minimum depth.

3.9 CUTTING CONCRETE

A. Obtain Design Professional's written approval prior to cutting concrete for installation of other work.

3.10 PATCHWORK AND REPAIRS

A. Notify Design Professional of any defective areas in concrete to be patched or repaired. Repair and patch defective areas with non-shrink grout. Cut out

defective areas over two inches in diameter to solid concrete, but not less than a depth of one inch. Make edges of cuts perpendicular to the concrete surface.

3.11 JOINT FILLING

A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least six months.
2. Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints.

D. Overfill joint, and trim joint filler flush with top of joint after hardening.

3.12 CONCRETE FINISHES

A. Finish concrete in accordance with ACI 301.

B. Finish concrete slabs to flatness and levelness tolerances which correspond to FF 25/FL 20 minimum overall for composite of all measured values and FF 17/FL 12 minimum for any individual floor section.

C. For concrete slabs to receive thin-set flooring, finish to flatness and levelness tolerances which correspond to FF 35/FL 25 minimum overall for composite of all measured values and FF 25/FL 20 minimum for any individual floor section.

D. For concrete slabs to receive wood flooring, finish to flatness and levelness tolerances which correspond to FF 45/FL 30 minimum overall for composite of all measured values and FF 30/FL 20 minimum for any individual floor section.

E. For metal deck construction, floors shall be finished to an FF 25.

F. For shored construction, FL values do not apply if slab is tested after shoring is removed.

G. Slabs, which do not meet the flatness and levelness criteria shall be repaired or replaced.

3.13 FIELD QUALITY CONTROL

A. Special Inspections: Special inspector to perform field tests and inspections and prepare testing and inspection reports.

B. Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

C. For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.

D. Inspections:

1. Headed bolts and studs.
2. Verification of use of required design mixture.
3. Concrete placement, including conveying and depositing.
4. Curing procedures and maintenance of curing temperature.
5. Verification of concrete strength before removal of shores and forms from beams and slabs.
6. Batch Plant Inspections: On a random basis, as determined by Architect.

E. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172 shall be performed in accordance with the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture for each 100 cubic yards per Section 1.
   a. When frequency of testing provides 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 C143:
   a. 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.
   b. Perform additional tests when concrete consistency appears to change.
3. Slump Flow: ASTM C1611:
   a. 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.
   b. Perform additional tests when concrete consistency appears to change.
4. Air Content: ASTM C231 pressure method, for normal-weight concrete; [ASTM C173 volumetric method, for structural lightweight concrete].
   a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
5. Concrete Temperature: ASTM C1064:
   a. One test hourly when air temperature is 40 deg F (4.4 deg C) and below or 80 deg F (27 deg C) and above, and one test for each composite sample.

6. Unit Weight: ASTM C138 fresh unit weight of structural concrete or ASTM C567 fresh unit weight of structural lightweight concrete.
   a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
7. Compression Test Specimens: ASTM C31:
   a. Cast and laboratory cure four 6-inch (150 mm) by 12-inch (300 mm) cylinder specimens for each composite sample. If testing agency chooses to use 4 inch by 8 inch cylinders an additional cylinder will be required.
8. Compressive-Strength Tests: ASTM C39.
   a. From each set:
      1. Test one laboratory-cured specimen at seven days and two specimens at 28 days. Fourth specimen is to be held in reserve.
   b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated. If 4 inch by 8 inch cylinders are used, it shall be from a set of three specimens.
9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
10. Strength of each concrete mixture will be satisfactory if both of the following conditions are met:
    a. Every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength.
    b. No compressive-strength test value falls below the specified compressive strength by: more than 500 psi (3.4 MPa) when specified compressive strength is less than or equal to 5000 psi (34.5 MPa) or more than 10 percent of specified compressive strength when the specified compressive strength is greater than 5000 psi (34.5 MPa).
11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
12. Additional Tests:
    a. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
    b. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

F. Measure floor and slab flatness and levelness in accordance with ASTM E1155 within 72 hours of completion of floor finishing and promptly report test results to Architect.

END OF SECTION 033000

SECTION 033001 – CAST-IN-PLACE CONCRETE - SITEWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes, but is not limited to, cast-in-place concrete for curb walls, retaining walls, steps, below grade slabs, bases, wall and water feature foundations, and light pole footings, as indicated on the Drawings.

1.2 REFERENCE

A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirement shall govern.

1. American Concrete Institute (ACI): 325.9R: Guide for Construction of Concrete Pavements and Concrete Bases.
2. American Plywood Association (APA): Ref. 1: APA Design/Construction Guide, Residential and Commercial
3. American Association of State Highway and Transportation Officials (AASHTO):

T22	Standard Method of Test for Compressive Strength of Cylindrical Concrete Specimens
T 23	Standard Method of Test for Making and Curing Concrete Test Specimens in the Field
R 60	Standard Practice for Sampling Freshly Mixed Concrete
T 119	Standard Method of Test for Slump of Hydraulic Cement Concrete
T 152	Standard Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method

4. American Society for Testing and Materials (ASTM):

A 36	Structural Steel
A 123	Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip
A 185	Welded Steel Wire Fabric for Concrete Reinforcement
A 307	Carbon Steel Externally Threaded Standard Fasteners
A 386	Zinc Coating (Hot-Dip) on Assembled Steel Products
A510	General Requirements for Wire Rods and Course Round Wire, Carbon Steel
A 569	Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip, Commercial Quality
A 615	Deformed and Plain Billet Steel Bars for Concrete Reinforcement
C 33	Concrete Aggregates
C 94	Ready-Mixed Concrete

C 143	Slump of Portland Cement Concrete
C 150	Portland Cement
C 171	Sheet Materials for Curing Concrete
C 260	Air Entraining Admixtures for Concrete
C 494	Chemical Admixtures for Concrete
D 1752	Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

B. Shop drawings of reinforcing steel shall be submitted. Drawings shall indicate bar sizes, locations, spacings, quantity required, bending and cutting schedules, and supporting and spacing devices.

C. Formwork Shop Drawings: Show formwork construction including form-facing joints, rustications, construction and contraction joints, form joint-sealant details, form tie locations and patterns, inserts and embedment's, cutouts, cleanout panels, and other items that visually affect exposed to view cast-in-place concrete. Comply with Section 031100 "Concrete Formwork".

D. Samples of the following shall be submitted:

Item	Sample Size
Preformed joint filler	Two pieces, full depth and width, 12 in. length
Form	12 in. x 12 in.
Form ties	1 each, complete

E. Submit manufacturer's product data, for the following:

1. Admixtures
2. Forms and accessories.
3. Form release agent.
4. Concrete coloring additive.
5. Preformed joint filler.
6. Curing materials.
7. Waterstops

F. Submit concrete design mix for Engineer's approval.

G. Prior to start of concrete work, Contractor shall submit to the Engineer for review a schedule for execution of the work of this section and a location plan indicating sequence of concrete placement and location of proposed control joints and construction joints, if required.

1.3 PRECONSTRUCTION MOCK-UPS

A. General

1. Schedule mock-up casting for acceptance 30 days prior to casting of concrete surfaces represented by the mockups.
2. Locate mock-up panels in non-public areas accepted by the Engineer.

3. Continue to cast mock-ups until acceptable mock-ups area produced. Accepted mock-ups shall be the standard for color, texture, and workmanship for the work.
4. Mock-up sequence of forming, placing, form removal, curing method shall be reviewed and accepted by the Engineer.
5. Demonstrate in the construction of the mock-up formwork, form release agent, and curing materials and methods to be used.
6. Mock-up formwork shall be inspected and accepted by the Engineer before placing of concrete.
7. Use the same concrete mixes and placement procedures, accepted in mock-ups, in the final work, unless otherwise directed by the Engineer.
8. Protect accepted mock-ups from damage until completion and acceptance of the work represented by the mock-up.
9. Remove mockups from site at completion of project, as directed by the Engineer.

B. Mockups: Cast mockups of full-size sections simulating actual design and execution conditions for concrete color, mix materials, reinforcement, formwork, wood fence board liners, placing sequence, form removal, curing, finishing methods and materials of stain removal and correction of defective work, and overall standard of workmanship.

1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Engineer.
2. Notify Engineer seven days in advance of dates and times when mockups will be constructed.
3. Obtain Engineer's approval of mockups before starting construction.
4. Maintain approved mockups during construction in an undisturbed condition as a standard for judging the completed pavement.
5. Demolish and remove approved mockups from the site when directed by Engineer.
6. Finish mockups, color, and sand blast, to be on vertical or horizontal surface to match final installation condition and be provided in at least two levels of light to medium range application each covering at least half of the mockup panel.

C. Source of Materials. Utilize the same source, stock, or brand of concrete materials for each class or mix of concrete which is to be exposed. Do not interchange materials or mixes until an additional mock-up shows that uniformity in finish texture and color, as compared to original mock-up will be maintained. If necessary, obtain and stockpile materials in sufficient quantity to ensure continuity and uniformity.

1.4 DESIGN OF CONCRETE MIX

A. Mix design shall be certified by Engineer or the City’s independent testing laboratory. Statement of materials constituting design of mixes (as required by referenced standards) shall be submitted for Engineer’s approval within one week following award of Contract.

B. Concrete mix design shall include the following information:

1. Proportions of cement, fine and coarse aggregates, and water.
2. Water-cement ratio, design strength, slump, and air content.

3. Type of cement and aggregates.
4. Type and dosage of all admixtures.
5. Special requirements for pumping.
6. Range of ambient temperature and humidity for which the design is valid.
7. Any special characteristics of the mix which require precautions in the mixing, placing, finishing, or curing methods to achieve the finished product specified.

C. No concrete shall be delivered to the job site until the Engineer has approved the design mixes.

1.5 QUALITY ASSURANCE

A. Unless otherwise specified, cast-in-place concrete work shall conform to the standards referenced above in Section 1.3 - Reference.

B. Proposed site steps shall be laid out and staked for review and approval by Engineer prior to pouring concrete.

C. 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 and has a minimum 10 years' experience in the production of specified products.

D. Installer Qualifications: Installer shall have a minimum 5 years' experience installing cast-in-place concrete for projects and elements of similar scope and complexity.

E. Source of Materials. Utilize the same source, stock, or brand of concrete materials for each class or mix of concrete which is to be exposed. Do not interchange materials or mixes until an additional mock-up shows that uniformity in finish texture and color, as compared to original mock-up will be maintained. If necessary, obtain and stockpile materials in sufficient quantity to ensure continuity and uniformity.

1.6 QUALITY CONTROL

A. Unless otherwise specified herein, or indicated on the Drawings, concrete formwork construction and materials shall conform to the City's Technical Manual, and the following:

1. Variation from plumb

a. In lines and surfaces of arises:

1)	In any 10 ft. of length	1/4 in.
2)	Maximum for the entire length	1 in.

b. For exposed conspicuous lines:

1)	In any 20 ft. length	1/4 in.

2) Maximum for the entire length 1/2 in.

2. Variation in sizes and location of sleeves, wall openings: 1/4 in. (+,-)

3. Variation in location of anchor bolts unless provided with sleeves or other means of adjustment: 1/4 in.

B. Maximum deflection of form facing materials at concrete surfaces exposed to view shall be 1/240 of span between structural members.

C. Reinforcing steel shall be fabricated to conform to the required shapes, dimensions, and tolerances specified in CRSI Manual.

D. Allowable Tolerances:

1. Fabricating:

a.	Sheared length:	Plus or minus 1 in.
b.	Stirrups and ties:	Plus or minus 1/2 in.
c.	Members more than 8 in., but not over 2 ft. - 0 in. deep:	Plus or minus 1/2 in.
d.	Members more than 2 ft. - 0 in. deep:	Plus or minus 1 in.
e.	Crosswise of members:	Space evenly within 2 in. of stated separation
f.	Lengthwise of members:	Plus or minus 2 in.

2. Maximum bar relocation to avoid interference with other reinforcing steel, conduits, or other embedded item: 1 bar diameter.

1.7 TESTING

A. Inspection and testing of the concrete mix will be performed by the Engineer, or by the City's independent testing laboratory. Testing equipment shall be supplied by the laboratory, and the preparation of samples and all testing shall be performed by the laboratory personnel.

1. Concrete materials and operations will be tested and inspected as work progresses. Failure to detect any defective work or material shall not in any way prevent later rejection when such defect is discovered, nor shall it obligate the City to final acceptance.
2. Cost for retesting required shall be paid for by the Contractor.

1.8 CONTRACTOR'S RESPONSIBILITY

A. Provide free access to work and full assistance and cooperation, concrete for samples, and such auxiliary personnel and equipment as needed for testing agency to take

samples for required tests. Notify testing agency and Engineer of intent to place concrete at least 24 hours before placement.

PART 2 - PRODUCTS

2.1 FORMS

A. Comply with Section 031100 “Concrete Formwork”.

2.2 CONCRETE

A. Concrete shall be air-entrained type, conforming to ASTM C 94. Air-Entraining Admixture: ASTM C 260.

1. Air Content: 6 percent, plus or minus 1.0 percent at point of delivery for 3/4-inch nominal maximum aggregate size.

B. Unless otherwise indicated on the Drawings, minimum 28 day compressive strength shall be 3,000 psi.

C. Concrete slump shall be no less than 4 in. nor greater than 6 in., determined in accordance with ASTM C 143.

D. Cement shall be Portland cement, conforming to ASTM C 150, Type I or II.

E. Normal Weight Aggregate shall conform to ASTM C 33, Class 3S and be provided from a single source.

F. Fly Ash: ASTM C 618, Class F.

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

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.

H. Water: ASTM C 94/C 94M and potable.

I. No calcium chloride or admixtures containing calcium chloride shall be added to the concrete. No admixtures other than those specified shall be used in the concrete without the specific written permission of the Architect in each case.

2.3 CONCRETE REINFORCING

A. Fiber reinforcement shall be polypropylene fiber processed into fibrillated bundles designed to open when placed in concrete to produce a homogeneously distributed monofilament polypropylene fiber reinforcement.

1. Fiber size (length) required shall be based on top size of coarse aggregate in the concrete mix, in accordance with manufacturer's recommendations and printed instructions.

2.4 COLOR ADMIXTURE

A. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, nonfading, and resistant to lime and other alkalis.

1. Color admixture shall be integral type, suitable for vertical architectural concrete and shall meet or exceed the requirements set by Portland Cement Association (PCA) and ASTM C 91, C 270 and C 494.
2. Color admixture shall not affect workability, setting, or strength of concrete adversely. Color pigments shall consist of chemically inert, non-fading, alkali-fast mineral oxides, finely ground and prepared for use in cement and mortar. Admixture shall not contain calcium chloride.
3. Color will be selected by Engineer.

2.5 CURING MATERIALS

A. Curing shall be by moist curing or by use of curing compound.

B. Curing paper shall be a non-staining, fiber reinforced laminated kraft bituminous product conforming to ASTM C 171. Four mil polyethylene sheeting may be substituted for curing paper.

C. Curing compound shall be a wax or resin-base, clear or white pigmented compound conforming to ASTM C 309, Type 1, Class B, dissipating.

2.6 EXPANSION JOINTS

A. Unless otherwise indicated on the Drawings, expansion joints shall be located 30 ft. o.c., maximum and when abutting rigid pavements and structures.

B. Where indicated, expansion joints shall be 1/2 in. wide, and recessed 1/2 in. from face of wall. Expansion joint filler shall be performed, non-bituminous type joint filler conforming to ASTM D 1752, Type II.

1. Pre-molded filler shall be one piece for the full depth and width of the joint.
2. Use of multiple pieces of lesser dimensions to make up required depth and width of joint will not be permitted.

3. Except as otherwise noted on the Drawings, joint filler shall be 1/2 in. thick.

C. Where indicated, concrete slab-on-grade shall be doweled at each expansion joint. One end of the dowel shall be greased.

D. Mortared expansion joint shall be a two-part system consisting of liquid rubber and reinforcing fabric.

E. Mortar grout for pointing of mortared expansion joint shall consist of one (1) part Portland cement, two (2) parts sand, mortar coloring additive, gauged with latex polymer additive.

1. Portland cement: ASTM C 150, complying with the staining requirements of ASTM C 91 for not more than 0.03% water soluble alkali. Furnish Type I, except Type III may be used for setting granite in cold weather.
2. Sand shall conform to ASTM C 144.
3. Hydrated lime shall conform the ASTM C 207.
4. Mortar coloring additive shall have mineral oxide pigment and shall be certified by the supplier to be resistant to alkali, light, and weather, and shall be of a chemical composition unaffected by cement and free of water and soluble salts. Color pigment shall not exceed 10% of the Portland cement in the mortar. Color of mortar shall be approved by the Engineer.
5. Latex polymer additive shall improve the working and physical properties of any cement mix, be suitable for interior and exterior installations, provide shock, chemical and frost resistance, increase bond and compressive strength, be water resistant and suitable for submerged applications and provide superior flexibility. Mix according to manufacturer's instructions.

2.7 CONTROL JOINTS

A. Control joints indicated to be sawn shall be made by saw cutting concrete slab after concrete is finished and when the surface is stiff enough to support the weight of workmen without damage to the slab. Saw blade shall cut into slab at least 1 in., but in no case less than 25% of slab depth.

B. Unless otherwise indicated on the Drawings, control joints shall be located 10 ft. o.c. maximum.

2.8 CONCRETE MIXTURES

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

2.9 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116 and furnish batch ticket information.

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

2.10 BOLTS

A. Anchor bolts shall be Type 316 stainless steel, sized as indicated on the Drawings, and evaluated by the ICC Evaluation Service, Inc., (ICC-ES) with an Evaluation Report.

B. Only expansion bolts evaluated by the ICC Evaluation Service, Inc., (ICC-ES) with an Evaluation Report shall be approved for anchoring into existing concrete.

2.11 WATERSTOPS

A. Waterstops shall be virgin polyvinyl chloride and shall not contain any scrap or reprocessed materials. Waterstop shall meet or exceed the requirements of the COE CRD-C 572 and the following:

1. PVC compound shall have a minimum tensile strength of 2,000 psi and shall have an elongation at break of not less than 300%.
2. Expansion joint waterstop shall be ribbed type with center bulb.
3. Corner intersections, and intersection of vertical and horizontal waterstops shall be factory spliced or factory-made.

2.12 SEALER

A. Concrete sealer shall be low VOC, clear penetrating concrete sealer, suitable for sealing exterior vertical concrete applications, manufactured by L.M. Scofield Company, W.R. Meadows, or Stone Technologies, Corp.

2.13 REPAIR MATERIALS

A. Repair Below Grade Slabs: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent slab elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4100 psi (29 MPa) at 28 days when tested according to ASTM C 109/C 109M.

PART 3 - EXECUTION

3.1 SUITABILITY OF SUBGRADE

A. Aggregate subbase to receive concrete slab-on-grade shall be inspected to ensure that material is suitable to receive concrete, including compaction. Subgrade unacceptable shall be brought to the attention of the Engineer.

3.2 EMBEDDED ITEMS

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

3.3 REINFORCING

A. Before being placed in position, reinforcing shall be thoroughly cleaned of loose mill and rust scale, dirt, ice, and other foreign material which may reduce the bond between the concrete and reinforcing. Where there is delay in placing concrete after reinforcement is in place, bars shall be reinspected and cleaned when necessary.

B. Any bar showing cracks after bending shall be discarded.

C. Unless otherwise indicated on the Drawings, reinforcing shall extend within 2 in. of formwork and expansion joints. Reinforcing shall continue through control joints. Adjacent sheets of fabric reinforcing shall lap 6 in.

D. After forms have been coated with form release agent, but before concrete is placed, reinforcing steel and anchors shall be securely wired in the exact position called for, and shall be maintained in that position until concrete is placed and compacted. Chair bars and supports shall be provided in a number and arrangement satisfactory to the Engineer.

E. Fiber reinforcement shall be introduced directly into the concrete either at the batch plant or job site at the rate of 1.6 pounds (minimum) per cubic yard (unless otherwise recommended by fiber reinforcement manufacturer). If introduced at the batch plant with the aggregate, no extra mixing time is required. If added at the job site, approximately 3 to 5 minutes mixing at agitating speed is required.

3.4 FORMWORK

A. Formwork shall be so constructed, braced, and tied that the formed surfaces of the concrete will be perfectly true, smooth, and to the dimensions shown on the Drawings, within the tolerances for formed surfaces as specified in ACI 301.

B. Forms shall be sufficiently tight to prevent leakage of mortar, and where necessary shall have temporary openings as required for thorough cleaning and as required for the introduction of concrete to avoid excessive free fall.

C. Limit deflection of form-facing panels to not exceed ACI 303.1 requirements.

D. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-in-place surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood rustications, keyways, reglets, recesses, and the like, for easy removal.

1. Seal form joints and penetrations at form ties with form joint tape or form joint sealant to prevent cement paste leakage.
2. Do not use rust-stained steel form-facing material.

E. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

F. Coat contact surfaces of formwork with sealer before placing reinforcement, anchoring devices, and embedded items.

G. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

H. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

I. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

J. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.5 WATERSTOP

A. Unless otherwise indicated on the Drawings, waterstop shall be centered over expansion joint and securely held in place during concrete placement to prevent misalignment.

B. Waterstop sections shall be butt spliced using a heat sealing method in accordance with the manufacturer's directions. Waterstop shall not be joined by lapping.

C. Special fittings at intersections shall be installed in accordance with the waterstop manufacturer's recommendations.

3.6 CONCRETE COLORING SYSTEM

A. Concrete coloring system mixture ratios, application rates, and application and curing methods shall be in strict conformance with the manufacturer's recommendations and produce a concrete color meeting the approved mockup and Engineer's approval.

3.7 PLACING CONCRETE

A. Before placing concrete, forms and space to be occupied by concrete shall be thoroughly cleaned and reinforcing steel and embedded metal shall be free from dirt, oil, mill scale, loose rust, paint, and other material which might tend to reduce bond.

B. Existing concrete, earth, and other water-permeable material against which new concrete is to be placed shall be thoroughly damp when concrete is placed. There shall be no free water on surface.

C. Concrete which has set or partially set before placing shall not be employed. Retempering of concrete will not be permitted.

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

1. Consolidate placed concrete with mechanical vibrating equipment to avoid honeycombing, according to ACI 301.
2. If concrete cannot be mechanically consolidated, concrete shall be thoroughly spaded and tamped to secure a solid and homogeneous mass, thoroughly worked around reinforcement and into corners of forms.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

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

F. Hot-Weather Placement: Comply with ACI 301.

G. When joining fresh concrete to concrete which has attained full set, latter shall be cleaned of foreign matter, and mortar scum and laitance shall be removed by chipping and washing. Clean, roughened base surface shall be saturated with water, but shall have no free water on surface. A coat of 1:1 cement-sand grout, approximately 1/8 in. thick, shall be well scrubbed into thoroughly dampened concrete base. New concrete shall be placed immediately, before grout has dried or set.

3.8 REMOVING FORMS AND SUPPORTS

A. Except as otherwise specifically authorized by the Engineer, forms shall not be removed until the concrete has aged for at least three days or the following number of day-degrees, whichever is greater.

Location	Day-Degrees*
Steps and Vertical Surfaces	100

*The term day-degrees represents the product of the number of days elapsed since time of concrete placement and the average daily air temperature at the surface of the concrete. For example, five days at a daily average temperature of 60 deg. F. equals 300 day-degrees.

1. Form removal by methods other than day-degree method will not be permitted.

3.9 FINISHING

A. Exposed vertical surfaces indicated to have a smooth form finish shall be formed to produce a "smooth form finish", as defined in ACI 301 and as follows:

1. All Exposed Concrete: Smooth-Formed Finish: As-cast concrete texture imparted by form- facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Remove fins and other projections exceeding specified limits on formed-surface irregularities. Repair and patch tie holes and defects.
2. Walls and Steps Rubbed Finish: Apply the following to smooth-form-finished concrete walls and steps:

    a. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
    b. After the concrete has been rubbed smooth and has set for a period of 5 to 8 days, it shall then be lightly moistened and again rubbed with a carborundum brick. Rubbing shall be continued until a smooth surface free from form marks and irregularities is obtained. On days when the sun is strong, rubbed surfaces shall be covered with canvas to keep the sun from drying out the surface too rapidly and thus causing checking.
    c. Before final acceptance on rubbed surfaces, all lather, powder, and dust on rubbed surfaces shall be removed by rubbing with canvas when the surface is dry.

3. To permit satisfactory finishing, forms shall be removed from the vertical faces of the concrete as early as is possible without damaging the surface. Immediately after stripping forms, any fins or projections left by the forms shall be chipped off, and the surfaces rubbed smooth.
4. Form tie holes and other voids and faults shall be patched. Voids, etc., shall be cleaned out, roughened, thoroughly wetted, coated with neat cement paste, and

filled with mortar of cement and sand in the same proportions, materials, and color as used in the concrete. The surface of the patch shall be flush with the surrounding surface after finishing operations are complete. Surface shall be kept continuously damp until patches are firm enough to be rubbed without damage.

5. Rubbing shall be performed while the surface is wet using a carborundum or cement sand brick, to achieve a smooth, uniform, even textured finish. Patched and chipped areas shall be blended to match as closely as possible the appearance of the rest of the surface. No cement wash or plastering will be permitted, and no mortar shall be used except as required above.
6. Seal rubbed surface finish in accordance with sealer manufacturer's printed instructions.

B. Steps: Apply the following to smooth-formed finished as-cast concrete for Steps, as follows: Light Blast finish on treads and smooth form finish on sides.

1. Light Sand Blast Finish: Provide light sand blast finish lightly exposing fine aggregate with no reveal, as on Engineer's sample panel, approved sample, and mockup installation. Finish shall be free of surface defects such as migrated entrained air or entrapped air bubbles over 1/8 in. diameter, sand streaks, staining, lack of uniformity of color or finish, blotches, wash, form leakage or honeycomb, and physical damage, any of which shall be deemed cause for rejection.

    a. Time between final curing and performing sandblast finish shall be same as for approved mockups.

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

3.10 FINISHING BELOW GRADE SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

1. Concrete slabs and pads shall be screeded off and finished true to line and grade, and free of hollows and bumps. Surface shall be dense, smooth, and at exact level and slope required.
2. Finished concrete surface for subbases shall be wood-floated to a slightly rough surface. Surface shall not deviate more than 1/4 in. in 10 ft.

B. Control joints shall be scored into slab surface with scoring tool.

C. Where finishing is performed before end of curing period, concrete shall not be permitted to dry out, and shall be kept continuously moist from time of placing until end of curing period, or until curing membrane is applied.

D. Immediately following finishing operations, arises at edges and both sides of expansion joints shall be rounded to a 1/4 in. radius. Control joints shall be scored into slab surface

with scoring tool. Adjacent edges of control joint shall at same time be finished to a 1/4 in. radius.

3.11 PROTECTION AND CURING

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

B. It is essential that concrete be kept continuously damp from time of placement until end of specified curing period. It is equally essential that water not be added to surface during floating and troweling operations, and not earlier than 24 hours after concrete placement. Between finishing operations surface shall be protected from rapid drying by a covering of waterproofing paper. Surface shall be damp when the covering is placed over it, and shall be kept damp by means of a fog spray of water, applied as often as necessary to prevent drying, but not sooner than 24 hours after placing concrete. None of the water so applied shall be troweled or floated into surface.

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

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

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

E. Colored concrete shall not under any circumstances, be cured using water fog misting or ponding, burlap, plastic sheeting, or other wet covering. Cure in accordance with color system manufacturer’s printed instructions.

3.12 FILLING TIE ROD AND BOLT HOLES

A. Holes resulting from the removal of bolts or tie rods shall be solidly filled with cement grout. Holes passing entirely through concrete members shall be filled from the inside face, with a plunger-type grease gun or other device that will force the mortar through to the outside face, holding a canvas sack at the exterior surface to assure complete filling. Holes which do not pass entirely through shall be filled, using tools which will permit the opening to be packed thoroughly full. Excess mortar at the faces of filled holes shall be struck off flush, with a canvas sack.

3.13 EXPANSION JOINTS

A. Expansion joint shall be doweled joint, 1/2 in. wide, clean, dry, and free of loose material, dirt, oil and grease, and shall be formed in the concrete to required width with preformed joint filler in place. Joint filler shall extend the full length of the expansion joint.

1. Depth of filler shall extend to the full thickness of the concrete in vertical surfaces and in concealed horizontal surfaces.
2. Depth of filler in exposed horizontal surfaces shall be as required to form a 1/2 in. deep sealant recess below finished surface.
3. Sealant expansion joint shall be sealed as specified in Section 079200, Joint Sealants.

B. Mortared expansion joints shall be made using Laticrete Blue 92 Anti-Fracture membrane system over top of doweled joint with mortar grout filler, as indicated on the Drawings.

3.14 CONTROL JOINTS

A. Control joints indicated to be sawn shall be sawn by using a diamond blade concrete power saw. Joint shall be made after concrete is finished and when the surface is stiff enough to support the weight of workmen without damage to the slab. Saw shall cut into slab at least 1 in., but in no case less than 25% of slab depth.

B. Control joints indicated to be tooled shall be scored into the concrete slab every 10 ft. o.c. maximum. Joint shall be made after concrete is finished and when the surface is stiff enough to support the weight of workmen without damage to the slab, but before slab has achieved its final set. Scoring shall cut into slab surface at least 1 in., but in no case not less than 25% of slab depth.

3.15 PATCHING FORMED SURFACES OF EXPOSED CONCRETE

A. After forms have been removed, inspect concrete surfaces and only at the direction of the Engineer, patch pour joints, voids, stone pockets, other defective areas and before concrete is thoroughly dry. Chip away defective areas to depth of not less than 1 in. with edges perpendicular to surface. Wet areas to be patched and space at least 6 in. wide entirely surrounding it, to prevent absorption of water from patching mortar. Do not patch concrete in freezing weather.

B. Apply chemical bonding agent to surface in accordance with manufacturer's printed instructions, followed immediately by patching mortar. Make patch of same proportions used for concrete except omit coarse aggregate. Add only enough water consistent with requirements for handling and placing.

C. Thoroughly compact mortar into place and screed off; leave patch slightly higher than surrounding surface. Leave undisturbed for one to two hours to permit initial shrinkage before final finishing. Finish patch to match texture and color of adjoining surface.

3.16 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer's approval. All repairs to concrete will be at the discretion of the Engineer.

3.17 FIELD QUALITY CONTROL

A. Special Inspections: The City will engage a special inspector to perform necessary field tests and inspections and prepare testing and inspection reports.

B. Testing Agency: The City will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

3.18 PROTECTION

A. Protect concrete surfaces as follows:

1. Protect from petroleum stains.
2. Diaper hydraulic equipment used over concrete surfaces.
3. Prohibit vehicles from interior concrete slabs.
4. Prohibit use of pipe-cutting machinery over concrete surfaces.
5. Prohibit placement of steel items on concrete surfaces.
6. Prohibit use of acids or acidic detergents over concrete surfaces.

END OF SECTION 033001

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SECTION 033511 - CONCRETE FLOOR FINISHES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Surface treatments for concrete floors and slabs.

B. Liquid densifiers and hardeners.

C. Concrete stains and dyes.

D. Clear coatings.

1.2 SUBMITTALS

A. Product Data: Manufacturer's published data on each finishing product, including information on compatibility of different products and limitations.

B. Maintenance Data: Provide data on maintenance and renewal of applied finishes.

C. Warranty Documentation: Manufacturer warranty; ensure that forms have been completed in Owner's name and registered with manufacturer.

1.3 MOCK-UP

A. For coatings, construct mock-up area under conditions similar to those that will exist during application, with coatings applied.

B. Mock-Up Size: 10 feet square.

C. Locate where directed.

D. Mock-up may remain as part of the work.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's sealed packaging, including application instructions.

1.5 FIELD CONDITIONS

A. Maintain light level equivalent to a minimum 200 W light source at 8 feet above the floor surface over each 20 foot square area of floor being finished.

B. Maintain ambient temperature of 50 degrees F minimum.

1.6 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Correct defective work within a two-year period commencing on the Date of Substantial Completion.

C. Finish Warranty: Provide five-year manufacturer warranty against excessive degradation of finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 - PRODUCTS

2.1 CONCRETE FLOOR FINISH APPLICATIONS

A. Liquid Densifier and Hardener:

B. Concrete Stain: Restroom Building Interior Floors

2.2 DENSIFIERS AND HARDENERS

A. Liquid Densifier and Hardener: Penetrating chemical compound that reacts with concrete, filling the pores, hardening, and dustproofing.

1. Composition: Lithium silicate.
2. Products:

a. Adhesives Technology Corporation; Pentra-Sil (244+): www.atcepoxy.com/#sle.
b. Euclid Chemical Company; ULTRASIL LI+: www.euclidchemical.com/#sle.
c. Green Umbrella Architectural Concrete Systems; DryShield: www.greenumbrellasystems.com/#sle.
d. PROSOCO, Inc; Consolideck LS/CS: www.prosoco.com/consolideck/#sle.
e. W. R. Meadows, Inc; Liqui-Hard Ultra: www.wrmeadows.com/#sle.
f. Substitutions: See Section 016000 - Product Requirements.

2.3 COATINGS

A. Concrete Stain or Dye: Translucent, penetrating compound for interior or exterior use; must be finished with a topical sealer.

1. Number of Coats: Minimum of two. Two colors for all applications
2. VOC: 100 g/L or less.
3. Application:

a. Primary Color: Spray applied.
b. Secondary Color: Spray applied.

4. Composition: Non-volatile acid-based, chemically reactive.

a. Products:

1) L.M. Scofield Company; LITHOCHROME Chemstain Classic Concrete Stain: www.scofield.com/#sle.

B. Low Gloss Clear Coating: Transparent, nonyellowing, acrylic polymer-based coating.

1. Composition: Solvent-based.
2. Nonvolatile Content: 20 percent, minimum, when measured by volume.
3. Products:

a. Clemons Concrete Coatings; SUPREME SEAL 23 V100: www.clemonsconcretecoatings.com/#sle.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that floor surfaces are acceptable to receive the work of this section.

B. Verify that flaws in concrete have been patched and joints filled with methods and materials suitable for further finishes.

3.2 GENERAL

A. Apply materials in accordance with manufacturer's instructions.

3.3 COATING APPLICATION

A. Verify that surface is free of previous coatings, sealers, curing compounds, water repellents, laitance, efflorescence, fats, oils, grease, wax, soluble salts, residues from cleaning agents, and other impediments to adhesion.

B. Protect adjacent non-coated areas from drips, overflow, and overspray; immediately remove excess material.

C. Apply coatings in accordance with manufacturer's instructions, matching approved mock-ups for color, special effects, sealing and workmanship.

END OF SECTION 033511

SECTION 033543 - POLISHED CONCRETE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Polished concrete system.

B. Surface treatments for concrete floors and slabs.

C. Densifiers and hardeners.

D. Coatings.

1.2 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Finishing of concrete surface; curing.

B. Section 079200 - Joint Sealants.

1.3 REFERENCE STANDARDS

A. ANSI/NFSI B101.1 - Test Method for Measuring the Wet SCOF of Hard-Surface Walkways 2020.

B. ANSI/NFSI B101.3 - Test Method for Measuring the Wet DCOF of Hard Surface Walkways 2020.

C. ASTM C1353/C1353M - Standard Test Method for Abrasion Resistance of Dimension Stone Subjected to Foot Traffic Using a Rotary Platform Abraser 2020, with Editorial Revision.

D. ASTM D1308 - Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Coating Systems 2020.

E. ASTM D4039 - Standard Test Method for Reflection Haze of High-Gloss Surfaces 2009 (Reapproved 2020).

F. ASTM D5767 - Standard Test Method for Instrumental Measurement of Distinctness-of-Image (DOI) Gloss of Coated Surfaces 2018.

G. ASTM G154 - Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials 2023.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordinate work of this section with concrete floor placement and concrete floor curing.

B. Preinstallation Meeting: Conduct a preinstallation meeting 10 days prior to start of work of this section.

1. Items for Review:

a. Physical requirements of completed concrete slab and slab finish.
b. Location and timing of test areas.
c. Protection of surfaces not scheduled for finish application.
d. Surface preparation.
e. Application procedure and quality control.
f. Cleaning and protection of finish.
g. Coordination with other work.

2. Require attendance of parties directly affecting work of this section, including:

a. Finish installer.
b. Contractor's representative.
c. Architect.
d. Owner's representative.

1.5 SUBMITTALS

A. Product Data: Manufacturer's published data on each finishing product, including information on compatibility of different products and limitations.

B. Product Data: Manufacturer's published data and installation instructions for concrete polishing system and finishing products, including manufacturer's installation instructions, information on compatibility of different products, and limitations.

C. Product Data: Submit certification that products comply with regulations controlling use of volatile organic compounds.

D. Maintenance Data: Provide data on maintenance and renewal of applied finishes.

E. Installer's qualification statement.

F. Executed warranty.

G. Floor protection plan.

1.6 QUALITY ASSURANCE

A. Comply with national, state, and local VOC regulations.

B. Installer Qualifications:

1. Company specializing in installing products specified in this section, having completed minimum of five projects of similar size and complexity.
2. Company is listed applicator of concrete finishes, having completed manufacturer's training program.

1.7 MOCK-UP

A. Mock-Up Size: 50 sq ft.

B. Locate on site where directed.

C. Accepted mock-up panel is considered basis of quality for the finished work. Keep mock-up exposed to view for duration of concrete work.

D. Mock-up may remain as part of work.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's sealed packaging, including application instructions.

B. Store materials per manufacturer's product data sheets:

1. Store containers upright in cool, dry, well-ventilated place, out of the sun, at temperature between 40 degrees F and 100 degrees F.
2. Protect from freezing.
3. Store away from other chemicals and potential sources of contamination.
4. Keep containers tightly closed when not in use.

1.9 FIELD CONDITIONS

A. Ambient Conditions:

1. Apply treatments and coatings when surface and air temperature is between 40 degrees F and 95 degrees F.
2. Apply treatments and coatings when surface and air temperature is expected to remain above 40 degrees F for a minimum of eight hours after application.
3. Maintain ambient temperature of 50 degrees F minimum.
4. Apply treatments and coatings during calm wind conditions; provide adequate ventilation of enclosed or confined area.
5. Apply treatments and coatings minimum 24 hours after rain exposure; suspend application when rain is anticipated within 8 hours of application.
6. Do not apply to frozen substrate.

1.10 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

PART 2 - PRODUCTS

2.1 POLISHED CONCRETE SYSTEM

A. Polished Concrete System: Materials, equipment, and procedures designed and furnished by a single manufacturer to produce dense polished concrete of the specified sheen.

1. Manufacturer: PROSOCO, Inc; Consolideck Polished Concrete System: www.prosoco.com/consolideck/#sle.

2.2 SURFACE TREATMENTS

A. Cutting Aid: Clear, water-based blended surfactant treatment spray-applied to wet concrete.

1. Product: PROSOCO, Inc; Consolideck First Cut: www.prosoco.com/consolideck/#sle.

B. Repair Material: Low-odor, liquid fill material.

1. Product: PROSOCO, Inc; Consolideck Grind-N-Fill: www.prosoco.com/consolideck/#sle.

C. Cleaner: Pre-densifier concrete cleaner for existing slab surfaces.

1. Product: PROSOCO, Inc; Consolideck Cleaner/Degreaser: www.prosoco.com/consolideck/#sle.

2.3 DENSIFIERS AND HARDENERS

A. Liquid Densifier and Hardener: Penetrating chemical compound, reacts with concrete, filling pores, hardening, and dustproofing.

1. Composition: Lithium silicate.
2. Abrasion Resistance: Greater than 50 percent improvement compared to untreated sample in accordance with ASTM C1353/C1353M.
3. Treated Material Slip Resistance: High traction range when tested according to ANSI/NFSI B101.1 and ANSI/NFSI B101.3.
4. UV Stability: No degradation or yellowing when tested in accordance with ASTM G154.
5. Product: PROSOCO, Inc; Consolideck LS: www.prosoco.com/consolideck/#sle.

2.4 COATINGS

A. Coatings, General:

1. Treated Material Slip Resistance: High traction range when tested according to ANSI/NFSI B101.1 and ANSI/NFSI B101.3.
2. Stain Resistance: No adverse effect when tested according to ASTM D1308.
3. UV Stability: No degradation or yellowing when tested according to ASTM G154.

B. Penetrating Sealer:

1. Low Gloss: Solvent-based penetrating clear protective treatment.

a. VOC Content: 100 g/L or less.
b. Product: PROSOCO, Inc; Consolideck Concrete Protector SB: www.prosoco.com/consolideck/#sle.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that floor surfaces are clean and free of previous coatings, sealers, curing compounds, water repellents, laitance, efflorescence, fats, oils, grease, wax, soluble salts, residues from cleaning agents, and other impediments to adhesion.

B. Verify that flaws in concrete have been patched and joints filled with methods and materials suitable for further finishes and allow complete curing before application of concrete hardener and densifier. See Section 079200.

3.2 GENERAL

A. Apply materials in accordance with manufacturer's instructions.

3.3 PREPARATION

A. Protect adjacent non-coated areas from drips, overflow, and overspray; avoid contact with metal, glass, and painted surfaces; immediately remove excess material.

3.4 CONCRETE POLISHING

A. Grind and polish in multiple passes with each full pass in direction perpendicular to previous pass.

B. Fill gaps, voids, and pop-outs during grinding operation.

C. Apply densifier and hardener at specified rates and intervals.

D. Final Polished Concrete Aggregate Exposure: Not to exceed CPC Class B - Fine Aggregate; fine aggregates, 85 to 95 percent; cement fines and coarse aggregate blend, 5 to 15 percent based on visual observation of overall area of polished floor versus Polished Concrete Aggregate Exposure Chart.

E. Final Polished Concrete Appearance: CPC Level 2 - Satin, image clarity value 10 to 39 percent with haze index less than 10.

3.5 PROTECTIVE TREATMENT

A. Apply coatings in accordance with manufacturer's instructions. Match approved mock-ups for color, texture, sealing, and workmanship.

B. Apply manufacturer's recommended protective treatment material to clean, dry slab after mechanically polishing.

1. Low gloss protective treatment:

a. Allow to dry tack-free before burnishing slab surface in accordance with manufacturer's recommendations.
b. Repeat treatment up to two coats.
c. For reduced haze, allow final coat to dry before burnishing slab surface in accordance with manufacturer's recommendations.

C. Clean spills on slab surfaces immediately, with manufacturer's recommended chemicals and absorptive materials.

D. No haze, white residue, streaking, or burnish marks permitted.

3.6 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements for additional requirements.

B. Final Polished Concrete Appearance: Test image clarity value and haze index prior to application of sealer at a rate of three tests per 1000 sq ft of polished concrete.

1. Image clarity: Test with Image Clarity Meter in accordance with ASTM D5767.
2. Haze index: Test with Glossmeter in accordance with ASTM D4039.
3. Match approved mock-ups for texture, appearance, and workmanship.

3.7 PROTECTION

A. Do not permit traffic over unprotected concrete floor surface until fully cured.

B. Protect finished surface as required and as recommended by manufacturer of polishing system until Final Completion.

END OF SECTION 033543

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SECTION 036200 - NON-SHRINK GROUT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Section includes non-shrink grout under base plates, bearing plates, and where specified in Contract Documents.

1.2 RELATED SECTIONS

A. Section 013330 - Structural Submittals.

B. Section 014525 - Structural Testing/Inspection Agency Services.

1.3 REFERENCES

A. ASTM C1107 – Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).

B. ASTM C109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens).

1.4 QUALITY ASSURANCE

A. Structural Testing/Inspection Agency shall perform the following quality related items:

1. Perform compressive strength tests in accordance with ASTM C109 with 2-inch x 2-inch cubes. Test one cube at three days, two cubes at seven days and three cubes at 28 days. Perform one test for each ten bags of grout used or one test in accordance with day of grouting.

1.5 SUBMITTALS

A. Submit product data sheets for review.

PART 2 - PRODUCTS

2.1 GROUT

A. Provide a non-shrink, non-metallic grout that complies with ASTM C1107.

B. Grout shall have a minimum compressive strength of 5000 psi at 28 days.

2.2 WATER

A. Provide clean, potable water.

PART 3 - EXECUTION

3.1 HANDLING

A. Store and protect non-shrink grout from moisture and contamination.

3.2 PREPARATION

A. Remove mud, dirt and other foreign materials from areas to be grouted.

3.3 MIXING

A. Mix grout to its fluid, self-leveling consistency in accordance with manufacturers recommendations. Do not retemper grout. Do not exceed manufacturer's maximum limit on water content or use at a consistency which produces free bleeding. Mix grout in a paddle-type mortar mixer. Do not mix by hand.

3.4 PLACEMENT

A. Consolidate grout to provide uniformity. Do not vibrate grout.

B. Use forms to contain grout.

3.5 PROTECTION

A. Protect grout and areas to be grouted from excessive heat and cold in accordance with manufacturer's specifications. Protect grout from excessive drying shrinkage resulting from wind or direct sunlight. Protect areas grouted from excessive vibrations for three days.

END OF SECTION 036200

SECTION 040511 - MORTAR AND GROUT

PART 1 - GENERAL

1.1 SUMMARY

A. This section specifies mortar and grout, mix design.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product specifications mixing and installation instructions for each manufactured product.

B. Manufacturer's Product Data

1. Specifications and Installation Data: Submit material specifications and installation data for colored mortar (2 copies).

a. Modifications: Modify submission by letter form to reflect project requirements and job conditions.
b. Required Product Data Submittals: Colored mortar.

C. Mix Designs and Test Reports: Submit mix design and test report for each type of mortar, including colored mortar. Testing to be performed by an independent testing laboratory for compressive strength in accordance with ASTM C 270.

D. Submittals Schedule

1. Before installation

a. Manufacturer's Product Data.
b. Mix designs and test reports.

1.3 QUALITY ASSURANCE

A. For each type of cement specified, only one brand shall be used throughout project.

B. Standards of the American Society for Testing and Materials (ASTM), as referenced herein.

C. Job Mockup: For project site mockup sample panel, refer to Section 044302 - "Granite”.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver materials, except aggregate, in original unopened containers, displaying product name, type, grade, and mixing instructions.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Portland Cement: ASTM C150, of natural color or white cement as required to produce required mortar color.

1. Type I Non-staining, and without air entrainment.

B. Masonry Cement: ASTM C 91, non-staining, except with 12% maximum air content by volume.

C. Hydrated Lime: ASTM C 207.

1. Type S: Special hydrated lime, high-early-plasticity with high water retention.

D. Aggregates:

1. ASTM C 144 Masonry Mortar Aggregates.
2. For Masonry Grout: ASTM C 404.
3. For Setting Bed: ASTM C 136, with 100% passing No. 4 Sieve.

E. Water reducing and plasticizing admixture; acceptable products:

1. UpCo Company, Hydroment.
2. Master Builders Co., Omicron Mortarproofing.
3. Sonneborn Div. of Contech, Inc., Hydrocide.
4. Chem-Masters Corp., Hydrolox 400.
5. Or approved equivalent.

F. Non-shrink grout:

1. Acceptable Products:

a. Gifford-Hill & Co., Supreme.
b. L & M Construction Chemicals Co., Crystex.
c. Master Builders Co., Master Flow 713.
d. Sonneborn Div. of Contech, Inc., Sonogrout.
e. The UpCo Co., UpCo High Flow 261.
f. U.S. Grout Corp., Five Star Grout.
g. W.R. Bonsal Co., Type A Construction Grout.
h. W.R. Meadows, Inc., 588.
i. Or approved equivalent.

2. Characteristics: High-flow, non-metallic, controller expansive type grout.

G. Water: Clean, potable, free from deleterious amounts of alkalies, acids, and organic materials, ASTM C 270.

H. Coloring Agent: As approved by Landscape Architect.

2.2 MORTAR MIXES

A. Do not lower the freezing point of mortar by use of admixtures or anti-freeze agents. Do not use calcium chloride in mortar or grout.

B. Mortar for Unit Masonry; Comply with ASTM C 270, Proportion Specifications, except limit materials to those specified herein.

1. Mortar Proportions

Portland Cement (cu. ft.)	Hydrated Lime/Lime Putty (cu. ft.)	Masonry Cement (cu.ft.)	Maximum Damp Loose Aggregate (cu.ft.)	Min. Compressive Strength 2" Cubes @ 28 days, ASTM C 270 (psi)
1	1/2	---	4-1/2	1800
or				
1/2	---	1	4-1/2	1800

The weight of one cubic foot of materials is considered to be Portland Cement 94 lbs. (1 bag); hydrated lime, 40 lbs.; lime putty, 80 lbs.; dry sand, 80 lbs.; masonry cement, weight printed on bag.

For each type of mortar, the figures above the line show proportions for Portland cement-lime mortar. Mortars made with masonry cement are shown below line. Damp, loose aggregate shall not be less than 2-1/4 times, nor more than three items, the cementitious material used, as measured by volume.

2.3 MASONRY GROUT AND MIXES

A. Cement grout: Proportion materials be volume in accord with ASTM C476-80 for fine or coarse grout as required. Grout shall consist of fresh mixtures of one part Portland cement to three parts of masonry sand and water.

B. Non-shrink grout: Mix prepared non-shrink grout product with water as directed by manufacturer's product data to achieve a minimum compressive strength of 3000 psi at 28 days.

C. Pointing Mortar: Three part clean masonry sand to one part Portland cement with admixture following manufacturer's recommendations.

PART 3 - EXECUTION

3.1 MIXING

A. Mix mortar and cement grout in power-driven, drum type mixers. Operate mixer minimum of five minutes after addition of all materials.

B. For job mixed mortars add water reducing and plasticizing admixture in accord with admixture manufacturer's product data.

C. Addition of other admixtures, including anti-freeze ingredients, will not be permitted.

D. Measure materials for job mixed mortars in a one cubic foot container. Do not measure by shovels.

E. Discard grout not placed within 1-1/2 hours after water is added to mix, or sooner as indicated by grout manufacturer.

3.2 PLACING MORTAR AND GROUT

A. Retemper mortar as necessary to keep plastic. Use no mortar after setting has begun or after 2-1/2 hours of initial mixing.

B. Keep bed uniform in width, except for minor variations required to maintain bond. Standard thickness for horizontal mortar joints shall be 1/2". See details for exceptions.

C. Adjustment shall be made only while mortar is still soft and plastic by tapping to plumb and bringing to alignment. Remove until and relay in fresh mortar when unit must be pulled back to align.

D. Where adjustment must be made after mortar has started to set, remove and replace mortar with fresh mortar.

END OF SECTION 040511

SECTION 042000 - UNIT MASONRY

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Concrete block.

B. Clay facing brick.

C. Mortar and grout.

D. Reinforcement and anchorage.

1.2 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2023.

B. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire 2019.

C. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement 2022.

D. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete 2022.

E. ASTM C91/C91M - Standard Specification for Masonry Cement 2023.

F. ASTM C129 - Standard Specification for Nonloadbearing Concrete Masonry Units 2022.

G. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale) 2023.

H. ASTM C270 - Standard Specification for Mortar for Unit Masonry 2019a, with Editorial Revision.

I. ASTM C404 - Standard Specification for Aggregates for Masonry Grout 2018.

J. ASTM C476 - Standard Specification for Grout for Masonry 2023.

K. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete 2016.

L. ASTM C1714/C1714M - Standard Specification for Preblended Dry Mortar Mix for Unit Masonry 2019a.

M. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures 2022, with Errata.

1.3 SUBMITTALS

A. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.

B. Shop Drawings: Indicate pertinent dimensions, materials, anchorage, size and type of fasteners, and accessories for brickwork support system.

C. Samples: Submit 4' x 4' sample board of facing brick and mortar to illustrate color, texture, and extremes of color range.

D. Manufacturer's Certificate: Certify that water repellent admixture manufacturer has certified masonry unit manufacturer as an approved user of water repellent admixture in the manufacture of concrete block.

E. Manufacturer's Qualification Statement.

F. Installer's Qualification Statement.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 016000 - Product Requirements, for additional provisions.
2. Extra Clay Units: 50 of each type, size, and color combination.

1.4 QUALITY ASSURANCE

A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.

B. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section with minimum three years of documented experience.

C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

PART 2 - PRODUCTS

2.1 CONCRETE MASONRY UNITS

A. Concrete Block: Comply with referenced standards and as follows:

1. Size: Standard units with nominal face dimensions of 16 by 8 inches and nominal depth of 8 inches or 6 inches as indicated.
2. Nonloadbearing Units: ASTM C129.

a. Hollow block, as indicated.
b. Lightweight.

2.2 BRICK UNITS

A. Manufacturers: Basis of Design. No substitutions allowed without prior approval

1. Glen Gery Brick; Sioux City: www.glengery.com.

B. Facing Brick: ASTM C216, Type FBS Smooth, Grade SW.

1. Color and texture: Cosmopolitan Series, Coppertone Smooth.
2. Nominal Norman sized brick _____. Nominal size: 11 5/8" long, 3 5/8" wide, 2 5/16" high.
3. Special brick: Provide brick with smooth finish on two long faces for exposed conditions as indicated on Drawings.

2.3 MORTAR AND GROUT MATERIALS

A. Masonry Cement: ASTM C91/C91M, Type N.

1. Colored Mortar: Premixed cement as required to match Architect's color sample.

a. Basis of Design color: HOLCIM Driftwood. No substitutions without prior approval.

B. Grout Aggregate: ASTM C404.

C. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M.

1. Color(s): As selected by Architect from manufacturer's full range. Basis of Design Color:

D. Water: Clean and potable.

E. Moisture-Resistant Admixture: Water repellent compound designed to reduce capillarity.

F. Packaged Dry Material for Mortar for Unit Masonry: Premixed Portland cement, hydrated lime, and sand; complying with ASTM C1714/C1714M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.

1. Type: Types as scheduled in this section.
2. Color: Standard gray.

2.4 REINFORCEMENT AND ANCHORAGE

A. Reinforcing Steel: Type specified in Section 032000; size as indicated on drawings; galvanized finish.

B. Joint Reinforcement: Use ladder type joint reinforcement where vertical reinforcement is involved and truss type elsewhere, unless otherwise indicated.

C. Multiple Wythe Joint Reinforcement: ASTM A951/A951M.

1. Type: Truss.
2. Material: ASTM A1064/A1064M steel wire, mill galvanized to ASTM A641/A641M Class 3.
3. Size: 0.1483 inch side rods with 0.1483 inch cross rods; width as required to provide not less than 5/8 inch of mortar coverage on each exposure.

D. Strap Anchors: Bent steel shapes, 1-1/2 inch width, 0.105 inch thick, 24 inch length, with 1-1/2 inch long, 90 degree bend at each end to form a U or Z shape or with cross pins, hot dip galvanized to ASTM A153/A153M Class B.

E. Flexible Anchors: 2-piece anchors that permit differential movement between masonry and building frame, sized to provide not less than 5/8 inch of mortar coverage from masonry face.

1. Steel frame: Crimped wire anchors for welding to frame, 0.25 inch thick, with trapezoidal wire ties 0.1875 inch thick, hot dip galvanized to ASTM A 153/A 153M, Class B.

F. Two-Piece Wall Ties: Formed steel wire, 0.1875 inch thick, adjustable, eye and pintle type, hot dip galvanized to ASTM A 153/A 153M, Class B, sized to provide not less than 5/8 inch of mortar coverage from masonry face and to allow vertical adjustment of up to 1-1/4 in.

G. Metal-to-Metal Fasteners: Self-drilling, self-tapping screws; corrosion resistant finish or hot dip galvanized to ASTM A153/A153M.

2.5 MORTAR AND GROUT MIXING

A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.

1. Masonry below grade and in contact with earth: Type S.
2. Exterior, loadbearing masonry: Type N.
3. Exterior, non-loadbearing masonry: Type N.

B. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio. Basis of Design color indicated above.

C. Grout: ASTM C476; consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches.

D. Admixtures: Add to mixture at manufacturer's recommended rate and in accordance with manufacturer's instructions; mix uniformly.

E. Mixing: Use mechanical batch mixer and comply with referenced standards

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive masonry.

B. Verify that related items provided under other sections are properly sized and located.

C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.2 PREPARATION

A. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

B. Provide temporary bracing at walls of Restroom building while grout infill is being placed. Shoring should prevent any movement in the wall, either bulging outward or shifting of individual or groups of units.

3.3 COLD AND HOT WEATHER REQUIREMENTS

A. Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

B. Maintain materials and surrounding air temperature to minimum 40 degrees F prior to, during, and 48 hours after completion of masonry work.

C. Maintain materials and surrounding air temperature to maximum 90 degrees F prior to, during, and 48 hours after completion of masonry work.

3.4 COURSING

A. Establish lines, levels, and coursing indicated. Protect from displacement.

B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

C. Concrete Masonry Units:

1. Bond: Running.
2. Coursing: One unit and one mortar joint to equal 8 inches.
3. Mortar Joints: Concave.

D. Brick Units:

1. Bond: Running.
2. Coursing: Three units and three mortar joints to equal 8 inches.
3. Mortar Joints: Concave on horizontals; Flush on vertical joints.

3.5 PLACING AND BONDING

A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.

B. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.

C. Remove excess mortar and mortar smears as work progresses.

D. Interlock intersections and external corners, except for units laid in stack bond.

E. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.

F. At Restroom Building, lay two full courses over grouted interior core and parge top of entire brick wall as indicated.

G. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

H. Cut mortar joints flush where wall tile is scheduled or resilient base is scheduled.

3.6 REINFORCEMENT AND ANCHORAGE - GENERAL and SINGLE WYTHE MASONRY

A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches on center.

B. Place continuous joint reinforcement in first and second joint below top of walls.

C. Reinforce stack bonded unit joint corners and intersections with strap anchors 16 inches on center.

D. Fasten anchors to structural framing where indicated and embed in masonry joints as masonry is laid. Unless otherwise indicated on drawings or closer spacing is indicated under specific wall type, space anchors at maximum of 36 inches horizontally and 24 inches vertically.

E. Embed ties and anchors in mortar joint and extend into masonry unit a minimum of 1-1/2 inches with at least 5/8 inch mortar cover to the outside face of the anchor.

3.7 REINFORCEMENT AND ANCHORAGES - MULTIPLE WYTHE UNIT MASONRY

A. Use individual metal ties installed in horizontal joints to bond wythes together. Provide ties spaced as indicated on drawings.

B. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.

3.8 GROUTED COMPONENTS

A. Lap splices minimum 24 bar diameters.

B. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.

C. Place and consolidate grout fill without displacing reinforcing.

D. At bearing locations, fill masonry cores with grout for a minimum 12 inches either side of opening.

3.9 BUILT-IN WORK

A. As work progresses, install built-in metal door frames and wood nailing strips and other items to be built into the work and furnished under other sections.

B. Bed anchors of metal door frames in adjacent mortar joints. Fill frame voids solid with grout.

1. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.

C. Do not build into masonry construction organic materials that are subject to deterioration.

3.10 TOLERANCES

A. Maximum Variation from Alignment of Columns: 1/4 inch.

B. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.

C. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.

D. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.

E. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.

F. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch.

G. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.

3.11 CUTTING AND FITTING

A. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.12 PARGING

A. Scarify each parging coat to ensure full bond to subsequent coat.

B. Parge top of brick walls as indicated on drawings, to maximum of 1/4"

C. Steel trowel surface smooth and flat with a maximum surface variation of 1/8 inch per foot.

D. Strike top edge of parging at 45 degrees.

3.13 CLEANING

A. Remove excess mortar and mortar droppings.

B. Replace defective mortar. Match adjacent work.

C. Clean soiled surfaces with cleaning solution.

D. Use non-metallic tools in cleaning operations.

3.14 PROTECTION

A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

3.15 SCHEDULES

A. Exterior Walls at Restroom and Pavilion: Glen Gery Coppertone Smooth brick at all locations. Stacked bond at ends of walls as indicated on drawings. Walls to be constructed of two single wythe's with grout infill between them. Ends of the brick wall shall be closed and fully mortared prior to pouring grout. Walls shall be buttressed with shoring and bracing as required during the application and curing of grouting.

END OF SECTION 042000

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SECTION 042200 - STRUCTURAL CONCRETE MASONRY

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Section includes structural concrete masonry shown on the Structural Drawings.

1.2 RELATED SECTIONS

A. Section 013330 - Structural Submittals.

B. Section 014525 - Structural Testing/Inspection Agency Services.

C. Section 032000 - Concrete Reinforcement.

D. Section 033000 - Cast-in-Place Concrete.

E. Section 042000 - Unit Masonry.

1.3 REFERENCES

A. TMS 602 - Specification for Masonry Structures.

B. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

C. ASTM A1064 - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.

D. ASTM C90 - Standard Specification for Load-Bearing Concrete Units.

E. ASTM C91 – Standard Specification for Masonry Cement.

F. ASTM C109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens).

G. ASTM C140 - Standard Methods of Sampling and Testing Concrete Masonry Units.

H. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar.

I. ASTM C270 - Standard Specification for Mortar for Unit Masonry.

J. ASTM C404 - Standard Specification for Aggregates for Masonry Grout.

K. ASTM C476 - Standard Specification for Grout for Masonry.

L. ASTM C1019 - Standard Method of Sampling and Testing Grout.

M. ASTM D2000 - Standard Classification System for Rubber Products in Automotive Applications.

N. ASTM E447 - Standard Test Methods for Compressive Strength of Masonry Prisms.

O. TMS 402 – Building Code for Masonry Structures.

1.4 SUBMITTALS

A. Submit coarse grout mix design.

B. Upon request, submit material certificates signed by the material supplier that the masonry units, mortar, reinforcement, and joint material complies with specification requirements.

C. Submit shop drawings for masonry reinforcement in accordance with Section 032000.

D. Submit procedures for construction of masonry walls to be filled with coarse grout. Procedures should include high lift or low lift grouting as applicable to project.

1.5 QUALITY ASSURANCE

A. Structural Testing/Inspection Agency shall perform the following quality related items:

1. Verify reinforcing steel for quantity, size, and location.
2. Verify placement of coarse grout as indicated in high or low lift procedure.
3. Verify compressive strength of concrete masonry units, mortar, coarse grout, or masonry prisms for each 5,000 sq. ft. of surface area as follows:
    a. Three (3) concrete masonry units shall be tested in accordance with ASTM C140.
    b. Six (6) mortar cube specimens shall be tested, three (3) at 7-days and three (3) at 28-days, in accordance with ASTM C109.
    c. Four (4) coarse grout specimens shall be tested, two (2) at 7-days and two (2) at 28-days, in accordance with ASTM C1019.
    d. In lieu of individual tests of masonry units, mortar, and grout, if directed by the Design Professional, perform one (1) prism test (which consists of three prisms) in accordance with ASTM E447.

B. The Structural Testing / Inspection Agency shall provide special inspections as required by Chapter 17 of the building code as required by Specification 014525.

1.6 HANDLING OF MATERIALS

A. Package, handle, and store materials to protect from elements and prevent contamination.

PART 2 - PRODUCTS

2.1 CONCRETE MASONRY

A. Concrete masonry shall have the minimum compressive strength (f'm) specified on the Drawings. Concrete masonry shall have a minimum density of 125 pcf.

2.2 CONCRETE MASONRY UNITS

A. Concrete masonry units shall conform to ASTM C90.

B. Provide normal weight concrete masonry units.

C. Concrete masonry units shall have, as a minimum, the net area compressive strength listed in Table 1 of TMS 602 required for the specified f'm.

D. Provide standard units with face dimensions of 16" long x 8" high nominal, unless indicated otherwise.

E. Provide special shapes where indicated on the Drawings.

2.3 MORTAR

A. Mortar shall be Type M or Type S Masonry cement in accordance with ASTM C270. Refer to Drawings for locations. For SDC D or greater, replace masonry cement with Portland Cement or Mortar Cement.

B. Do not use admixtures that contain chlorides.

2.4 COARSE GROUT

A. Coarse grout shall conform to ASTM C1064.

B. Coarse grout shall have the minimum compressive strength specified on the Drawings.

C. Mix grout to a consistency which has a slump between 8 and 10 inches.

D. Do not use admixtures that contain chlorides.

2.5 WATER

A. Provide clean potable water free of deleterious substances.

2.6 REINFORCEMENT

A. Horizontal and vertical reinforcing bars shall comply with Section 032000.

2.7 HORIZONTAL JOINT REINFORCEMENT

A. Horizontal joint reinforcement shall be manufactured with longitudinal parallel, deformed side wires in accordance with ASTM A951 and of the size specified on the Drawings. Cross wires shall be No. 9 gauge spaced not more than 16” on center.

B. Provide as a minimum, one side wire for each face shell of hollow masonry units. Provide additional side wires or eye sections for adjustable wall ties as specified for multiwythe wall construction.

C. Provide ladder type reinforcement.

D. Horizontal joint reinforcement shall be hot-dipped galvanized in accordance with ASTM A153, Class B-2.

E. Provide in lengths of not less than 10 feet. Provide prefabricated corner and tee shape corner accessories.

2.8 CONTRACTION JOINT MATERIAL

A. Contraction joint material shall comply with ASTM D2000, M2AA-805 with rubber shear keys with a minimum durometer hardness of 80.

PART 3 - EXECUTION

3.1 MIXING

A. Except as otherwise approved for small batches, mix in mechanically operated batch mixers of drum type in which water can be accurately and uniformly controlled. Allow five minutes maximum mixing time, two minutes for dry mixing and three minutes for continued mixing after water has been added. Do not permit volume of batch to exceed manufacturer's rated capacity of mixer drum. Empty drum completely before placing next batch. Keep mixers and wheelbarrows clean. Do not deposit mortar upon or permit contact with ground.

B. Do not use anti-freeze compounds.

3.2 CONSTRUCTION

A. Use dry masonry units. No frozen or wet units shall be used.

B. Discard cracked, chipped, and spalled masonry units.

C. Deliver mortar to mason's board at point of use within 45 minutes after mixing. Do no retempering. Use no admixtures. Use pre-hydrated mortar for tuck points. Prepare pointing mortar with as dry consistency as will produce mortar sufficiently plastic to be worked into joints.

D. During erection cover top of wall with strong waterproof membrane at end of each day when shutdown. Cover partially completed walls when work is not in progress. Extend and secure cover a minimum of 24 in. down both sides. Do not apply uniform floor or roof loading for at least 12 hours after building masonry columns or walls. Do not apply concentrated loads for at least 3 days after building masonry columns or walls.

E. Provide temporary bracing during erection as required to stabilize erected masonry.

F. Except where otherwise indicated, lay block in running bond.

3.3 PLACING AND BONDING

A. Lay masonry in full beds of mortar on mating surfaces, and properly jointed with other work. Buttering corners of joints, deep or excess furrowing of mortar joints is not permitted.

B. Fully bond external corners of concrete block. Where interior block partitions intersect other block walls or partitions, provide control joints with mortar raked back 1/4 inch.

C. Isolate masonry partitions from vertical structural framing members with control joints, with mortar racked back 1/4 inch.

D. Where non-bearing masonry partitions extend to underside of floor, roof deck or structural system, stop masonry short 3/8 to 1/2 inch to allow for live load deflection. Fill gap with soft joint filler.

E. Where masonry chase walls are constructed, one wall can be stopped above ceiling to provide access space.

3.4 CONTRACTION JOINTS

A. Install contraction joints at locations indicated on the Drawings in all masonry walls. Do not run masonry reinforcement through contraction joints.

3.5 TOLERANCES

A. Variation from Unit to Adjacent Unit: 1/32 inch maximum.

B. Variation from Plan of Wall: Maximum 1/4 inch in 10 feet, and 1/2 inch in 20 feet or more.

C. Variation from Plumb: +/- 1/4 inch in 10 feet, +/- 3/8 inch in 20 feet; +/- 1/2 inch maximum.

D. Variation in Level Coursing: +/- 1/4 inch in 10 feet; +/- 1/2 inch maximum.

E. Variation in Joint Thickness: +/- 1/8 inch Maximum.

3.6 HORIZONTAL JOINT REINFORCEMENT

A. Place horizontal joint reinforcement in the horizontal mortar beds at spacings as noted in the Drawings, except as specified herein.

B. For masonry below grade, space horizontal joint reinforcing at 8 inches vertically.

C. Above lintels and below sills at openings, place a continuous run of horizontal joint reinforcement in the first two bed joints, 8 inches apart. Extend joint reinforcement two feet beyond opening.

D. Joint reinforcement shall be continuous, except it shall not pass through vertical masonry contraction joints. Lap joint reinforcement a minimum of 6 inches.

3.7 ENVIRONMENTAL PROVISIONS

A. Cold weather masonry construction shall comply with TMS 602-16 per the following:

1. When ambient temperature is below 40 degrees F, implement cold weather procedures per the following:
    a. Do not lay masonry units having either a temperature below 20 degrees F or containing frozen moisture, visible ice or snow on their surface.
    b. Remove visible ice and snow from the top surface of existing foundations and masonry to receive new construction and heat these surfaces above freezing using methods that do not result in damage.
    c. Do not heat water or aggregates used in mortar or grout above 140 degrees F. Comply with the following:
        1. Between 40 degrees F and 32 degrees F -
            i. Heat sand or mixing water to produce mortar temperature between 40 degrees F and 120 degrees F at time of mixing.
            ii. Heat grout materials when the temperature of the materials is below 32 degrees F.
        2. Between 32 degrees F and 25 degrees F –

i. Heat sand or mixing water to produce mortar temperature between 40 degrees F and 120 degrees F at time of mixing.
ii. Heat grout materials and mixing water to produce grout temperature between 70 degree F and 120 degree F at the time of mixing. Maintain grout temperature above 70 degree F at the time of grout placement.

3. Between 25 degrees F and 20 degrees F –
i. Heat sand or mixing water to produce mortar temperature between 40 degrees F and 120 degrees F at time of mixing. Maintain mortar temperature above freezing until used in masonry.
ii. Heat masonry surfaces under construction to a minimum temperature of 40 degrees F.
iii. Heat grout aggregates and mixing water to produce grout temperature between 70 degree F and 120 degree F at the time of mixing. Maintain grout temperature above 70 degree F at the time of grout placement.
iv. Use wind breaks or enclosures when the wind velocity is greater than 15 mph.
v. Heat masonry to 40 degrees F prior to grouting.

4. Below 20 degrees F –
i. Comply with previous requirements and provide an enclosure and auxiliary heat to maintain air temperature above 32 degrees F within the enclosure.

2. When ambient temperature is between 25 degrees F and 40 degrees F, cover newly constructed masonry completely with weather-resistive blankets or equal protection for 24 hours after completion of work. Extend time period to 48 hours for grouted masonry.
3. Below 25 degrees F, maintain newly constructed masonry temperature above 32 degrees F for at least 24 hours after being completed by using heated enclosures, electric heating blankets, infrared lamps or other acceptable methods. Extend time period to 48 hours for grouted masonry.

B. Hot weather masonry construction shall comply with TMS 602-16 per the following:

1. When ambient temperature exceeds 100 degrees F or exceeds 90 degrees F with a wind velocity greater than 8mph:
a. Maintain sand piles in a damp, loose condition.
b. Provide necessary conditions and equipment to produce mortar having a temperature below 120 degrees F.
c. Maintain temperature of mortar and grout below 120 degrees F.
d. Flush mixer, mortar transport container, and mortar boards with cool water before they come into contact with mortar ingredients or mortar.
e. Maintain mortar consistency by retempering with cool water.
f. Use mortar within 2 hours of initial mixing.

g. Fog spray newly constructed masonry until damp, at least 3 times a day until the masonry is three days old.

2. When ambient temperature exceeds 115 degrees F or exceeds 105 degrees F with a wind velocity greater than 8mph follow requirements in section 3.8.B.1 and the following additional requirements:
   a. Shade materials and mixing equipment from direct sunlight.
   b. Use cool mixing water for mortar and grout. Ice is permitted in the mixing water prior to use. Do not permit ice in the mixing water when added to other mortar or grout materials.

3.8 FIELD QUALITY CONTROL

A. Testing and Inspecting: Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

B. Inspections: Special Inspections according to the specification 014525 and TMS 402.

1. Begin masonry construction only after inspectors have verified proportions of site prepared mortar.
2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes and locations of reinforcement.
3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing: Test according to Section 1.5 – Quality Assurance.

3.9 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.

2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

END OF SECTION 042200

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SECTION 044213 - STONE VENEER

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all equipment and materials, and do all work necessary to construct the granite veneer work at shade structure columns, as indicated on the Drawings and as specified herein.

1.2 REFERENCES

A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirement shall govern.

1. American Institute of Steel Construction (AISC):

Specification	Specification for the Design, Fabrication and Erection of Structural Steel for Buildings

2. American Society for Testing and Materials (ASTM):

A 36	Structural Steel
C 144	Aggregate for Masonry Mortar
C 150	Portland Cement
C 207	Hydrated Lime for Masonry Purposes
C 270	Mortar for Unit Masonry
C 615	Structural Granite
D 1752	Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

1.3 SUBMITTALS

A. Samples: Submit representative samples of product to be furnished under this Section to Architect for selection and approval, as follows. Delivered materials shall closely match the approved samples.

1. Granite Veneer Facing: Sufficient 12 in. by 12 in. samples to show the full range of color, texture, and finish of granite proposed for use.
2. Granite Veneer Accessories: Duplicate samples of cramps, anchors, dowels, and other accessories as may be requested by Architect.

B. Manufacturer's Product Data: Manufacturer's product data shall be submitted for the following items:

1. Expansion joint filler
2. Grout materials, including additives
3. Mortar coloring additive
4. Mortar materials, including additives

C. Shop Drawings: Cutting and setting drawings of granite pieces specified herein shall be submitted. Drawings shall indicate ISR anchorage system, including steel support angles, anchors, cramps, dowels, etc., complete granite sizes, dimensions, layout, finishes, arrangement and other necessary details for reception of other work.

1. Drawings shall indicate locations of inserts for granite anchors and supports which are to be built into concrete and masonry, and locations and dimensions of cut-outs, holes, openings, and other provisions required for the work of other trades.
2. Shop drawings shall indicate the setting number of each piece and each piece shall bear the corresponding number in a non-staining paint.

D. Contractor's Review: Before commencing work, submit written statement signed by the Contractor stating that the Contract Documents have been reviewed with a qualified representative of the granite supplier, and that he is in agreement that the selected materials and construction are proper, compatible with adjacent materials, and adequate for the application shown.

1.4 SAMPLE INSTALLATION

A. With Architect’s permission, mockup may be constructed in place and if accepted become part of permanent installation.

B. Install in specific location directed by Architect at least one sample granite column veneer installation conforming to typical project construction. Sample installation shall be approximately 3 ft. high x full column dimension, located as directed by Architect, and shall show the proposed granite type, color, and finish, anchorage system, joint sealing (by other trade), weepholes, and other pertinent details of installation.

C. Replace sample installation as many times as necessary until Architect's approval of the installation has been obtained. Upon Architect's approval, construct all subsequent granite veneer work to conform to approved sample installation.

1.5 COORDINATION

A. The work of this Section shall be coordinated with that of other trades affecting, or affected by, this work, as necessary to assure the steady progress of the work under the Contract.

B. Do all cutting and drilling to accommodate the work of others as may be reasonably implied from the Drawings and Specifications, or required for the proper completion of the Work.

1.6 DELIVERY, HANDLING, AND STORAGE

A. Granite shall be carefully packed and banded by the supplier for shipment. Following shipping Granite shall be stored on wood skids or pallets, covered with non-staining, waterproof membrane and protected from the weather. Skids shall be placed and stacked in such a manner as to evenly distribute the weight of the Granite materials and to prevent breakage, cracking, and damage to granite pieces. Granite materials shall be stored in such a manner as to allow air to circulate around the granite material. Granite shall not be permitted to be in direct contact with the ground any time during storage.

B. Granite shall be carefully handled to prevent chipping, breakage, soiling, or other damage. Pinch or wrecking bars shall not be used without protecting edges of granite with wood or other rigid materials. Granite units shall be lifted with wide-belt type slings wherever possible; wire rope or ropes containing tar or other substances which might cause staining or damage to granite finish shall not be used.

C. Granite damaged in any manner will be rejected and shall be replaced with new materials at no additional cost to the Owner.

D. Store setting materials on raised platforms or slabs, under watertight covers or indoors. Protect metal angles, anchors, cramps, dowels, etc. from the elements. Immediately before placing remove all loose dirt, and other foreign materials.

1.7 PROTECTION OF FINISHED SURFACES

A. Finished surfaces adjacent to the granite work shall be adequately protected from soiling, staining, and other damage.

1.8 QUALITY ASSURANCE

A. Granite shall be supplied by a source approved by the Architect.

B. Granite shall be standard grade, free of cracks, seams, starts, or other defects which may impair its strength, durability, or appearance. Exposed surfaces shall be free from spots, spalls, chips, stains, discoloration, or other defects which would affect its appearance. Color, texture, and finish shall be within the range of samples approved by the Architect.

PART 2 - PRODUCTS

2.1 GRANITE

A. Granite shall conform to the requirements of ASTM C 615, Architectural Grade and NBGQA Specifications.

B. Granite shall be supplied by a quarrying member of the Elberton Granite Association, Inc., One Granite Plaza, P.O. Box 640, Elberton, GA 30635; Tel. 706-283-2551; Web: www.egaonline.com.

1. Granite shall be sound and uniform in quality, texture, and strength, and shall be free of any flaws, reeds, rifts, laminations, seams, or defects which would impair its strength, durability, or appearance.

a. Absorption by weight shall not exceed 0.4 %.
b. Compressive strength of not less than 19,000 psi.
c. Minimum density of 160 pcf.

2. Finish: Exposed surfaces shall be split face on vertical surfaces and sawn and flamed on horizontal face of the cap stone; sawn bottom and concealed sides. Granite surfaces which will be concealed in the finished work shall be sawn to approximately true planes. Maximum variation in thickness shall be 3/8 in. Sawn backs shall be cleaned of rust stains and iron particles.
3. Veneer Stone Sizes

a. Face stones shall all be 3/4” thick min granite veneer. Stones shall range in size from 12” to 36” in length and 6” to 18” height. Proportion of each stone shall have a length at least two time its height.

4. Color: “Elberton Gray”.

2.2 SETTING BED MORTAR

A. Setting bed mortar shall conform to ASTM C 270, Type S, except that latex polymer additive shall be mixed with the cementitious materials and aggregate in lieu of water.

1. Cement shall conform to ASTM C 150, Type I, complying with the staining requirements of ASTM C 91 for not more than 0.03% water soluble alkali. Furnish Type I, except Type III may be used for setting stone in cold weather.
2. Sand shall conform to ASTM C 144, non-staining.
3. Hydrated lime shall conform to ASTM C 207.
4. Latex polymer additive shall be specially designed latex additive to make high strength latex thin-set bed up to 1/8" and medium bed up to 5/8" mortars; for installing all types of natural stone Mix according to manufacturer's instructions.

2.3 MORTAR GROUT FOR POINTING

A. Mortar grout for pointing of joints shall consist of one (1) part Portland cement, two (2) parts sand, mortar coloring additive, gauged with latex polymer additive.

1. Portland cement; ASTM C 150, complying with the staining requirements of ASTM C 91 for not more than 0.03% water soluble alkali. Furnish Type I, except Type III may be used for setting in cold weather.

2. Latex polymer additive shall be specially designed latex admixture suitable for exterior installations, for use with thin-set mortars, cement grouts, cement mortar beds, and other cement mixes. Used in place of water, improves the working and physical properties of any cement mix providing shock, chemical and frost resistant, Increased bond and compressive strength, water resistant; suitable for submerged applications, and superior flexibility. Mix according to manufacturer's instructions.
3. Except as otherwise indicated, all other mortar grout materials shall be as specified in Paragraph 2.2 above.

B. Mortar grout shall contain a coloring additive. Color shall be approved by the Architect.

1. Coloring additive shall be manufactured by Solomon Grind Chem Service, Springfield, IL 62705; Davis Colors, Los Angeles, CA 90023; or L.M. Scofield Co., Douglasville, GA 30134.
2. Mortar coloring additive shall have mineral oxide pigment and shall be certified by the supplier to be resistant to alkali, light, and weather, and shall be of a chemical composition unaffected by cement and free of water and soluble salts.
3. Color shall match color of stone.

2.4 METAL ITEMS

A. Steel angle support anchors for general use shall consist of continuous lengths of steel angles, indicated sizes, ASTM A 36, pre-drilled for anchor bolts, all as shown on the approved shop drawings. Steel support angles at interior veneer work shall be prime painted with rust-inhibitive metal primer. Steel support angles at exterior veneer work shall be hot dip galvanized after fabrication in accordance with ASTM A 123, with all field welds and/or field cuts shall be thoroughly cleaned to bare metal and prime painted with ZRC or zinc dust primer.

B. Anchors, cramps, dowels, and other items to be set into concrete or masonry shall be furnished under this Section for installation under the concrete section or masonry section, as applicable. All other metal items shall be installed under this Section.

1. Anchors, cramps, dowels, shims, and other metal items, shall be AISI Type 304 stainless steel or suitable non-ferrous metal of the types and sizes shown on approved Shop Drawings.

PART 3 - EXECUTION

3.1 PLACEMENT OF STEEL SUPPORT ANCHORS

A. Granite veneer shall be anchored and dowelled as indicated, and as shown on the approved shop and setting drawings.

B. The steel support angles shall be leveled and shimmed to provide level seating and plumb plane for the facing veneer, and shall be securely welded or bolted to the back-

up construction, in accordance with AISC Specifications. Threads of studs shall be nicked after adjustment and tightening to prevent loosening.

3.2 SETTING GRANITE

A. Setting shall be done by competent granite setters under adequate supervision and in accordance with the approved shop and setting drawings.

B. Granite units with chips, cracks, stains, or other defects which might be visible in the finished work shall not be used.

C. Before setting, granite shall be clean and free of dirt, and foreign matter on all sides thoroughly scrubbed with mild cleaner and rinsed with fresh clean water. Granite shall be dry before setting.

D. Granite pieces shall be anchored to back-up construction with appropriate types of anchors, cramps, dowels, etc., as indicated on the Drawings and specified herein. Particular care shall be exercised to equalize bed and joint openings and eliminate the need for redressing of exposed surfaces. Exposed surfaces shall be kept free of mortar at all times.

E. Install granite veneer plumb; true to line; with level courses; straight, clean, uniformly wide joints; true surfaces; and straight plumb corners. Maintain horizontal and vertical alignment of joints.

F. Install anchors, cramps, dowels, etc., as the granite veneer facing work progresses. Securely anchor to back-up construction as indicated on the approved shop and setting drawings.

G. All joints shall be kept open to receive compressible joint filler and sealant to be installed by Joint Sealant trade. There shall be no direct contact between adjoining granite pieces.

H. Do not use installed granite veneer work to support or in any way receive scaffolding or other temporary supports.

I. Cooperate with Sheet Metal and Sealant trades, coordinating work of this Section with installation of sheet metal flashings, sealant, and other related work.

J. Provide complete protection against breakage, staining, and weather damage during and after installation of the granite work by use of suitable, strong, impervious film or fabric securely held in place. Tops of granite shall be positively protected with non-staining waterproof coverings, properly weighted, at night, during showers, and whenever Granite setters are not working on the walls.

K. Maintain granite veneer work clean as the work progresses. Exercise extreme care at exposed work to prevent smearing or staining with mortar. Wash mortar stains immediately from exposed surfaces.

L. Joint Sealing: Joints shall be left clean and uniformly wide, ready to receive joint backing and sealant by Joint Sealant trade under the work of Section 079200, JOINT SEALANTS.

3.3 CLEANING

A. After granite work has been carefully cleaned, removing all dirt, excess mortar, stains, and other defacements.

1. Mild abrasive cleaners that contain no harsh or caustic ingredients may be used, with fiber brooms or brushes and clear water. Wire brushes, steel wool, and acids or other solutions which may cause discoloration are expressly prohibited.
2. Expansion joints and other joints to receive sealant shall be cleaned of all mortar and left ready for sealing of joints under Section 079200, JOINT SEALANTS.

B. Upon completion of granite work, surfaces shall be left in a clean, unsoiled condition, acceptable to the Architect.

END OF SECTION 044213

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SECTION 044302 - GRANITE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes solid granite wall veneer, granite capstone with milled water course, granite stair treads and steps, and all other site granite masonry, as indicated on the Drawings.

1.2 REFERENCES

A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirement shall govern.

1. American Society for Testing and Materials (ASTM):

C 144	Aggregate for Masonry Mortar
C 150	Portland Cement
C 207	Hydrated Lime for Masonry Purposes
C 270	Mortar for Unit Masonry
C 615	Structural Granite
D 624	Test Method for Rubber Property - Tear Resistance
D 1752	Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

2. National Building Granite Quarries Association, Inc. (NBGQA):

Specifications	Specifications for Architectural Granite

3. Federal Specifications (Fed. Spec.):

TT-S-00227	Sealing Compound: Elastomeric Type, Multi- Component (For Calking, Sealing, and Glazing in Buildings and Other Structures)

1.3 SUBMITTALS

A. Samples: Samples of the following shall be submitted:

Item	Quantity and Size
Dowels	One each of each size, 4 in. length

Straight Granite Wall Veneer	One section required, full height and width x 4 ft. long, specified color and finish.
Mortar grout	Cured sample, 2 in. x 2 in. of selected color

1. Granite sample shall fully demonstrate color, shade, veining, texture, range, and finish.

B. Verification Samples: Submit actual representative samples of each sealant material that is to be exposed in the completed work. Show full color ranges and finish variations expected. Provide sealant samples having minimum size of 4 in. long.

C. Manufacturer's Product Data: Manufacturer's product data shall be submitted for the following items:

1. Expansion joint filler
2. Grout materials, including additives
3. Joint sealant
4. Mortar materials, including additives

D. Shop Drawings: Cutting and setting drawings of granite pieces specified herein shall be submitted. Drawings shall indicate sizes, dimensions, layout, finishes, arrangement and provisions for jointing, anchoring, cut-out and holes, and other necessary details for reception of other work.

1. Drawings shall indicate locations of inserts for stone anchors and supports which are to be built into concrete, and locations and dimensions of cut-outs, holes, openings, and other provisions required for the work of other trades.
2. Shop drawings shall indicate the setting number of each piece and each piece shall bear the corresponding number in a non-staining paint.

E. Contractor's Review: Before commencing work, submit signed statement that Contract Documents have been reviewed with a qualified representative of granite supplier, and that selected materials and construction are proper, compatible, and adequate for application shown.

F. Test Report: Submit reports from tests conforming to ASTM C 67 methods indicating:

1. Compressive strength, psi. (ASTM C 170)
2. Density, lbs./c.f. (ASTM C 97)
3. Absorption by weight, % (ASTM C 97)
4. Abrasion resistance (ASTM C 241)
5. Flexural strength psi, (MPa) (ASTM C880)

1.4 COORDINATION

A. Coordinate work with that of other sections affecting, affected by, this work, as necessary to assure the steady progress of the work under the Contract.

B. Do all cutting and drilling to accommodate work of other sections, as expressly indicated and as reasonably inferred from Contract Documents Specifications, or required for the proper completion of the Work.

1.5 DELIVERY, HANDLING, AND STORAGE

A. Granite shall be carefully packed and banded by the supplier for shipment. Following shipping granite shall be stored on wood skids or pallets, covered with non-staining, waterproof membrane and protected from the weather. Skids shall be placed and stacked in such a manner as to evenly distribute the weight of the granite materials and to prevent breakage, cracking, and damage to granite pieces. Granite materials shall be stored in such a manner as to allow air to circulate around the granite material. Granite shall not be permitted to be in direct contact with the ground any time during storage.

B. Granite shall be carefully handled to prevent chipping, breakage, soiling, or other damage. Pinch or wrecking bars shall not be used without protecting edges of granite with wood or other rigid materials. Granite units shall be lifted with wide-belt type slings wherever possible; wire rope or ropes containing tar or other substances which might cause staining or damage to granite finish shall not be used.

C. Granite damaged in any manner will be rejected and shall be replaced with new materials at no additional cost to the Owner.

1.6 PROTECTION OF FINISHED SURFACES

A. Finished surfaces adjacent to the granite work shall be adequately protected from soiling, staining, and other damage.

1.7 QUALITY ASSURANCE

A. Granite shall be supplied by a source approved by the Design Professional.

B. Granite shall conform to the requirements of ASTM C 615, Architectural Grade and NBGQA Specifications, except as modified herein.

C. Granite shall be standard grade, free of cracks, seams, starts, or other defects which may impair its strength, durability or appearance. Exposed surfaces shall be free from spots, spalls, chips, stains, discoloration, or other defects which would affect its appearance. Color, texture and finish shall be within the range of samples approved by the Design Professional.

D. Joint Sealing: A firm with a minimum of five years' experience in type of work required by this Section and which is acceptable to the manufacturers of the primary materials.

1.8 JOB CONDITIONS

A. Cold Weather Protection:

1. Remove any ice or snow formed on granite or concrete bed by carefully applying heat until top surface is dry to touch.
2. Remove granite work determined to be damaged by freezing conditions.
3. Perform the following construction procedures while work is progressing:

Air Temperature	Procedures
40° - 32°F.	Heat sand to produce mortar temperatures between 40° and 120°F.
32° - 25°F.	Heat sand to produce mortar temperatures between 40° and 120°F. Maintain temperature of mortar on boards above freezing.
25° - 20°F.	Heat sand to produce mortar temperatures between 40° and 120°F. Maintain temperature of mortar on boards above freezing. Use wind breaks when wind is in excess of 15 mph.
20°F. - below	Heat sand to produce mortar temperatures between 40° and 120°F. Provide enclosures and auxiliary heat to maintain air temperature above 32°F. Do not lay units which have a surface temperature below 20°F.

4. Latex admixture shall be kept at 40°F. minimum.

B. Cold Weather Protection for Completed Granite Work:

Mean Daily Air Temperatures	Procedures
40° - 32°F.	Protect granite work from rain or snow for at least 24 hours by covering with weather-resistive membrane.
32° - 25°F.	Completely over granite work with weather- resistive membrane for at least 24 hours.
25° - 20°F.	Completely cover granite work with insulating blankets or similar protection for at least 24 hours.
20°F. - below	Maintain granite work at temperature above 32°F. for 24 hours using enclosures and supplementary heat.

1. Do not use frozen materials or materials mixed or coated with ice or frost. Do not lower the freezing point of mortar by use of admixtures or antifreeze agents, and do not use calcium chloride in mortar or grout.
2. Do not build on frozen work; remove and replace granite work damaged by frost or freezing.
3. During all seasons, protect partially completed granite work against weather when work is not in progress.

1.9 JOINT SEALANT WARRANTY

A. Furnish joint sealant manufacturer's written single-source performance warranty that joint sealant work will be free of defects related to workmanship or material deficiency for five years from date of Substantial Completion of the Project.

PART 2 - PRODUCTS

2.1 GENERAL STANDARDS

A. Quarrying Supervision

1. Quarrying shall be supervised and coordinated by the granite fabricator to ensure that the as-quarried block orientations will yield finished material with characteristics as described herein.
2. All granite shall be cut from matched blocks. Matched blocks shall mean blocks extracted from a single bed of stratum in the quarry. The use of blocks chosen at random, though similar in general character and color to that of the approved granite will not be permitted, except by written permission of the Design Professional.

B. Examinations

1. Examination at the Quarry: Quarried blocks shall be made available for inspection by the Design Professional at his request.
2. Examination at the Fabrication Plant: Production units shall be made available for inspection by the Design Professional at his request. To this end, the Subcontractor shall, after approval of final shop drawings, advise the Design Professional when production has begun and of the earliest possible opportunity to inspect a representative sampling of production work.
3. Contractor shall provide lighting that is sufficient in intensity and color range to permit an adequate examination to the satisfaction of the Design Professional.

C. Criteria for Granite

1. Visual: All examinations, selections, and approvals shall be for the purpose of achieving a final appearance of granite with greatest possible uniformity, and will be based upon the following criteria:
2. All granite shall be of sound stock and uniform texture, and shall be free from holes, seams, shakes, clay pockets, spalls, stains, starts, and other defects which would impair the strength, durability and appearance of the work, as determined by the
3. Design Professional.
4. Inherent variations characteristic of the granite and the quarry from which the granite is to be obtained shall be brought to the attention of the Design Professional at the time the samples are submitted for approval, and shall be subject to approval of the Design Professional.

5. All granite shall be selected for background color, veining, marking and matching, shall run in even shades, and shall be set accordingly.

D. Physical and Mechanical: Contractor to submit data to the Design Professional.

1. Absorption and Bulk Specified Gravity (ASTM C 97).
2. Flexural strength (ASTM C 880).
3. Compressive Strength (ASTM C 170).
4. Modulus of Rupture (ASTM C 99).
5. Abrasion Resistance, Hardness (ASTM C 241).

E. Any granite materials rejected for non-compliance with these standards shall be replaced at no additional cost to the Owner.

2.2 STONE FABRICATION

A. General: Fabricate stone units in sizes and shapes required to comply with requirements indicated, including details on Drawings and Shop Drawings.

1. For granite, comply with recommendations in NBGQA's "Specifications for Architectural Granite."

B. Cut and drill sinkage’s and holes in stone for anchors, fasteners, supports, and lifting devices as indicated or needed to set stone securely in place; shape beds to fit supports.

C. Cut stone to produce pieces of thickness, size, and shape indicated and to comply with fabrication and construction tolerances recommended by applicable stone association or, if none, by stone source, for faces, edges, beds, and backs.

1. Clean backs of stone to remove rust stains, iron particles, and stone dust.

D. Contiguous Work: Provide chases, reveals, reglets, openings, and similar features as required to accommodate contiguous work.

E. Finish exposed faces and edges of stone, except sawed reveals, to comply with requirements indicated for finish and to match approved samples and mockups.

F. Carefully inspect finished stone units at fabrication plant for compliance with requirements for appearance, material, and fabrication. Replace defective units.

1. Grade and mark stone for overall uniform appearance when assembled in place. Natural variations in appearance are acceptable if installed stone units match range of colors and other appearance characteristics represented in approved samples and mockups.

G. Flatness Tolerance: Variation from true plane, or flat surfaces, shall be determined by use of a 4 ft. long straightedge, applied in any direction on the surface. Such variations

on polished, honed and fine rubbed surfaces at the bed and joint arris lines shall not exceed:

1. 3/64 in. or 1/16 of the specified joint width, whichever is greater. On surfaces having other finishes the maximum variation from true plane shall not exceed 1/4 of the specified joint width.

H. Variations from true plane on other parts of face surfaces shall not exceed the following:

1. 4-cut and sawn finishes 1/8 in.
2. Thermal and coarse stippled sandblasted finishes 3/16 in.

I. Backs of pieces shall be sawn or roughly dressed to approximate true planes. Maximum variation in thickness from the specified shall not exceed the following:

1. 1/2 in. on pieces above 3 in. modular thick

2.3 GRANITE

A. Granite shall conform to the requirements of ASTM C 615, Architectural Grade and NBGQA Specifications.

1. Granite shall be sound and uniform in quality, texture, and strength, and shall be free of any flaws, reeds, rifts, laminations, seams, or defects which would impair its strength, durability, or appearance.

a. Absorption by weight shall not exceed 0.4 %.
b. Compressive strength of not less than 19,000 psi.
c. Minimum density of 160 pcf.

B. Suppliers and Colors:

1. Granite shall be supplied by a quarrying member of the Elberton Granite Association, Inc., One Granite Plaza, P.O. Box 640, Elberton, GA 30635; Tel. 706-283-2551; Web: www.egaonline.com.

a. Granite color shall be “Elberton Gray”; finish shall be as indicated on the Drawings.
b. Finish: Exposed vertical surfaces shall be split face, Granite surfaces which will be concealed in the finished work shall be sawn to approximately true planes.

C. Granite shall be of the sizes and dimensions indicated on the Drawings.

D. All faces shall be at right angles to the plane of the top.

E. Granite shall be cut accurately to required shapes and dimensions.

F. Holes, cut-outs, sinkages and openings in granite work for anchors, cramps, dowels, supports, and lifting devices, shall be accurately cut or drilled to required dimensions, as shown on the approved shop drawings, and as necessary to secure granite in place to insure correct location and accurate fit of all fixtures. Setting beds shall be shaped to fit supports.

G. Arrises shall be cut sharp and true to square, and continuous with adjoining arrises. Where exposed, arrises shall be eased.

2.4 SETTING BED MORTAR

A. Setting bed mortar shall be a pre-mixed and packaged polymer fortified blend of carefully selected polymers, portland cement and graded aggregates which does not require the use of a latex admixture, but only the need to add water to produce a thick bed mortar with exceptional strength, conforming to ASTM C 270.

2.5 MORTAR GROUT FOR JOINTS

A. Mortar grout for pointing of joints shall consist of one (1) part white Portland cement, two (2) parts sand, mortar coloring additive, gauged with latex polymer additive.

1. White Portland cement; ASTM C 150, complying with the staining requirements of ASTM C 91 for not more than 0.03% water soluble alkali. Furnish Type I, except Type III may be used for setting pavers in cold weather.
2. Color pigment shall not exceed 10% of the Portland cement in the mortar.
3. Color will be selected by Design Professional.

2.6 WATER

A. Water shall be potable and shall be free of injurious contaminants.

2.7 EXPANSION JOINT FILLER

A. Preformed expansion joint filler shall be a nonextruding, resilient, nonbituminous type, conforming to ASTM D 1752, Type II.

2.8 SEALANT FOR EXPANSION JOINTS

A. Provide multi-part, non-sag, polyurethane based elastomeric sealant, complying with ASTM C 920 Type M, Grade NS, Class 25, Fed. Spec. TT-S-00227E Class A, having Shore A hardness of 20 to 30, cured modulus of elasticity at 100% elongation of not more than 75 psi, and tear resistance of not less than 50 lbs./inch when tested according to ASTM D 624.

B. Provide one of the following products that meet or exceed specified requirements:

1. Mameco International Vulkem 227
2. Harry S. Peterson Co. Iso-Flex 2000
3. Sika Sikaflex 2c NS.
4. Sonneborn Sonolastic NP 2.
5. Tremco Dymeric

C. Where joint requires 50% movement capabilities, provide Tremco Dymeric Plus, or equal product approved by Design Professional.

D. Extent: Provide non-sag polyurethane sealant for all granite to granite joints.

2.9 ANCHORAGE AND SETTING MATERIALS

A. Anchors, dowels, shims, and other metal items required for the support and anchorage of the granite work shall be furnished under this Section.

B. Anchors, dowels, and other items to be set into concrete shall be furnished under this Section for installation under the concrete section. Other metal items shall be installed under this Section.

C. Anchors, dowels, shims, and other metal items, shall be Type 304 stainless steel.

D. Provide plastic setting buttons as necessary.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine conditions under which stonework is to be installed, and notify in writing of conditions detrimental to proper and timely completion of work. Do not proceed with the installation of stonework until unsatisfactory conditions have been corrected in acceptable manner.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of dimension stone.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Do not use stone units with chips, cracks, voids, stains or other defects which might be visible in the finished work unless otherwise acceptable to the Design Professional.

C. Contractor shall examine the concrete subbase to determine its adequacy to receive granite sections and mortar setting bed. Evidence of inadequate subbase shall be brought to the immediate attention of the Design Professional.

D. Start of work of this Section shall constitute acceptance of the concrete subbase.

3.2 PREPARATION

A. Advise installers of other work about specific requirements for placement of inserts and similar items to be used by dimension stone Installer for anchoring and supporting stone system. Furnish installers of other work with Drawings or templates showing locations of these items.

B. Protect dimension stone during erection as follows:

1. Cover tops of stone with nonstaining, waterproof sheeting at end of each day's work.

a. Cover partially completed structures when work is not in progress. Extend cover a minimum of 24 inches down both sides and hold securely in place.

2. Prevent staining of stone from mortar, grout, sealants, and other sources. Immediately remove such materials without damaging stone.
3. Protect stone from rain-splashed mud and mortar splatter by coverings spread on ground and over wall surface.

C. Clean stone surfaces that are dirty or stained by removing soil, stains, and foreign materials before setting. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.

3.3 SETTING

A. All setting shall be done by competent granite setters under adequate supervision and in accordance with the approved shop drawings.

B. Granite units with chips, cracks, stains, or other defects which might be visible in the finished work shall not be used.

C. Before setting, granite shall be clean and free of dirt, and foreign matter on all sides. Granite shall be dry before setting.

D. Granite shall be set true to the required lines and grades. Joints shall be uniform in thickness. Expansion joints shall be 1/2 in. wide. Unless otherwise indicated on the Drawings all other joints shall be 1/4 in. wide. Direct bearing contact between granite pieces shall be prohibited.

E. Before setting, the back of each granite piece shall be dampened and shall receive a slurry of mortar to ensure maximum contact with mortar bed. Each piece shall be carefully bedded in a full bed of mortar and tapped home with a rawhide mallet to a full and solid bearing. Particular care shall be exercised to equalize bed and joint openings and eliminate the need for redressing of exposed surfaces.

F. Exposed surfaces shall be kept free from mortar at all times. Any mortar smears shall be immediately removed with a clean sponge and clean water before latex modified mortar can set.

G. Holes, slots, and other sinkages for anchors, and dowels, shall be completely filled with mortar during setting of granite.

H. All joints shall be completely filled with non-sag polyurethane sealant to a depth of not less than 3/4 in. Sealant between granite pieces shall be uniform in appearance, texture, and color.

I. Expansion joints shall be located as indicated on the Drawings. Expansion joint shall be 1/2 in. wide. Preformed joint filler shall be installed between granite units at expansion joint locations.

3.4 JOINT SEALANT

A. The Installer shall examine substrates and conditions under which this work is to be performed and notify Contractor, in writing, of conditions detrimental to proper completion of work. Do not proceed with work until unsatisfactory conditions are corrected. Beginning of sealant work means Installer's acceptance of joint surfaces and conditions.

B. Preparation

1. Strictly comply with manufacturers' instructions and recommendations, except where more restrictive requirements are specified in this Section.
2. Clean joint surfaces immediately before installation of sealants, primers, tapes and fillers. Remove substances which could interfere with bond. Etch or roughen joint surfaces to improve bond. Surfaces which have been given protective coatings and those that contain oil or grease shall be thoroughly cleaned with xylol or MEK solvent, with due precautions taken to minimize hazards.
3. Unless otherwise indicated, use of sealants shall conform to the following: ASTM C 790 for latex sealants and ASTM C 962 for other sealants.
4. Tape or mask adjoining surfaces to prevent spillage and migration problems.
5. Prime surfaces as recommended by sealant manufacturer.

C. Installation

1. Schedule work as long as possible after completion of concrete work and finished brick paving and granite work.
2. Provide backer rods for liquid sealants except where specifically recommended against by sealant manufacturers.
3. Prevent three sided adhesion by use of bond breaker tapes or backer rods.
4. Force sealant into joints to provide uniform, dense, continuous ribbons free from gaps and air pockets. Completely wet both joint surfaces equally on opposite sides.

5. Except in hot weather, make sealant surface slightly concave. Install sealants so that compressed sealants do not protrude from joints. Dry tool sealants to form a smooth dense surface. At horizontal joints form a slight cove to prevent trapping water.
6. Provide sealants to depths indicated, or if not indicated, follow manufacturer's recommendations. For joints up to 3/8 in. width, depth of joint shall not exceed 1/2 in.; for joints larger than 1/2 in. width, depth of joint shall not exceed 5/8 in.

D. Cure sealants in strict compliance with manufacturers' instructions and recommendations to obtain highest quality surface and maximum adhesion. Make every effort to minimize accelerated aging effects and increase in modulus of elasticity.

3.5 CLEANING

A. Remove smears from adjacent surfaces immediately, as the work progresses. Exercise particular care to prevent smearing or staining of surrounding surfaces which will be exposed in the finished work, and repair any damage done to same as result of this work without additional cost to Owner.

B. Final Cleaning: After stones are set in final position, clean granite stone assemblies removing all dirt, excess mortar, stains, and other defacements as follows:

1. Test cleaning methods on mockup; leave on-half panel uncleaned for comparison purposes. Obtain Design Professional’s approval of sample cleaning before cleaning permanent stone assemblies.
2. Protect adjacent stone and non-masonry surfaces from contact with cleaner.
3. Prep surfaces, clean and rinse in strict accordance with manufacturer’s printed instructions.
4. Expansion joints and other joints to receive sealant shall be cleaned of all mortar and left ready for sealing of joints under Division 07.

C. Upon completion of granite work, surfaces shall be left in a clean, unsoiled condition, acceptable to the Design Professional.

3.6 PROTECTION

A. Granite work shall be properly and adequately protected under the responsibility of the Contractor until final acceptance of the Project by Owner.

B. After the granite work has been installed, it shall be properly and adequately protected from damage. Boxing or other suitable protection shall be provided by Contractor wherever required. However, no lumber which may stain or deface the granite shall be used. Nails shall be high-quality galvanized or non-rusting.

END OF SECTION 044302

SECTION 051000 - STRUCTURAL STEEL

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Section includes fabrication and erection of structural steel indicated in the Contract Documents or otherwise required for proper completion of the work.

1.2 RELATED SECTIONS

A. Section 013330 - Structural Submittals.

B. Section 014525 - Structural Testing/Inspection Agency Services.

C. Section 052000 - Steel Joists and Joist Girders.

D. Section 053000 - Metal Decking.

1.3 REFERENCES

A. AISC - Code of Standard Practice for Steel Buildings and Bridges.

B. AISC 360-16 - Standard Specification for Structural Steel Buildings, 15th Edition.

C. RCSC - Specification for Structural Joints Using High-Strength Bolts.

D. AWS A5.1 - Specification for Carbon Steel Electrodes for Shield Metal Arc Welding.

E. AWS A5.5 - Specification for Low-Alloy Steel Covered Arc Welding Electrodes.

F. AWS A5.17 - Specification for Carbon Steel Electrodes and Fluxes for Submerged Arc Welding.

G. AWS A5.20 - Specification for Carbon Steel Electrodes for Flux Cored Arc Welding.

H. AWS D1.1 - Structural Welding Code.

I. ASTM A36 - Standard Specification for Structural Steel.

J. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

K. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

L. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

M. ASTM F3125 – Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi and 150 ksi Minimum Tensile Strength, Inch and Metric Dimensions.

N. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Tubing in Rounds and Shapes.

O. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.

P. ASTM A563 – Standard Specifications for Carbon and Alloy Steel Nuts.

Q. ASTM A780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

R. ASTM A992 - Standard Specification for Steel for Structural Shapes For Use in Building Framing.

S. ASTM F436 - Standard Specification for Hardened Steel Washers.

T. ASTM F844 - Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use.

U. ASTM A563 – Standard Specifications for Carbon and Alloy Steel Nuts.

V. SSPC - Steel Structures Painting Manual.

1.4 SUBMITTALS

A. Contact Design Professional prior to detailing structural steel shop drawings.

B. Reproduction of Structural Drawings for shop drawings is not permitted.

Electronic drawing files will not be provided to the Contractor.

C. Submit shop drawings for review.

D. Shop drawings shall clearly indicate the profiles, sizes, ASTM Grade, spacings and locations of all structural steel members, including connections, attachments, anchorages, framed openings, sizes and types of fasteners, method of tightening fasteners, cambers, and the number, type and spacing of the headed shear connectors.

E. For connections and elements designed by the contractor, submit shop drawings and calculations sealed by an engineer licensed in the project state.

F. For record only, submit written welding procedures for each type of welded joint used in accordance with Appendix E of the AWS Structural Welding Code. Submit manufacturer certifications for welding consumables/materials.

G. Maintain at construction office mill certification that the steel supplied meets the specifications.

H. Maintain at construction office certification that high strength bolts supplied meet the specifications.

I. Submit certification that the fabricator meets the required qualifications. If fabricator must have an independent testing agency to inspect fabrication as required by these specifications, submit the name and qualifications of the independent testing agency.

J. For each approved fabricator that is exempt from Special Inspections of shop fabrications and implementation procedures in accordance with Section 1704.2 of the Building Code, submit “Fabricator’s Certificate of Compliance”. Provide copies of fabricator’s certification or building code evaluation services report and fabricator’s quality control manual.

K. Submit certification that the erector meets the required qualifications.

L. Upon request, submit the erection sequence and procedures to be used by the steel erector.

M. Manufacturer’s recommendations for expansion anchor installation.

N. Manufacturer’s recommendations for adhesive anchor installation.

O. Qualification Data: For Erector, manufacturer, professional engineer, land surveyor and testing agency.

1.5 QUALITY ASSURANCE

A. Structural Testing/Inspection Agency shall perform the following quality related items:

1. Anchor Bolts
   a. Anchor bolt size, configuration, and embedment shall be verified prior to placement of concrete.
2. Welded Connections
   a. Inspection shall be in accordance with AWS Structural Welding Code.

b. Visually inspect all field welded connections. Visual inspection of welded joints includes periodic examination of fitup.
c. Ultrasonically inspect 100% of the complete penetration welds.
d. Review approved welding procedures. Verify that welding procedures are being adhered to during field welding.
e. Verify welder qualifications.

3. Bolted Connections
   a. Inspection and testing shall be in accordance with RCSC Specification for Structural Joints Using High-Strength Bolts.
   b. Prior to visual and physical testing, tension testing using a calibration device must indicate tensions at least 5% in excess of the AISC minimum. Structural steel erector shall supply the tension calibration device.
   c. Test a minimum of 10% of the bolted connections.

B. The Structural Testing / Inspection Agency shall provide special inspections as required by Chapter 17 of the building code as required by Specification 01 4525.

Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and with a minimum of five years' experience in providing surveying services of the kind indicated.

1.6 FABRICATOR'S QUALIFICATIONS

A. Steel fabricator shall be certified by the American Institute of Steel Construction (AISC) Quality Certification Program for Conventional Steel Buildings (BU).

B. Fabricator not certified by the AISC Quality Certification Program shall have fabrication procedures and fabricated steel tested and inspected by the Materials Testing and Special Inspection Agency contracted by the Owner Payment of these tests and inspections shall be by the fabricator. Tests and inspections shall be performed by AWS Certified Welding Inspectors. Prior to delivery of structural steel to the project, submit copies of the inspection reports to the Design Professional. The purpose of this inspection is to enable the testing/inspection agency to verify that, in general, the steel is being fabricated in accordance with the Contract Documents. A minimum of one trip per week is recommended. The first trip should be scheduled at the first requirement for inspections as required by IBC Chapter 17. Contact Design Professional prior to initial inspection. Tests and inspections shall include the following:

1. Examine mill test reports and verify that material being used is the same as the mill test reports.
2. Review the fabricator's written welding procedures. Verify that the fabricator's welding procedures are being followed. Verify that welders are certified with current papers and that they demonstrate proper techniques.
3. Observe high strength bolting procedures. Verify that shop installation of high strength bolts conform to AISC specifications.

4. Examine joint preparation for complete penetration joints. Ultrasonically inspect 100% of the complete penetration welds.
5. Examine fillet welds for proper size, profile, throat, porosity and end returns.
6. Examine steel members for lamellar tearing. Spot check dimensions and hole sizes.
7. Examine bolted areas for burrs.

1.7 WELDER'S QUALIFICATIONS: Qualify procedures and personnel in accordance with AWS D1.1.

1.8 STORAGE

A. Store materials off ground to permit easy access for inspection and identification. Store steel members and packaged items in a manner that provides protection against contact with deleterious materials.

PART 2 - PRODUCTS

2.1 ANCHOR ROD

A. Anchor rods shall conform to ASTM F1554, Grade 36 (unless noted otherwise on drawings) and shall be a headed rod or threaded rod with a double heavy hexagonal nut at the bottom of the threaded rod, Grade A563A, unless noted otherwise.

B. Provide two heavy hexagonal nuts at the base of the anchor rod conforming to ASTM A563 Grade C with one plain steel washer between conforming to ASTM F844. Provide one hexagonal nut at the top with plate washer listed below.

C. Provide 3/8-inch-thick plate washers (3-inch x 3-inch) in lieu of top steel washer on base plates with oversized holes conforming to ASTM A36, unless noted otherwise on drawings.

2.2 ROLLED STEEL WIDE FLANGE, CHANNEL AND WT SHAPES

A. Rolled steel wide flange, channels and WT shapes shall conform to ASTM A992.

2.3 PLATES AND BARS

A. Plates and bars shall conform to ASTM A36.

2.4 ROUND STRUCTURAL STEEL TUBING

A. Round structural steel tubing shall conform to ASTM 500, Grade C, 46 ksi minimum yield strength.

2.5 RECTANGULAR STRUCTURAL STEEL TUBING

A. Rectangular structural steel tubing shall conform to ASTM A500, Grade C, 50 ksi minimum yield strength.

B. Hardened steel washers shall conform to ASTM F436.

2.6 HIGH-STRENGTH FASTENERS

A. High-strength bolts shall conform to ASTM F3125 Type 1, 120 ksi as noted on the Structural Drawings.

B. Provide 3/4-inch minimum diameter bolts, unless noted otherwise.

C. Hardened steel washers shall conform to ASTM F436.

D. Spline-type tension control bolts, plain hardened washers and suitable nuts are an acceptable alternate design bolt assembly.

E. Do not use load indicating washers.

2.7 HEADED STUDS

A. Headed steel studs shall conform to the requirements of AWS D1.1.

B. Provide 3/4-inch diameter headed steel studs, unless noted otherwise.

C. Provide heat-resistant ceramic arc shields with studs.

2.8 EXPANSION ANCHORS

A. Expansion anchors shall have been evaluated by the ICC Evaluation Services, Inc. (ICC-ES) or IAPMO Uniform ES (UES) with a published evaluation report. Anchors shall be evaluated by ICC-ES Acceptance Criteria 193 and be specifically approved for use in cracked concrete. All anchors shall be approved for resisting wind and seismic loads.

2.9 ADHESIVE ANCHORS

A. Adhesive anchors shall consist of:

1. An all-thread steel anchor conforming to ASTM A307, Grade A or ASTM A36, zinc plated in accordance with ASTM B633, unless noted otherwise on the Structural Drawings, and
2. An adhesive conforming to ASTM C881-02, Type IV, Grade 3, CLASS A, B, & C except gel times and epoxy content. Adhesive shall consist of a

two-component adhesive system contained in side-by-side packaging connected to a mixing nozzle which thoroughly mixes the components as it is injected into the hole. Adhesive shall have passed ICC Evaluation Services, Inc. Acceptance Criteria 308 for long term creep and be specifically approved for use in cracked concrete.

2.10 WELD ELECTRODES

A. E-70 series low hydrogen electrodes shall conform to AWS A5.1, A5.5, A5.I7, or A5.20.

B. Properly store electrodes to maintain flux quality.

2.11 PAINT

A. Oxide primer shall conform to AISC Specifications, Code of Standard Practice, and SSPC Steel Structure Painting Manual, unless indicated otherwise.

B. Paint primer shall be free of lead and chromate and shall comply with State and Federal volatile organic compound (VOC) requirements.

C. Paint primer shall be compatible with finish coating.

2.12 GALVANIZING

A. Galvanized coating shall conform to ASTM A123.

B. Galvanize bolts, nuts, and washers in accordance with ASTM A153 when used to connect steel members that are specified to be galvanized.

C. Expansion anchors or adhesive anchors specified to be galvanized shall be mechanically galvanized in accordance with ASTM B695, Class 65, Type I.

PART 3 - EXECUTION

3.1 GENERAL

A. Fabricate and erect structural steel in accordance with AISC Specifications and Code of Standard Practice.

B. Notify Design Professional and Structural Testing/Inspection Agency at least 48 hours prior to structural steel fabrication and erection.

3.2 ANCHOR BOLT SETTING

A. Provide templates for setting anchor bolts. Position anchor bolts by using templates with two nuts to secure in place prior to placement of concrete.

B. Do not erect steel where anchor bolt nuts will not have full threads.

3.3 CONNECTIONS

A. Provide a minimum of two fasteners at each bolted connection.

B. Ensure fasteners are lubricated prior to installation.

C. Provide high-strength bolted connections in accordance with RCSC Specification for Structural Joints Using High-Strength Bolts using ASTM F3125 Bolts.

D. Provide connections for expansion and contraction where steel beams connect to concrete walls or concrete columns and at expansion joints. Secure nuts on bolts against loosening. (Dent threads with a chisel.)

3.4 FASTENER INSTALLATION

A. Bolts shall be installed in holes of the connection and brought to snug tight condition. Tighten connection progressing systematically from the most rigid part to the free edges of the connection to minimize relaxation of the bolts.

B. High-strength bolts installed shall have a hardened washer under the element turned in tightening.

C. Installation and tightening of bolts shall conform to the RCSC Specification for Structural Joints Using High-Strength Bolts

3.5 HEADED STUDS

A. Headed studs shall be welded in accordance with AWS D1.1.

B. Locate shear studs directly over the web of beams with flanges less than 0.3 inches thick.

C. The minimum center spacing shall be 6 diameters along the longitudinal axis of the beam and 4 diameters transverse to the longitudinal axis of the beam.

D. Where double rows of shear studs are required, begin double rows at each end of the beam.

E. Remove shields after welding studs.

3.6 EXPANSION ANCHOR INSTALLATION

A. Install in accordance with manufacturer's recommendation.

B. Minimum embedment shall be equal to 4.5 times the anchor diameter unless noted otherwise.

3.7 ADHESIVE ANCHOR INSTALLATION

A. Install in accordance with manufacturer's recommendation.

B. Minimum embedment shall be equal to 4.5 times the anchor diameter unless noted otherwise.

3.8 WELDING

A. Comply with AWS D1.1 Structural Welding Code. Use prequalified weld procedures.

B. Provide end returns where fillet welds terminate at end or sides. Returns shall be continuous for a distance of not less than two times the nominal size of the weld.

C. Complete penetration joints shall be back gouged to sound metal before the second side is welded or have 1/4-inch root opening with 3/16 x 1 inch backing bar. Access holes are required. Filling access holes is not required.

D. Remove all slag and weld splatter from deposited weld metal.

3.9 SPLICING

A. Splice members only where indicated unless authorized in writing by the Design Professional.

B. Provide shim plates at bottom flange splice at continuous beam splices with different depths.

3.10 CUTTING

A. Do not use flame cutting to correct errors unless authorized in writing.

B. Re-entrant corners shall have a minimum radius of one inch and be free of notches. Notches and gouges resulting from flame cutting shall be finished to a smooth appearance.

3.11 MILL SCALE

A. Remove loose mill scale.

3.12 BOLT HOLES

A. Cut, drill, or punch holes perpendicular to metal surfaces. Do not enlarge holes by burning. Drill or punch holes in bearing plates. Remove burrs.

3.13 PAINTING

A. Paint steel that is not encased in concrete, plaster, or sprayed fireproofing. Do not shop paint in areas to be field welded, contact surfaces of slip critical connections, or areas to receive special finishes.

B. Field paint as required steel that has been welded or that is unpainted after connections have been tightened.

3.14 GALVANIZING

A. Galvanize shelf angles that support the exterior building veneer, for example brick shelf angles.

B. Galvanize environmentally exposed steel, for example mechanical equipment or balcony supports.

C. Touch-up welds and abrasions in galvanized members in accordance with ASTM A780.

3.15 EXAMINATION

A. Before Erection begins, survey elevations and plan locations of concrete and masonry bearing surfaces and locations of anchor rods, bearing plates, and other embedments to receive structural framing, with Erector present, for compliance with requirements and specified tolerances.

1. Engage land surveyor to perform surveying.
2. Survey submittals shall indicate elevations and plan locations, and discrepancies between actual installation and Contract Documents.
3. Connections to surveyed items cannot be made until submittal has been approved by Design Professional and unsatisfactory conditions have been corrected.

B. As erection proceeds, survey final elevations and plan locations of columns, beams and other major structural steel elements for compliance with requirements and specified tolerances.

1. Engage land surveyor to perform surveying.
2. Steel frame survey submittals shall indicate final elevations and plan locations of columns, beams and other major framing, as well as column plumbness. Indicate discrepancies between actual installation and the contract Documents.
3. Placement or application of other materials which might obscure or restrain surveyed elements cannot be made until submittal has been

approved by the Design Professional and unsatisfactory conditions have been corrected.

C. Contractor shall check all architecturally exposed structural steel members upon delivery for twist, kinks, gouges or other imperfections which may result in rejection of the appearance of the member. Coordinate remedial action with the fabricator prior to erecting steel.

3.16 REPAIR

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780.

B. Touchup Painting:

1. Touchup Priming: Cleaning and touchup priming are specified in Section 099600 "High-Performance Coatings."

3.17 FIELD QUALITY CONTROL

A. Special inspector to perform the following special inspections in accordance with specification Section 014525

1. Bolted Connections: Inspect bolted connections in accordance with RCSC's
"Specification for Structural Joints Using High-Strength Bolts."
2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1.
    a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1 and the following inspection procedures, at testing agency's option:
        1. Liquid Penetrant Inspection: ASTM E165.
        2. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
        3. Ultrasonic Inspection: ASTM E164.
        4. Radiographic Inspection: ASTM E94.

END OF SECTION 051000

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SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Shop fabricated steel items.

B. Downspout boots.

1.2 REFERENCE STANDARDS

A. ASTM A48/A48M - Standard Specification for Gray Iron Castings 2022.

B. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2022.

C. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates 2018.

D. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength 2021.

E. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing 2021.

F. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination 2020.

G. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification 2021.

H. AWS D1.1/D1.1M - Structural Welding Code - Steel 2020, with Errata (2023).

I. AWS D1.2/D1.2M - Structural Welding Code - Aluminum 2014, with Errata (2020).

J. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172 2019.

K. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer 2004.

L. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic) 2019.

1.3 SUBMITTALS

A. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.

1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
2. Design data: Submit drawings and supporting calculations, signed and sealed by a qualified professional structural engineer.

a. Include the following, as applicable:

1) Design criteria.
2) Engineering analysis depicting stresses and deflections.
3) Member sizes and gauges.
4) Details of connections.
5) Support reactions.
6) Bracing requirements.

B. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.

C. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.4 QUALITY ASSURANCE

A. Design under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.

B. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and AWS D1.2/D1.2M and dated no more than 12 months before start of scheduled welding work.

C. Fabricator Qualifications: A qualified steel fabricator that is accredited by IAS AC172.

PART 2 - PRODUCTS

2.1 MATERIALS - STEEL

A. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.

B. Plates: ASTM A283/A283M.

C. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.

D. Mechanical Fasteners: Same material as or compatible with materials being fastened; type consistent with design and specified quality level.

E. Bolts, Nuts, and Washers: ASTM A307, Grade A, plain.

F. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

G. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

H. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.2 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

D. Furnish components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.3 DOWNSPOUT BOOTS

A. Downspout Boots: Smooth interior without boxed corners or choke points; include integral lug slots and on-body cleanout and cover with neoprene gaskets.

1. Configuration: Angular.
2. Material: Cast iron; ASTM A48/A48M; casting thickness 3/8 inch (9.5 mm), minimum.
3. Finish: Manufacturer's standard factory applied powder coat finish.
4. Color: To be selected by Architect from manufacturer's full range.
5. Accessories: Manufacturer's standard stainless steel fasteners, stainless steel building wall anchors, and rubber coupling.

2.4 FINISHES - STEEL

A. Prime paint steel items.

1. Exceptions: Galvanize items to be embedded in concrete and items to be embedded in masonry.

B. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

C. Prime Painting: One coat. - see Exterior Painting for Specifications.

2.5 FABRICATION TOLERANCES

A. Squareness: 1/8 inch maximum difference in diagonal measurements.

B. Maximum Offset Between Faces: 1/16 inch.

C. Maximum Misalignment of Adjacent Members: 1/16 inch.

D. Maximum Bow: 1/8 inch in 48 inches.

E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.2 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Furnish setting templates to the appropriate entities for steel items required to be cast into concrete.

3.3 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Field weld components as indicated on drawings.

D. Perform field welding in accordance with AWS D1.1/D1.1M.

E. Obtain approval prior to site cutting or making adjustments not scheduled.

F. After erection, prime welds, abrasions, and surfaces not shop primed , except surfaces to be in contact with concrete.

3.4 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION 055000

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SECTION 055000.01 - METAL FABRICATIONS - SITE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Miscellaneous steel framing and supports.
2. Loose bearing and leveling plates.
3. Metal edge.

B. Products furnished, but not installed, under this Section include the following:

1. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

C. Submittals:

1. Product Data.
2. Shop Drawings: Show fabrication and installation details.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

2.2 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Steel Tubing: ASTM A 500/A 500M, cold-formed steel tubing.

2.3 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply Contract Documents.

B. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.4 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Use connections that maintain structural value of joined pieces.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges. Remove sharp or rough areas on exposed surfaces.

C. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended.

D. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Locate joints where least conspicuous.

E. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

2.5 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

2.6 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

2.7 METAL EDGE

A. Metal edge for typical landscape. Basis-of-Design: J.D. Russell, P.O. Box 311, Farmersville, TX 75442, 270-826-7008, jdrussellco.com; 3/16-inch Heavy Duty Dura Edge 6-inch-deep; Color: Black. Or Pre-weathered Corten Steel; 3/8-inch thick.

2.8 FINISHES, GENERAL

A. Finish metal fabrications after assembly.

2.9 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

C. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."

D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.

4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLING BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with nonshrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.3 INSTALLING METAL GRATE, CORRUGATED METAL, METAL EDGE

A. Install in accordance with manufacturers written recommendations and regulatory requirements. Include recommended fasteners and accessories required for installation.

3.4 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 055000.01

SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Stair railings.

1.2 REFERENCE STANDARDS

A. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2022.

B. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes 2023.

C. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings 2020.

D. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings 2021.

E. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination 2020.

F. AWS D1.1/D1.1M - Structural Welding Code - Steel 2020, with Errata (2023).

G. AWS D1.6/D1.6M - Structural Welding Code - Stainless Steel 2017, with Amendment (2021).

H. AWS C3.4M/C3.4 - Specification for Torch Brazing 2016.

I. AWS C3.5M/C3.5 - Specification for Induction Brazing 2016, with Amendment (2017).

J. AWS C3.9M/C3.9 - Specification for Resistance Brazing 2020.

K. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer 2004.

1.3 SUBMITTALS

A. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.

1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

1.4 QUALITY ASSURANCE

A. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located, or personnel under direct supervision of such an engineer.

B. Welder Qualifications: Welding processes and welding operators qualified within previous 12 months.

C. Fabricator Qualifications:

1. A company specializing in manufacturing products specified in this section, with not less than ten years of documented experience.

PART 2 - PRODUCTS

2.1 RAILINGS - GENERAL REQUIREMENTS

A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of applicable local code.

B. Distributed Loads: Design railing assembly, wall rails, and attachments to resist distributed force of 75 pounds per linear foot applied to the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935

C. Concentrated Loads: Design railing assembly, wall rails, and attachments to resist a concentrated force of 200 pounds applied at any point on the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935

D. Allow for expansion and contraction of members and building movement without damage to connections or members.

E. Dimensions: See drawings for configurations and heights.

F. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.

G. Provide welding fittings to join lengths, seal open ends, and conceal exposed mounting bolts and nuts, including but not limited to elbows, T-shapes, splice connectors, flanges, escutcheons, and wall brackets.

H. Welded and Brazed Joints: Make visible joints butt tight, flush, and hairline; use methods that avoid discoloration and damage of finish; grind smooth, polish, and restore to required finish.

1. Ease exposed edges to a small uniform radius.
2. Welded Joints:

    a. Carbon Steel: Perform welding in accordance with AWS D1.1/D1.1M.
    b. Stainless Steel: Perform welding in accordance with AWS D1.6/D1.6M.

3. Brass/Bronze Brazed Joints:

    a. Perform torch brazing in accordance with AWS C3.4M/C3.4.
    b. Perform induction brazing in accordance with AWS C3.5M/C 3.5.
    c. Perform resistance brazing in accordance with AWS C3.9M/C3.9.

2.2 STEEL RAILING SYSTEM

A. Steel Tube: ASTM A500/A500M Grade B cold-formed structural tubing.

B. Steel Pipe: ASTM A53/A53M Grade B Schedule 80, black finish.

C. Welding Fittings: Factory- or shop-welded from matching pipe or tube; seams continuously welded; joints and seams ground smooth.

D. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

2.3 FABRICATION

A. Accurately form components to suit specific project conditions and for proper connection to building structure.

B. Fit and shop assemble components in largest practical sizes for delivery to site.

C. Fabricate components with joints tightly fitted and secured. Provide spigots and sleeves to accommodate site assembly and installation.

D. Welded Joints:

1. Exterior Components: Continuously seal joined pieces by intermittent welds and plastic filler. Drill condensate drainage holes at bottom of members at locations that will not encourage water intrusion.
2. Interior Components: Continuously seal joined pieces by intermittent welds and plastic filler.
3. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

E. Weld connections that cannot be shop welded due to size limitations.

1. Weld in accordance with AWS D1.1/D1.1M.
2. Match shop welding and bolting.
3. Clean welds, bolted connections, and abraded areas.
4. Touch up shop primer and factory-applied finishes.
5. Repair galvanizing with galvanizing repair paint per ASTM A780/A780M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.2 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Supply items required to be cast into concrete with setting templates, for installation as work of other sections.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.

C. Anchor railings securely to structure.

3.4 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per floor level, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION 055213

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Structural dimension lumber framing.

B. Sheathing.

C. Roofing nailers.

D. Roofing cant strips.

E. Preservative treated wood materials.

F. Communications and electrical room mounting boards.

G. Concealed wood blocking, nailers, and supports.

1.2 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2023.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2015.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2016.

D. AWC (WFCM) - Wood Frame Construction Manual for One- and Two-Family Dwellings 2018, with Errata (2019).

E. AWPA U1 - Use Category System: User Specification for Treated Wood 2023.

F. PS 1 - Structural Plywood 2009.

G. PS 20 - American Softwood Lumber Standard 2021.

H. SPIB (GR) - Standard Grading Rules 2021.

1.3 SUBMITTALS

A. Product Data: Provide technical data on insulated sheathing, wood preservative materials, and application instructions.

B. Samples: For rough carpentry members that will be exposed to view, submit three samples, 12"-18" long in size illustrating wood grain, color, and general appearance. Samples must be of the final wood proposed and include all applied finishes.

C. Manufacturer's Certificate: Certify that wood products supplied for rough carpentry meet or exceed specified requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

1.5 WARRANTY

A. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.

2.2 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

A. Joist, Rafter, and Small Beam Framing (2 by 6 through 4 by 16): Clear Structural

B. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring NOT EXPOSED TO VIEW:

1. Lumber: S4S, No. 2 or Standard Grade.
2. Boards: Standard or No. 3.

2.3 EXPOSED DIMENSION LUMBER

A. Grading Agency: Southern Pine Inspection Bureau, Inc; SPIB (GR).

B. Sizes: Nominal sizes as indicated on drawings.

C. Surfacing: S4S.

D. Moisture Content: S-dry or MC19.

E. Joist and Rafter Framing (2 by 6 through 4 by 16):

1. Species: Southern Pine.
2. Grade: Clear Structural.

2.4 EXPOSED BOARDS

A. Submit manufacturer's certificate that products meet or exceed specified requirements, in lieu of grade stamping.

B. Moisture Content: Kiln-dry (15 percent maximum).

C. Surfacing: S4S.

D. Species: Southern Pine.

E. Grade: Select Clear

2.5 CONSTRUCTION PANELS

A. Roofing and Wall Sheathing: Plywood, PS 1, Grade C-D, Exposure I. Sizes and performance characteristics as specified.

B. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

2.6 ACCESSORIES

A. Fasteners and Anchors:

1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.

B. Die-Stamped Connectors: Hot dipped galvanized steel, sized to suit framing conditions.

1. For contact with preservative treated wood in exposed locations, provide minimum G185 galvanizing complying with ASTM A653/A653M.

C. Joist Hangers: Hot dipped galvanized steel, sized to suit framing conditions.

1. For contact with preservative treated wood in exposed locations, provide minimum G185 galvanizing complying with ASTM A653/A653M.

D. Construction Adhesives: Adhesives complying with ASTM C557 or ASTM D3498.

2.7 FACTORY WOOD TREATMENT

A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.

1. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWPA standards.

B. Preservative Treatment:

1. Preservative Pressure Treatment of Lumber Above Grade: AWPA U1, Use Category UC3B, Commodity Specification A using waterborne preservative.

a. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
b. Treat lumber exposed to weather.
c. Treat lumber in contact with roofing, flashing, or waterproofing.
d. Treat lumber in contact with masonry or concrete.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate installation of rough carpentry members specified in other sections.

3.2 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.

B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.3 FRAMING INSTALLATION

A. Set structural members level, plumb, and true to line. Discard pieces with defects that would lower required strength or result in unacceptable appearance of exposed members.

B. Make provisions for temporary construction loads, and provide temporary bracing sufficient to maintain structure in true alignment and safe condition until completion of erection and installation of permanent bracing.

C. Install structural members full length without splices unless otherwise specifically detailed.

D. Comply with member sizes, spacing, and configurations indicated, and fastener size and spacing indicated, but not less than required by applicable codes, AWC (WFCM) Wood Frame Construction Manual.

E. Construct double joist headers at floor and ceiling openings and under wall stud partitions that are parallel to floor joists; use metal joist hangers unless otherwise detailed.

F. Frame wall openings with two or more studs at each jamb; support headers on cripple studs.

3.4 BLOCKING, NAILERS, AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

B. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.

C. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.

3.5 ROOF-RELATED CARPENTRY

A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.

B. Provide wood curb at all roof openings except where prefabricated curbs are specified and where specifically indicated otherwise. Form corners by alternating lapping side members.

3.6 INSTALLATION OF CONSTRUCTION PANELS

A. Roof Sheathing: Secure panels with long dimension perpendicular to framing members, with ends staggered and over firm bearing.

1. At long edges use sheathing clips where joints occur between roof framing members.
2. Nail panels to framing; staples are not permitted.

B. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using nails, screws, or staples.

C. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board.

1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
3. Install adjacent boards without gaps.

3.7 SITE APPLIED WOOD TREATMENT

A. Apply preservative treatment compatible with factory applied treatment at site-sawn cuts, complying with manufacturer's instructions.

B. Allow preservative to dry prior to erecting members.

3.8 TOLERANCES

A. Framing Members: 1/4 inch from true position, maximum.

B. Variation from Plane (Other than Floors): 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.9 CLEANING

A. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.

B. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION 061000

SECTION 061519 - WOOD DECKING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Softwood lumber structural wood decking.

1.2 RELATED SECTIONS

A. Section 013330 - Structural Submittals.

B. Section 014525 - Structural Testing/Inspection Agency Services.

C. Section 09900 - Paints and Coatings: Field finishing.

1.3 REFERENCES

A. PS20-American Softwood Lumber Standard; National Institute of Standards and Technology (Department of Commerce); 1999.

B. SPIB (GR) – Grading Rules; Southern Pine Inspection Bureau, Inc.; 2002.

1.4 SYSTEM DESCRIPTION

A. Design roof live and dead load: As indicated on structural drawings with deflection limited to 1/240 of span.

1.5 SUBMITTALS

A. Shop Drawings: Indicate deck framing system, loads and cambers, bearing details, and framed openings.

B. Samples of Wood Deck Exposed to View: Submit samples, 12 inch long in size.

1.6 QUALITY ASSURANCE

A. Comply with the following:

1. Lumber: PS 20 and approved grading rules and inspection agencies.

PART 2 - PRODUCTS

2.1 SOLID WOOD DECKING

Lumber Decking.

1. Species: Southern Pine.
2. Grade: Select Decking.
3. Moisture Content: 15 percent maximum moisture content.
4. Pattern and Dressing: beveled edges, single tongue, surfaced 2 sides.
5. Size: nominal 2 x 8, actual 1 ½ inches x 7 ½ inches.

2.2 ACCESSORIES

Fasteners and Anchors:

1. Fasteners: Hot dipped galvanized steel.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that support framing is ready to receive decking.

3.2 PREPARATION

A. Coordinate placement of bearing items.

3.3 INSTALLATION – LUMBER DECKING

A. Install decking at 90 degrees to framing members, with ends staggered over firm bearing. On sloped surfaces, lay decking with tongue upward. Install decking in a controlled random layout as required by applicable building code.

B. Fit butt end deck joints occurring between support members with metal splines to maintain tight, aligned joints.

C. Engage decking tongue and groove edges.

D. Secure with fasteners.

E. Maintain decking joint space of 1/16 inch maximum.

3.4 TOLERANCES

A. Surface Flatness of Decking Without Load: ¼ inch in 1 feet maximum, and ½ inch in 30 feet maximum.

END OF SECTION 061519

SECTION 071300 - SHEET WATERPROOFING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Self-adhered rubberized asphalt sheet membrane.

1.2 REFERENCE STANDARDS

A. NRCA (WM) - The NRCA Waterproofing Manual 2021.

1.3 SUBMITTALS

A. Shop Drawings: Indicate special joint or termination conditions and conditions of interface with other materials.

B. Manufacturer's Installation Instructions: Indicate special procedures.

C. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.5 FIELD CONDITIONS

A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application and until liquid or mastic accessories have cured.

1.6 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Contractor to correct defective Work within period of five years after Date of Substantial Completion; remove and replace materials concealing waterproofing at no extra cost to Owner.

C. Provide five year manufacturer warranty for waterproofing failing to resist penetration of water.

PART 2 - PRODUCTS

2.1 SHEET WATERPROOFING APPLICATIONS

A. Self-Adhered Rubberized Asphalt Sheet Membrane:

1. Location: Restroom and Pavilion roof structures.

2.2 SHEET WATERPROOFING MATERIALS

A. Self-Adhered Rubberized Asphalt Sheet Membrane:

1. Thickness: 63 mil, 0.061 inch, minimum.
2. Sheet Width: 3.28 feet, minimum.
3. Adhesives, Sealants, Tapes, and Accessories: As recommended by membrane manufacturer.

2.3 ACCESSORIES

A. Seaming Materials: As recommended by membrane manufacturer.

B. Membrane Sealant: As recommended by membrane manufacturer.

C. Sealant for Cracks and Joints In Substrates: Resilient elastomeric joint sealant compatible with substrates and waterproofing materials.

D. Self-Adhered Flashing: Composite membrane with top layer consisting of Ketone Ethylene Ester (KEE) reinforced membrane and backed by bottom layer of synthetic butyl adhesive covered with release paper.

1. Overall Thickness: 35 to 45 mil, 0.035 to 0.045 inch, nominal.
2. Width: 12 inches, nominal.
3. Color: White.

E. Adhesives: As recommended by membrane manufacturer.

F. Thinner and Cleaner: As recommended by adhesive manufacturer, compatible with sheet membrane.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify existing conditions are acceptable prior to starting work.

B. Verify substrate surfaces are durable; free of matter detrimental to adhesion or application of waterproofing system.

C. Verify that items penetrating surfaces to receive waterproofing are securely installed.

D. Where existing conditions are responsibility of another installer, notify Architect of unsatisfactory conditions.

E. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protect adjacent surfaces from damage not designated to receive waterproofing.

B. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions; vacuum substrate clean.

C. Do not apply waterproofing to surfaces unacceptable to membrane manufacturer.

D. Fill nonmoving joints and cracks with a filler compatible with waterproofing materials.

E. Surfaces for Adhesive Bonding: Apply surface conditioner at a rate recommended by manufacturer, and protect conditioner from rain or frost until dry.

3.3 INSTALLATION - MEMBRANE

A. Install membrane waterproofing in accordance with manufacturer's instructions and NRCA (WM) applicable requirements.

B. Roll out membrane, and minimize wrinkles and bubbles.

C. Self-Adhering Membrane: Remove release paper layer, and roll out onto substrate with a mechanical roller to provide full contact bond.

D. Overlap edges and ends, minimum 3 inches, seal permanently waterproof by method recommended by manufacturer, and apply uniform bead of sealant to joint edge.

E. Reinforce membrane with multiple thickness of membrane material over joints, whether joints are static or dynamic.

F. Weather lap joints on sloped substrate in direction of drainage, and seal joints and seams.

G. Flexible Flashings: Seal items watertight that penetrate through waterproofing membrane with flexible flashings.

H. Seal membrane and flashings to adjoining surfaces.

3.4 PROTECTION

A. Do not permit traffic over unprotected or uncovered membrane.

END OF SECTION 071300

SECTION 071400 - FLUID-APPLIED WATERPROOFING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Modified polymer elastomeric fluid-applied waterproofing.

1.2 REFERENCE STANDARDS

A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer 2015 (Reapproved 2022).

B. ASTM C836/C836M - Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course 2018 (Reapproved 2022).

C. ASTM D2370 - Standard Test Method for Tensile Properties of Organic Coatings 2016 (Reapproved 2021).

D. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials 2022a, with Editorial Revision (2023).

1.3 SUBMITTALS

A. Product Data: Provide data for membrane, surface conditioner, flexible flashings, joint cover sheet, and joint and crack sealants.

B. Warranty:

1. Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
2. Submit installer's certification that installation complies with warranty conditions for the waterproofing membrane.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.5 FIELD CONDITIONS

A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application and until cured.

1.6 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Contractor to correct defective work within a five-year period after Date of Substantial Completion; remove and replace materials concealing waterproofing at no cost to Owner.

C. Provide five year manufacturer warranty against failure of waterproofing to resist penetration of water, except where such failures are the result of structural failures of building.

1. Hairline cracking of concrete due to temperature change or concrete shrinkage is not considered a structural failure.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Fluid-Applied Waterproofing:

1. Carlisle Coatings & Waterproofing: www.carlisleccw.com/#sle.

2.2 PRODUCT TYPES

A. Modified Polymer Elastomeric Fluid-Applied Waterproofing:

1. Location: Restroom building at retaining wall.
2. Vertical Surfaces: Apply directly to concrete substrate.
3. Cover with reinforcing.

2.3 MATERIALS

A. Modified Polymer Elastomeric Fluid-Applied Waterproofing: Fluid-applied, single-component, moisture-reacted, elastomeric, modified polymer waterproof membrane complying with ASTM C836/C836M

1. Product:
2. Cured Thickness: 60 mil, 0.060 inch, minimum.
3. Suitable for installation over concrete substrates.

4. Tensile Strength: 95 psi, minimum, measured in accordance with ASTM D2370.
5. Ultimate Elongation: 350 percent, minimum, measured in accordance with ASTM D2370.
6. Hardness: 10, plus or minus 3, measured in accordance with ASTM C661 using Shore A durometer.
7. Water Vapor Transmission: 0.06 perm inch, maximum, measured in accordance with ASTM E96/E96M.
8. Reinforcing: 1.18 oz/sq yd spunbonded polyester fabric.

    a. Thickness: 7.1 mil, 0.0071 inch.
    b. Width: 36 inches.
    c. Product:

9. Perimeter Drainage Composite: Nonwoven filter fabric bonded to individual dimples of molded polypropylene core to minimize fabric intrusion of flow channels, 1.0 inch thick.

    a. Width: 6 inches, minimum.
    b. Product:

        1) Carlisle Coatings & Waterproofing Inc; MiraDRAIN HC.

10. Adhesives, Sealants, Tapes, and Accessories: As indicated below or by waterproofing manufacturer in accordance with requirements.

2.4 ACCESSORIES

A. Seaming Materials: As recommended by waterproofing manufacturer.

B. Membrane Sealant: As recommended by waterproofing manufacturer.

C. Adhesives: As recommended by waterproofing manufacturer.

D. Thinner and Cleaner: As recommended by adhesive manufacturer, compatible with fluid-applied waterproofing.

E. Sealant for Cracks and Joints In Substrates: Resilient elastomeric joint sealant compatible with substrates and waterproofing materials, as recommended by waterproofing manufacturer.

F. Backer Rods: Closed-cell polyethylene foam rod, as recommended by waterproofing manufacturer.

G. Primer: Synthetic rubber solvent-based primer and surface cleaner.

1. Product:

    a. Carlisle Coatings & Waterproofing Inc; Sure-Seal HP-250 Primer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting this work.

B. Verify substrate surfaces are free of frozen matter, dampness, loose particles, cracks, pits, projections, penetrations, or foreign matter detrimental to adhesion or application of waterproofing system.

C. Verify that substrate surfaces are smooth, free of honeycomb or pitting, and not detrimental to full contact bond of waterproofing materials.

D. Verify that items penetrating surfaces to receive waterproofing are securely installed.

E. Where existing conditions are responsibility of another installer, notify Architect of unsatisfactory conditions.

F. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protect adjacent surfaces from damage not designated to receive waterproofing.

B. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions; vacuum substrate clean.

C. Do not apply waterproofing to surfaces unacceptable to waterproofing manufacturer.

D. Fill nonmoving joints and cracks with a filler compatible with waterproofing materials.

E. Seal moving cracks with sealant and nonrigid filler, using procedures recommended by sealant and waterproofing manufacturers.

3.3 INSTALLATION

A. Install fluid-applied waterproofing in accordance with manufacturers instructions and applicable requirements.

B. Apply primer or surface conditioner at a rate recommended by manufacturer; protect conditioner from rain or frost until dry.

C. At joints and cracks less than 1/2 inch in width including joints between horizontal and vertical surfaces, apply 12 inch wide strip of joint cover sheet.

D. At joints from 1/2 inch to 1 inch in width, loop joint cover sheet down into joint between 1-1/4 inch to 1-3/4 inch, and extend sheet at least 6 inches on either side of expansion joint.

E. Center joint cover sheet over joints, roll sheet into 1/8 inch thick coating of waterproofing material and apply second coat over sheet extending at least 6 inches beyond sheet edges.

F. Extend membrane over cants and up intersecting surfaces at membrane perimeter minimum 6 inches above horizontal surface for first ply and six inches at subsequent plies laid in shingle fashion.

G. Apply extra thickness of waterproofing material at corners, intersections, and angles.

H. Seal membrane and flashings to adjoining surfaces.

3.4 INSTALLATION - DRAINAGE COMPOSITE and PROTECTION BOARD

A. Place drainage composite directly against membrane, butt joints, place to encourage drainage downward, and scribe and cut boards around projections, penetrations, and interruptions.

B. Place protection board directly against drainage composite; butt joints, and scribe and cut boards around projections, penetrations, and interruptions.

C. Install perimeter drainage composite over drainage composite; butt joints.

3.5 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements for additional requirements.

B. Owner will provide testing services, and Contractor to provide temporary construction and materials for testing.

C. Provide daily on-site attendance of roofing and insulation manufacturer's representative during installation of this work.

D. Upon completion of horizontal membrane installation, dam installation area in preparation for flood testing.

1. Flood to minimum depth of 1 inch with clean water, and after 48 hours inspect for leaks.
2. If leaking is found, remove water, repair leaking areas with new waterproofing materials as directed by Architect; repeat flood test, and repair damage to building.
3. When area is proven watertight, drain water and remove dam.

3.6 PROTECTION

A. Do not permit traffic over unprotected or uncovered membrane.

END OF SECTION 071400

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Mineral fiber blanket insulation.

1.2 REFERENCE STANDARDS

A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus 2021.

B. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing 2023.

C. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel 2008 (Reapproved 2023).

D. ASTM C1338 - Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings 2019 (Reapproved 2022).

E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2016.

F. EN 15804 - Sustainability of Construction Works - Environmental Product Declarations - Core Rules for the Product Category of Construction Products 2022 (Corrigendum 2021).

G. ISO 14025 - Environmental Labels and Declarations - Type III Environmental Declarations - Principles and Procedures 2006.

H. UL (GGG) - GREENGUARD Gold Certified Products Current Edition.

I. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.3 SUBMITTALS

A. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

B. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.

C. Manufacturer's qualification statement.

D. Installer's qualification statement.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials and accessories in insulation manufacturer’s original packaging with identification labels intact and in sizes to suit project.

1. Ensure insulation materials are not exposed to moisture during delivery.
2. Replace wet or damaged insulation materials.

B. Store materials off ground in dry location and protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer; store in original packaging until installed.

C. Packaging Waste Management: Remove waste packaging materials from site and dispose of packaging materials at appropriate recycling facilities. Collect and separate for disposal paper and plastic material in appropriate on-site storage containers for recycling.

1.6 FIELD CONDITIONS

A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Thermal Insulation:

1. ROCKWOOL: www.rockwool.com/#sle.

2.2 MINERAL FIBER BLANKET INSULATION MATERIALS

A. Type INS 1 - Mineral Fiber Blanket Thermal Insulation: Semi-rigid stone wool insulation that is noncombustible; Type 1 in accordance with ASTM C665.

1. Applications: Insulation for wood stud exterior roofing for thermal control as indicated on drawings.
2. Flame Spread Index (FSI): 25 or less, when tested in accordance with ASTM E84 or UL 723.
3. Smoke Developed Index (SDI): 50 or less, when tested in accordance with ASTM E84 or UL 723.
4. Facing: Unfaced.
5. Wood Framing: See Section 061000.

    a. Blanket Overall Size: 5-1/2 inches thick by 15-1/4 inches wide by 47 inches long, nominal.
    b. Thermal Resistance: R-value of 21 at 75 degrees F, minimum, when tested in accordance with ASTM C518.

6. Density: Greater than 2 pcf, nominal.
7. Moisture Resistance: Absorption of less than 0.03 percent by weight.
8. Metallic Corrosion Resistance: Noncorrosive/passed, when tested in accordance with ASTM C665 for steel, and ASTM C795 for stress corrosion cracking tendency of austenitic stainless steel.
9. Melting Point: 2,150 degrees F, minimum.
10. Fungi Resistance: Zero mold growth when tested in accordance with ASTM C1338.
11. Environmental Product Declaration (EPD): Material included on UL-certified EPD in accordance with EN 15804 and ISO 14025; see 016000 - Product Requirements for additional information.
12. Low-Emitting VOC Material Certification: Greenguard Gold certified and listed in UL (GGG).
13. Products:

    a. ROCKWOOL; COMFORTBATT: www.rockwool.com/#sle.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.

B. Verify substrate surfaces are flat, free of honeycombs, fins, or irregularities.

3.2 INSTALLATION

A. Install insulation in accordance with manufacturer's written installation instructions.

B. Ensure that insulation installation maintains continuity of thermal protection to building interior spaces.

C. Do not compress insulation to fit into spaces.

D. Install insulation at least 3 inches from heat-emitting devices such as recessed light fixtures, and at least 2 inches from sidewalls of vents.

3.3 PROTECTION

A. Do not permit installed insulation to be damaged prior to its concealment.

B. Cover open ventilation ducts to reduce passage of particulate into ductwork.

END OF SECTION 072100

SECTION 074213 - METAL WALL PANELS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Manufactured metal panels for exterior wall panels, with related flashings and accessory components.

1.2 REFERENCE STANDARDS

A. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2021a.

1.3 SUBMITTALS

A. Product Data - Wall System: Manufacturer's data sheets on each product to be used, including:

1. Physical characteristics of components shown on shop drawings.
2. Storage and handling requirements and recommendations.
3. Installation instructions and recommendations.

B. Shop Drawings: Indicate dimensions, layout, joints, construction details, support clips, and methods of anchorage.

C. Samples: Submit two samples of wall panel, 12 inches by 12 inches in size illustrating finish color, sheen, and texture.

D. Manufacturer's qualification statement.

E. Installer's qualification statement.

F. Warranty Documentation for Installation of Building Rainscreen Assembly: Submit installer warranty and ensure that forms have been completed in Owner's name and registered with installer.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in installing products specified in this section with minimum three years of documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect panels from accelerated weathering by removing or venting sheet plastic shipping wrap.

B. Store prefinished material off the ground and protected from weather; prevent twisting, bending, or abrasion; provide ventilation; slope metal sheets to ensure proper drainage.

C. Prevent contact with materials that may cause discoloration or staining of products.

1.6 FIELD CONDITIONS

A. Do not install wall panels when air temperature or relative humidity are outside manufacturer's limits.

1.7 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Finish Warranty: Provide 5-year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking. Complete forms in Owner's name and register with warrantor.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Metal Wall Panels - Concealed Fasteners: Basis of Design. No substitutions without approval prior to bid submission.

1. Petersen Aluminum Corporation; Redi-Roof Standing Seam: www.pac-clad.com

2.2 METAL WALL PANEL SYSTEM

A. Wall Panel System: Factory fabricated prefinished metal panel system, site assembled.

1. Provide exterior wall panels.

2. Design and size components to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of wall.
3. Maximum Allowable Deflection of Panel: L/180 for length(L) of span.
4. Movement: Accommodate movement within system without damage to components or deterioration of seals, movement between system and perimeter components when subject to seasonal temperature cycling; dynamic loading and release of loads; and deflection of structural support framing.
5. Drainage: Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.
6. Fabrication: Formed true to shape, accurate in size, square, and free from distortion or defects; pieces of longest practical lengths.
7. Corners: Factory-fabricated in one continuous piece with minimum 2-inch returns.

B. Exterior Wall Panels:

1. Profile: Vertical. PAC-Clad Redi-roof Standing Seam pattern.
2. Side Seams: Double-interlocked, tight-fitting, sealed with continuous gaskets.
   a. Without offsets.
   b. Rib height to be 1 3/8".
3. Material: Precoated aluminum sheet, 20 gauge, 0.032 inch minimum thickness.
4. Panel Width: Varies - as indicated on Drawings. 18" standard size maximum panel size.
5. Color: PAC-Clad Ore Finishes: Black Ore (note - this is a special order color and shall form the basis for any finish option/color).

C. Internal and External Corners: Same material, thickness, and finish as exterior sheets; profile to suit system; shop cut and factory mitered to required angles.

D. Trim: Same material, thickness and finish as exterior sheets; brake formed to required profiles.

E. Anchors: Stainless steel.

2.3 MATERIALS

A. Precoated Aluminum Sheet: ASTM B209/B209M, 3105 alloy, O temper, with smooth surface texture; continuous-coil-coated on exposed surfaces with specified finish coating and on panel back with specified panel back coating.

2.4 FINISHES

A. Exposed Surface Finish: Panel manufacturer's top coating as indicated above. Basis of Design PAC-Clad "Ore" finish.

B. Panel Backside Finish: Panel manufacturer's standard siliconized polyester wash coat.

2.5 ACCESSORIES

A. Concealed Sealants: Non-curing butyl sealant or tape sealant, see Section 079200

B. Exposed Sealant: Elastomeric; silicone, polyurethane, or silyl-terminated polyether/polyurethane.

C. Fasteners: Manufacturer's standard type to suit application; with soft neoprene washers, steel, hot dip galvanized. Fastener cap same color as exterior panel.

1. Metal-to-Metal Fasteners: Self-drilling, self-tapping screws.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that building framing members are ready to receive panels.

3.2 PREPARATION

A. Protect surrounding areas and adjacent surfaces from damage during execution of this work.

3.3 INSTALLATION

A. Install panels on walls and soffits in accordance with manufacturer's instructions.

B. Protect surfaces in contact with cementitious materials and dissimilar metals with bituminous paint; allow to dry prior to wall panel installation.

C. Locate joints over supports.

D. Use concealed fasteners unless otherwise indicated by Architect.

E. Seal and place gaskets to prevent weather penetration. Maintain neat appearance.

3.4 TOLERANCES

A. Offset From True Alignment Between Adjacent Members Abutting or In Line: 1/16 inch, maximum.

B. Variation from Plane or Location As Indicated on Drawings: 1/4 inch, maximum.

3.5 CLEANING

A. Remove site cuttings from finish surfaces.

B. Remove protective material from wall panel surfaces.

C. Clean and wash prefinished surfaces with mild soap and water; rinse with clean water.

3.6 PROTECTION

A. Protect metal wall panels until completion of project.

B. Touch-up, repair, or replace damaged wall panels or accessories before Date of Substantial Completion.

END OF SECTION 074213

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SECTION 075419 - THERMOPLASTIC SINGLE-PLY ROOFING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Mechanically attached PVC thermoplastic roofing membrane.

B. Insulation, flat and tapered.

1.2 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures Most Recent Edition Cited by Referring Code or Reference Standard.

B. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation 2016.

C. ASTM D4434/D4434M - Standard Specification for Poly(Vinyl Chloride) Sheet Roofing 2021.

D. ASTM E1980 - Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces 2011 (Reapproved 2019).

E. FM DS 1-28 - Wind Design 2015, with Editorial Revision (2022).

F. FM DS 1-29 - Roof Deck Securement and Above-Deck Roof Components 2016, with Editorial Revision (2022).

G. NRCA (RM) - The NRCA Roofing Manual 2023.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week before starting work of this section.

1. Review preparation and installation procedures and coordinating and scheduling required with related work.

1.4 SUBMITTALS

A. Shop Drawings: Indicate joint or termination detail conditions, conditions of interface with other materials, and paver layout.

B. Warranty:

1. Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
2. Submit installer's certification that installation complies with all warranty conditions for the waterproof membrane.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum twenty (20) years of documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section:

1. With minimum five (5) years documented experience.
2. Approved by membrane manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in manufacturer's original containers, dry, undamaged, with seals and labels intact.

B. Protect products in weather protected environment, clear of ground and moisture.

1.7 FIELD CONDITIONS

A. Do not apply roofing membrane during unsuitable weather.

B. Do not apply roofing membrane when ambient temperature is below 40 degrees F or above 80 degrees F.

C. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.

D. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

1.8 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Material Warranty: Provide membrane manufacturer's warranty agreeing to replace material that shows manufacturing defects within 10 years after installation.

C. System Warranty: Provide manufacturer's system warranty agreeing to repair or replace roofing that leaks or is damaged due to wind or other natural causes.

1. Warranty Term: 20 years.
2. For repair and replacement include costs of both material and labor in warranty.
3. Exceptions NOT Permitted:

    a. Damage due to roof traffic.
    b. Damage due to wind of speed greater than 56 mph but less than 90 mph.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Carlisle SynTec Systems: www.carlisle-syntec.com/#sle.

2.2 ROOFING APPLICATIONS

A. PVC Membrane Roofing: One ply membrane, mechanically fastened, over insulation.

B. Roofing Assembly Performance Requirements and Design Criteria:

1. Solar Reflectance Index (SRI): 78, minimum, calculated in accordance with ASTM E1980.

    a. Field applied coating may not be used to achieve specified SRI.

2. Wind Uplift:

    a. Designed to withstand wind uplift forces calculated with ASCE 7.
    b. Design Wind Speed: In accordance with local building code and authorities having jurisdiction (AHJ).

3. Drainage: No standing water within 48 hours after precipitation.

2.3 ROOFING MEMBRANE AND ASSOCIATED MATERIALS

A. Single Source Responsibility: Provide and install products from single source.

B. Base Sheet: Manufacturer's standard, non-asphaltic, resin-bound, fiberglass-reinforced mat with mineral-filled fire-resistant coating on one side.

C. Membrane:

1. Material: Polyvinyl chloride (PVC) complying with ASTM D4434/D4434M.
2. Thickness: 50 mil, 0.050 inch, minimum.
3. Sheet Width: Factory fabricated into largest sheets possible.
4. Color: White.
5. Products:

a. Carlisle SynTec Systems; SureFlex PVC.
b. Carlisle SureFlex FRS PVC.
c. Carlisle SureFlex FleeceBACK KEE HP PVC.

D. Seaming Materials: As recommended by membrane manufacturer.

E. Membrane Fasteners: As recommended and approved by membrane manufacturer.

F. Flexible Flashing Material: Same material as membrane.

G. Base Flashing: Provide waterproof, fully adhered base flashing system at all penetrations, plane transitions, and terminations.

2.4 INSULATION

A. Extruded Polystyrene (XPS) Board Insulation: Complies with ASTM C578 with natural skin surface, drainage channels on one face.

1. Type and Compressive Resistance: Type IV, 25 psi (173 kPa), minimum.
2. Tapered Board: Slope as indicated; minimum thickness 1/2 inch; fabricate of fewest layers possible.
3. Products:

a. Owens-Corning Foamular 250, distributed by Carlisle SynTec Systems.
b. Dow Styrofoam Deckmate, distributed by Carlisle SynTec Systems.
c. Dow Styrofoam Deckmate Plus, distributed by Carlisle SynTec Systems.

2.5 ACCESSORIES

A. Prefabricated Flashing Accessories:

1. Corners and Seams: Same material as membrane, in manufacturer's standard thicknesses.

a. Carlisle SynTec Systems; Sure-Flex PVC Inside Corners; 80 mils (0.080 inch) thick.

2. Penetrations: Same material as membrane, with manufacturer's standard cut-outs, rigid inserts, clamping rings, and flanges.

a. Carlisle SynTec Systems; Sure-Flex PVC Molded Pipe Flashings; for pipes 1 inch to 6 inches in diameter.

3. Contour Rib Profile: Manufacturer's standard extruded PVC; 1-1/4 inch tall, 2-1/8 inch wide, 3/8 inch profile.
4. Miscellaneous Flashing: Non-reinforced PVC membrane; 80 mils (0.080 inch) thick, in manufacturer's standard lengths and widths.

B. Insulation Adhesive: Two component polyurethane, expanding foam.

1. Products:

a. Carlisle Flexible FAST.

C. Insulation Joint Tape: Glass fiber reinforced type as recommended by insulation manufacturer, compatible with roofing materials; 6 inches wide; self adhering.

D. Insulation Fasteners: Appropriate for purpose intended and approved by roofing manufacturer.

1. Length as required for thickness of insulation material and penetration of deck substrate, with metal washers. FASTENERS MUST NOT PENETRATE THROUGH DECK SUBSTRATE.
2. HP Fastener: Threaded, E-coat, square head fastener for insulation attachment to steel, wood plank, plywood or oriented strand board (OSB) decks.

E. Membrane Adhesive: As recommended by membrane manufacturer.

1. Products:

F. Surface Conditioner for Adhesives: Compatible with membrane and adhesives.

G. Sealants: As recommended by membrane manufacturer.

1. Products:

a. Sure-Flex PVC Cut Edge Sealant.

H. Cleaner: Manufacturer's standard, clear, solvent-based cleaner.

I. Edgings and Terminations: Manufacturer's standard edge and termination accessories.

1. Snap-On Edge System:
2. Anchor Bar Fascia System:
3. Drip Edge:
4. Coping:
5. PVC Coated Sheet Metal.
6. Termination Bar.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that surfaces and site conditions are ready to receive work.

B. Verify deck is supported and secure.

C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.

D. Verify deck surfaces are dry and free of snow or ice.

E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and cant strips are in place.

3.2 PREPARATION, GENERAL

A. Clean substrate thoroughly prior to roof application.

3.3 WOOD DECK PREPARATION

A. Verify flatness and tightness of joints of wood decking. Verify that all wood decking edges are fully supported. Fill knot holes with latex filler or completely cover with securely nailed sheet metal.

B. Confirm dry deck by moisture meter with 12 percent moisture maximum.

3.4 INSTALLATION - GENERAL

A. Perform work in accordance with manufacturer's instructions and NRCA (RM) applicable requirements.

B. Do not apply roofing membrane during unsuitable weather.

C. Do not apply roofing membrane when ambient temperature is outside the temperature range recommended by manufacturer.

D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.

E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

F. Coordinate the work with installation of associated counterflashings installed by other sections as the work of this section proceeds.

3.5 INSTALLATION - GENERAL

A. Perform work in accordance with manufacturer's instructions.

B. Do not apply roofing membrane during unsuitable weather.

C. Do not apply roofing membrane when ambient temperature is outside the temperature range recommended by manufacturer.

D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.

E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

F. When substrate preparation is responsibility of another installer, notify Architect of unsatisfactory conditions before proceeding.

3.6 INSULATION INSTALLATION

A. Attachment of Insulation:

1. Mechanically fasten insulation to deck in accordance with roofing manufacturer's instructions and Factory Mutual requirements.

B. Lay subsequent layers of insulation with joints staggered minimum 6 inches from joints of preceding layer.

C. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions.

D. Lay boards with edges in moderate contact without forcing, and gap between boards no greater than 1/4 inch. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.

E. Tape joints of insulation in accordance with roofing and insulation manufacturers' instructions.

F. Do not apply more insulation than can be completely waterproofed in the same day.

3.7 MEMBRANE APPLICATION

A. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.

B. Shingle joints on sloped substrate in direction of drainage.

C. Seam Welding:

1. Seam Welding: Overlap edges and ends and seal seams by heat welding, minimum 2 inches.
2. Cover all seams with manufacturer's recommended joint covers.
3. Probe all seams once welds have thoroughly cooled. (Approximately 30 minutes.)

4. Repair all deficient seams within the same day.
5. Seal cut edges of reinforced membrane after seam probe is complete.

D. Mechanical Attachment:

1. Apply membrane and mechanical attachment devices in accordance with manufacturer's instructions.

E. At intersections with vertical surfaces:

1. Extend membrane over cant strips and up a minimum of 4 inches onto vertical surfaces.
2. Fully adhere flexible flashing over membrane and up to nailing strips.

F. At gravel stops, extend membrane under gravel stop and to the outside face of the wall.

G. Coordinate installation of roof drains and sumps and related flashings.

H. Daily Seal: Install daily seal per manufacturers instructions at the end of each work day. Prevent infiltration of water at incomplete flashings, terminations, and at unfinished membrane edges.

3.8 CLEANING

A. See Section 017000 - Execution and Closeout Requirements for additional requirements.

B. Remove wrappings, empty containers, paper, and other debris from the roof daily. Dispose of debris in compliance with local, State, and Federal regulations.

C. Remove bituminous markings from finished surfaces.

D. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and conform to their documented instructions.

E. Repair or replace defaced or damaged finishes caused by work of this section.

3.9 PROTECTION

A. Protect installed roofing and flashings from construction operations.

B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

END OF SECTION 075419

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Fabricated sheet metal items, including flashings, gutters, downspouts, exterior penetrations, and other items indicated in Schedule.

B. Sealants for joints within sheet metal fabrications.

1.2 REFERENCE STANDARDS

A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2023.

B. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.

C. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free 2007 (Reapproved 2018).

D. CDA A4050 - Copper in Architecture - Handbook current edition.

E. SMACNA (ASMM) - Architectural Sheet Metal Manual 2012.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week before starting work of this section.

1.4 SUBMITTALS

A. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

B. Samples: Submit two samples 12 inches in size, illustrating gutter construction, downspout connection, and metal finish color.

1.5 QUALITY ASSURANCE

A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.

B. Fabricator and Installer Qualifications: Company specializing in sheet metal work with five years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

B. Prevent contact with materials that could cause discoloration or staining.

PART 2 - PRODUCTS

2.1 SHEET MATERIALS

A. Stainless Steel: ASTM A666, Type 304 alloy, soft temper, 20 gauge thick; smooth No. 4 - Brushed finish.

2.2 FABRICATION

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.

B. Form pieces in longest possible lengths.

C. Hem exposed edges on underside 1/2 inch; miter and seam corners.

D. Form flashing material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.

E. Form gutter from welded sections.

F. Fabricate corners from one piece with minimum 18-inch long legs; seam for rigidity, seal with sealant.

G. Fabricate flashings to allow toe to extend 2 inches over roofing gravel. Return and brake edges.

2.3 GUTTERS AND DOWNSPOUTS

A. Gutters: SMACNA (ASMM) Rectangular profile. Note that profile shape is a custom radius.

B. Downspouts: Round profile.

C. Gutters and Downspouts: Size indicated.

D. Accessories: Profiled to suit gutters and downspouts.

1. Gutter Supports: Brackets.
2. Downspout Supports: Straps.

E. Downspout Boots: Cast iron.

F. Seal metal joints.

2.4 ACCESSORIES

A. Fasteners: Galvanized steel, with soft neoprene washers.

B. Primer Type: Zinc chromate.

C. Concealed Sealants: Non-curing butyl sealant.

D. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.

E. Asphalt Roof Cement: ASTM D4586/D4586M, Type I, asbestos-free.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.

B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.2 PREPARATION

A. Install starter and edge strips, and cleats before starting installation.

B. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil, 0.015 inch.

3.3 INSTALLATION

A. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted.

B. Apply plastic cement compound between metal flashings and felt flashings.

C. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.

D. Seal metal joints watertight.

E. Secure gutters and downspouts in place with concealed fasteners.

F. Slope gutters 1/4 inch per 10 feet, minimum.

G. Connect downspouts to downspout boots, and grout connection watertight.

3.4 SCHEDULE

A. Fascia and Cornices at roofing edges:

B. Gutters and Downspouts: Custom sizes as indicated on Drawings.

C. Counterflashings at Roofing Terminations (over roofing base flashings):

D. Roofing Penetration Flashings, for Pipes, Structural Steel, and Equipment Supports:

END OF SECTION 076200

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Nonsag gunnable joint sealants.

B. Self-leveling pourable joint sealants.

C. Joint backings and accessories.

1.2 REFERENCE STANDARDS

A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer 2015 (Reapproved 2022).

B. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants 2018 (Reapproved 2022).

C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.

D. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems 2023.

E. ASTM C1193 - Standard Guide for Use of Joint Sealants 2016 (Reapproved 2023).

F. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants 2022.

G. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants 2023.

H. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints 2019 (Reapproved 2020).

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical datasheets for each product to be used; include the following:

1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
2. List of backing materials approved for use with the specific product.

3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
4. Substrates the product should not be used on.
5. Sample product warranty.
6. Certification by manufacturer indicating that product complies with specification requirements.

B. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.

C. Samples for Verification: Where custom sealant color is specified, obtain directions from Architect and submit at least two physical samples for verification of color of each required sealant.

D. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.

E. Installation Plan: Submit at least four weeks prior to start of installation.

F. Preinstallation Field Adhesion Test Plan: Submit at least two weeks prior to start of installation.

G. Preinstallation Field Adhesion Test Reports: Submit filled out Preinstallation Field Adhesion Test Reports log within 10 days after completion of tests; include bagged test samples and photographic records.

H. Installation Log: Submit filled-out log for each length or instance of sealant installed.

I. Field Quality Control Log: Submit filled-out log for each length or instance of sealant installed, within 10 days after completion of inspections/tests; include bagged test samples and photographic records, if any.

J. Executed warranty.

1.4 QUALITY ASSURANCE

A. Maintain one copy of each referenced document covering installation requirements on site.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of documented experience.

D. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.

1. Adhesion Testing: In accordance with ASTM C794.

2. Compatibility Testing: In accordance with ASTM C1087.
3. Allow sufficient time for testing to avoid delaying the work.
4. Deliver sufficient samples to manufacturer for testing.
5. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.

E. Installation Plan: Include schedule of sealed joints, including the following:

1. Joint width indicated in Contract Documents.
2. Joint depth indicated in Contract Documents; to face of backing material at centerline of joint.
3. Method to be used to protect adjacent surfaces from sealant droppings and smears, with acknowledgment that some surfaces cannot be cleaned to like-new condition and therefore prevention is imperative.
4. Approximate date of installation, for evaluation of thermal movement influence.
5. Installation Log Form: Include the following data fields, with known information filled out.

    a. Date of installation.
    b. Name of installer.
    c. Actual joint width; provide space to indicate maximum and minimum width.
    d. Actual joint depth to face of backing material at centerline of joint.
    e. Air temperature.

F. Preinstallation Field Adhesion Test Plan: Include destructive field adhesion testing of one sample of each combination of sealant type and substrate, except interior acrylic latex sealants, and include the following for each tested sample.

1. Identification of testing agency.
2. Preinstallation Field Adhesion Test Log Form: Include the following data fields, with known information filled out.

    a. Test date.
    b. Copy of test method documents.
    c. Age of sealant upon date of testing.
    d. Test results, modeled after the sample form in the test method document.
    e. Indicate use of photographic record of test.

G. Field Adhesion Test Procedures:

1. Allow sealants to fully cure as recommended by manufacturer before testing.
2. Have a copy of the test method document available during tests.
3. Record the type of failure that occurred, other information required by test method, and the information required on the Field Quality Control Log.
4. When performing destructive tests, also inspect the opened joint for proper installation characteristics recommended by manufacturer, and report any deficiencies.
5. Deliver the samples removed during destructive tests in separate sealed plastic bags, identified with project, location, test date, and test results, to Owner.

6. If any combination of sealant type and substrate does not show evidence of minimum adhesion or shows cohesion failure before minimum adhesion, report results to Architect.

H. Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Destructive Tail Procedure.

1. Sample: At least 18 inches long.
2. Minimum Elongation Without Adhesive Failure: Consider the tail at rest, not under any elongation stress; multiply the stated movement capability of the sealant in percent by two; then multiply 1 inch by that percentage; if adhesion failure occurs before the 1-inch mark is that distance from the substrate, the test has failed.
3. If either adhesive or cohesive failure occurs before minimum elongation, take necessary measures to correct conditions and retest; record each modification to products or installation procedures.

1.5 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Manufacturer Warranty: Provide 2-year manufacturer warranty for installed sealants and accessories that fail to achieve a watertight seal, exhibit loss of adhesion or cohesion, or do not cure. Complete forms in Owner's name and register with manufacturer.

C. Extended Correction Period: Correct defective work within 2-year period commencing on Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Nonsag Sealants:

1. Bostik Inc; www.bostik-us.com/#sle.
2. Dow; www.dow.com/#sle.
3. Sika Corporation; www.usa.sika.com/#sle.
4. Tremco Commercial Sealants & Waterproofing; www.tremcosealants.com/#sle.
5. W.R. Meadows, Inc; www.wrmeadows.com/#sle.

2.2 JOINT SEALANT APPLICATIONS

A. Scope:

1. Exterior Joints:

a. Seal the following joints:

1) Joints between doors, windows, and other frames or adjacent construction.

2. Interior Joints:

a. Seal the following joints:

1) Joints between door frames and window frames and adjacent construction.
2) Joints at edge of tile in Restroom interior room.

B. Type SLT1 - Exterior Joints: Use nonsag nonstaining silicone sealant, unless otherwise indicated.

1. Control and Expansion Joints in Concrete Paving: Self-leveling polyurethane traffic-grade sealant.

C. Type ___ - Interior Joints: Use nonsag polyurethane sealant, unless otherwise indicated.

1. Wall and Ceiling Joints in Wet Areas: Nonsag polyurethane sealant for continuous liquid immersion.
2. Floor Joints in Wet Areas: Nonsag polyurethane non-traffic-grade sealant suitable for continuous liquid immersion.
3. Joints between Tile in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; white.

D. Interior Wet Areas: restrooms; fixtures in wet areas include plumbing fixtures, countertops, and other similar items.

2.3 NONSAG JOINT SEALANTS

A. Type ___ - Nonstaining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.

1. Movement Capability: Plus and minus 35 percent, minimum.
2. Nonstaining to Brick: Nonstaining to light-colored natural stone when tested in accordance with ASTM C1248.
3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
4. Hardness Range: 15 to 35, Shore A, when tested in accordance with ASTM C661.
5. Color: To be selected by Architect from manufacturer's full range.
6. Service Temperature Range: Minus 20 to 180 degrees F.

B. Type ___ - Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic.

1. Color: To be selected by Architect from full range.

C. Type ___ - Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; not expected to withstand continuous water immersion or traffic.

1. Movement Capability: Plus and minus 35 percent, minimum.
2. Hardness Range: 20 to 35, Shore A, when tested in accordance with ASTM C661.
3. Color: To be selected by Architect from manufacturer's full range.
4. Service Temperature Range: Minus 40 to 180 degrees F.

D. Type ___ - Polyurethane Sealant for Continuous Water Immersion: ASTM C920, Grade NS, Uses M and A; single or multicomponent; explicitly approved by manufacturer for continuous water immersion; suitable for traffic exposure when recessed below traffic surface.

1. Movement Capability: Plus and minus 35 percent, minimum.
2. Hardness Range: 20 to 35, Shore A, when tested in accordance with ASTM C661.
3. Color: To be selected by Architect from manufacturer's full range.
4. Service Temperature Range: Minus 40 to 180 degrees F.

2.4 SELF-LEVELING JOINT SEALANTS

A. Type ___ - Self-Leveling Polyurethane Sealant: ASTM C920, Grade P, Uses M and A; single or multicomponent; explicitly approved by manufacturer for traffic exposure; not expected to withstand continuous water immersion.

1. Movement Capability: Plus and minus 25 percent, minimum.
2. Hardness Range: 35 to 55, Shore A, when tested in accordance with ASTM C661.
3. Color: To be selected by Architect from manufacturer's full range.
4. Service Temperature Range: Minus 40 to 180 degrees F.

2.5 ACCESSORIES

A. Sealant Backing Rod, Closed-Cell Type:

1. Cylindrical flexible sealant backings complying with ASTM C1330 Type C.
2. Size: 25 to 50 percent larger in diameter than joint width.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that joints are ready to receive work.

B. Verify that backing materials are compatible with sealants.

C. Verify that backer rods are of the correct size.

D. Preinstallation Adhesion Testing: Install a sample for each test location indicated in the test plan.

1. Test each sample as specified in PART 1 under QUALITY ASSURANCE article.
2. Notify Architect of date and time that tests will be performed, at least seven days in advance.
3. Record each test on Preinstallation Adhesion Test Log as indicated.
4. If any sample fails, review products and installation procedures, consult manufacturer, or take other measures that are necessary to ensure adhesion; retest in a different location; if unable to obtain satisfactory adhesion, report to Architect.
5. After completion of tests, remove remaining sample material and prepare joints for new sealant installation.

3.2 PREPARATION

A. Remove loose materials and foreign matter that could impair adhesion of sealant.

B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.

C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.

D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

3.3 INSTALLATION

A. Install this work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Provide joint sealant installations complying with ASTM C1193.

C. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.

D. Install bond breaker backing tape where backer rod cannot be used.

E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.

F. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.

G. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

H. Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.

3.4 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements for additional requirements.

B. Perform field quality control inspection/testing as specified in PART 1 under QUALITY ASSURANCE article.

C. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

3.5 POST-OCCUPANCY

A. Post-Occupancy Inspection: Perform visual inspection of entire length of project sealant joints at a time that joints have opened to their greatest width, i.e., at low temperature in thermal cycle. Report failures immediately and repair them.

END OF SECTION 079200

SECTION 079200.01 - JOINT SEALANTS - SITE

PART 1 - GENERAL

1.1 SUMMARY OF WORK

A. This section specifies joint sealants for the following locations. The extent of each form and type of joint sealant is indicated on the drawings.

B. Exterior joints on horizontal traffic surfaces as indicated below:

1. Expansion joints cast-in-place concrete slabs for paving.
2. Joints between different materials listed above and between curbs, building facades and existing structures.

C. Exterior joints in vertical surfaces as indicated below:

1. Control and expansion joints in unit masonry.

1.2 REFERENCE STANDARDS

A. ASTM C 834 - Standard Specification for Latex Sealants; 2005.

B. ASTM C 1193 - Standard Guide for Use of Joint Sealants; 2009.

C. ASTM D 1056 - Standard Specification for Flexible Cellular Materials--Sponge or Expanded Rubber; 2007.

D. ASTM D 1667 - Standard Specification for Flexible Cellular Materials--Poly(Vinyl Chloride) Foam (Closed-Cell); 2005.

E. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168; current edition; www.aqmd.gov.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that have been produced and installed to establish and to maintain watertight and airtight continuous seals without causing staining or deterioration of joint substrates.

1.4 SUBMITTALS

A. Product Data from manufacturers for each joint sealant product required, including instructions for joint preparation and joint sealant application.

B. Samples for Initial Selection Purposes Manufactures standard bead samples consisting of strips of actual products showing full range of colors available.

C. Samples for verification purposes of each type and color of joint sealant required. Install joint sealant sample in project mock-up for approval by Owner's Representative.

D. Certificates for manufacturers of joint sealants attesting that their products comply with specification requirements and are suitable for the use indicated.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an installer who has successfully completed within the last 3 years at least 3 joint sealant applications similar in type and size to that of this project.

B. Obtain joint sealant materials from a single manufacturer for each different product required.

C. Provide test data for each type of joint sealant for compliance with requirements specified by reference to ASTM C 920.

D. Field Constructed Mock-ups: Prior to installation of joint sealants, apply elastomeric sealants as follows to verify selections made under sample submittals and to demonstrate aesthetic effects as well as qualities of materials and execution.

1. Joints in field constructed mock-ups of assemblies specified in other sections that are to receive elastomeric joint sealants specified in this section.

1.6 PRODUCT DELIVERY; STORAGE, AND HANDLING

A. Deliver materials to project site in original unopened containers with labels informing about manufacturer; product name; color, expiration date, pot life, and mixing instructions.

B. Store and handle materials in compliance with manufacturer's recommendations.

1.7 PROJECT CONDITIONS

A. Environmental Conditions: Do not proceed with installation of joint sealers when temperature limits are outside manufacturer's limits and when substrates are wet.

B. Joint widths must comply with that allowed by joint sealer manufacturer.

C. Joint Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are removed from joint substrates.

D. Sequence joint sealant installation to occur after water repellent installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Silicone Sealants:

1. Bostik Inc: www.bostik-us.com.
2. BASF Construction Chemicals-Building Systems: www.chemrex.com.
3. Or approved equivalent

2.2 MATERIALS, GENERAL

A. Provide joint sealants, joint fillers and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

B. Color of exposed joint sealant to be selected by Owner's Representative.

2.3 ELASTOMERIC JOINT SEALANT DATA SHEET

A. Elastomeric Joint Sealant Designation ES 1

1. Base Polymer Urethane
2. Type M (multicomponent)
3. Grade NS (nonsag)
4. Class 25 with a shore A hardness of 35 or greater.

B. Additional Movement Capability: 50% movement in extension and 50% in compression for a total of 100% movement.

C. Use(s) Related to Exposure T (traffic) and NT (nontraffic)

D. Uses Related to Joint Substrates M and, as applicable to joint substrates indicated, O.

1. Use O Joint Substrates Brick, granite, limestone, marble and ceramic tile.

2.4 ELASTOMERIC SEALANT STANDARD

A. Elastomeric Joint Sealants: Provide manufacturer's standard chemical curing, elastomeric sealant of base polymer indicated which complies with ASTM C 920 requirements and other requirements indicated on each Elastomeric Joint Sealant Data Sheet at end of this Section, including those referenced for Type, Grade, Class and Uses.

1. Additional Movement Capability: Where additional movement capability is specified in Elastomeric Joint Sealant Data Sheet, provide products with the capability, where tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719, to withstand the specified percentage change in the joint width existing at time of installation and remain in compliance with other requirements of ASTM C 920 for uses indicated.

2.5 JOINT SEALANT BACKING

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Plastic Foam Joint Fillers: Preformed, compressible, resilient, nonstaining, nonwaxing, nonextruding strips of flexible plastic foam of material indicated below and of size, shape, and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

1. Open-cell polyurethane foam. Not suitable for horizontal surfaces.
2. Closed-cell polyethylene foam, nonabsorbent to liquid water and gas, nonoutgassing in unruptured state.
3. Resin impregnated fibre board, complying with ASTM D 1751.

C. Bond-Breaker Tape: Polythylene tape or other plastic tape as recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.6 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming in any way joint substrates and adjacent nonporous surfaces, and formulated to promote optimum adhesion of sealants with joint substrates.

C. Masking Tape: Non-staining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

D. Joint Backing: Round foam rod compatible with sealant; ASTM D 1667, closed cell PVC; oversized 30 to 50 percent larger than joint width.

E. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

PART 3 - EXECUTION

3.1 EXAMINATIONS

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation, tolerances, and other conditions affecting joint sealant performance. Do not proceed with installation of joint sealants until satisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clear out joints immediately before installing joint sealants to comply with recommendations of joint sealant manufacturers and the following requirements.

1. Remove all foreign material from joint substrates which could interfere with adhesion of joint sealant.
2. Clean concrete, masonry, stone, brick and similar porous joint substrate surfaces by brushing and blowing out joints to provide optimum bond with joint sealants in accordance with manufacturer’s instructions.
3. Perform preparation in accordance with manufacturer’s instructions and ASTM C 1193.
4. Remove laitance and form release agents from concrete.

B. Joint Priming: Prime joint substrates where indicated or where recommended by joint sealant manufacturers.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Protect elements surrounding the work.

3.3 INSTALLATION

A. General: Comply with joint sealant manufacturer's printed installation instructions.

B. Sealant Installation Standard: Comply with recommendation of ASTM C 1193 for use of joint sealants as applicable to materials indicated.

C. Installation of Sealant Backings: Install sealant backings to comply with the following requirements:

1. Install joint fillers of type indicated to provide support of sealants during application and at position required to produce shapes and depths of installed sealants.
2. Do not leave gaps between ends of joint fillers.
3. Do not stretch, twist, or tear joint fillers.
4. Remove wet joint filler and replace with dry material.

D. Installation of Sealants: Install sealants by proven techniques that result in sealants completely filling recesses provided for each joint configuration, and providing uniform cross - sectional shapes and depths.

E. Tooling of Non-Sag Sealants: Immediately tool sealants to form smooth, uniform beads and to ensure contact and adhesion of sealant with sides of joint.

1. Provide concave joint configuration per ASTM C 1193.

3.4 CLEANING

A. Clean off excess sealants or sealant smears adjacent to joints.

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substance or from damage from construction operations.

B. Cut out and remove damaged or deteriorated joint sealants immediately and reseal joints with new materials.

END OF SECTION 079200.01

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Non-fire-rated hollow metal doors and frames.

B. Thermally insulated hollow metal doors with frames.

C. Stainless-steel hollow metal doors and frames.

1.2 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design 2010.

B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors 2022.

C. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames 2020.

D. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100) 2023.

E. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames 2020.

F. ASTM A480/A480M - Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip 2023b.

G. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2015.

H. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2023.

I. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable 2023.

J. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength 2023.

K. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete 2020.

L. ASTM C476 - Standard Specification for Grout for Masonry 2023.

M. BHMA A156.115 - Hardware Preparation in Steel Doors and Frames 2016.

N. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.

O. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames 2002.

P. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames 2011.

Q. NAAMM HMMA 840 - Guide Specifications For Receipt, Storage and Installation of Hollow Metal Doors and Frames 2017.

R. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames 2014.

S. NAAMM HMMA 866 - Guide Specifications for Stainless Steel Hollow Metal Doors and Frames 2012 (Reapproved 2018).

T. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames 2023.

1.3 SUBMITTALS

A. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.

B. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.

C. Samples: Submit two samples of metal, 2 by 2 inches in size, showing factory finishes, colors, and surface texture.

D. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.

E. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Provide hollow metal doors and frames from SDI Certified manufacturer: https://steeldoor.org/sdi-certified/#sle.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

C. Maintain at project site copies of reference standards relating to installation of products specified.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Hollow Metal Doors and Frames:

1. Mesker, dormakaba Group; F Series Masonry Frames : www.meskeropeningsgroup.com/#sle.
2. Steelcraft, an Allegion brand: www.allegion.com/#sle.
3. Trudoor; www.trudoor.com.

B. Stainless-Steel Hollow Metal Doors and Frames:

1. Mesker, dormakaba Group; Mesker Stainless Doors and Frames: www.meskeropeningsgroup.com/#sle.
2. Next Door Company; Stainless-Steel Door and Frame, Type 304 alloy: www.nextdoorco.com/#sle.
3. Steelcraft, an Allegion brand: www.allegion.com/#sle.
4. Trudoor; www.trudoor.com.

2.2 PERFORMANCE REQUIREMENTS

A. Requirements for Hollow Metal Doors and Frames:

1. Steel Sheet: Comply with one or more of the following requirements; galvannealed steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
2. Accessibility: Comply with ICC A117.1 and ADA Standards.
3. Door Edge Profile: Seamless.
4. Typical Door Face Sheets: Flush.

5. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

B. Hollow Metal Panels: Same construction, performance, and finish as doors.

C. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.3 HOLLOW METAL DOORS

A. Door Finish: Factory primed and field finished.

B. Type EXTDR1, Exterior Doors: Thermally insulated.

1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).

a. Level 2 - Heavy-duty.
b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
c. Model 1 - Full Flush.
d. Door Face Metal Thickness: 18 gauge, 0.042 inch, minimum.

2. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.
3. Door Thickness: 1-3/4 inches, nominal.
4. Top Closures for Outswinging Doors: Flush with top of faces and edges.
5. Weatherstripping: Refer to Section 087100.
6. Door Finish: Factory primed and field finished.

C. Type SSDR1, Stainless-Steel Exterior Doors:

1. Based on NAAMM HMMA Custom Guidelines: Comply with guidelines of NAAMM HMMA 866 for stainless-steel hollow metal doors.

a. Physical Endurance - Level A (1,000,000 cycles), in accordance with ANSI/SDI A250.4 for Swing Test.
b. Door Face Metal Thickness: 16 gauge, 0.053 inch, minimum.

2. Applications: Comply with designated application in accordance with NAAMM HMMA 866 guidelines.

a. Moderately corrosive.

3. Door Face Sheets: Stainless-steel, Type 304 alloy in compliance with ASTM A666.

a. Sheet Thickness: 18 gauge, 0.042 inch, minimum.
b. Door Finish: No.4 - Brushed satin finish in accordance with ASTM A480/A480M.

4. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.
5. Door Thickness: 1-3/4 inches.

2.4 HOLLOW METAL FRAMES

A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.

B. Frame Finish: Factory primed and field finished.

C. Exterior Door Frames: Full profile/continuously welded type.

1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A40/ZF120 coating.
2. Frame Metal Thickness: 18 gauge, 0.042 inch, minimum.
3. Weatherstripping: Separate, see Section 087100.

D. Stainless-Steel Door Frames: Provide full profile and continuously welded type in compliance with NAAMM HMMA 866, with Type 304 alloy in compliance with ASTM A666.

1. Sheet Thickness: 16 gauge, 0.053 inch, minimum.
2. Frame Finish: Same as stainless-steel door finish in compliance with ASTM A480/A480M.

E. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.

F. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inches high to fill opening without cutting masonry units.

2.5 FINISHES

A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

2.6 ACCESSORIES

A. Grout for Frames: Mortar grout complying with ASTM C476 with maximum slump of 4 inches as measured in accordance with ASTM C143/C143M for hand troweling in place; plaster grout and thinner pumpable grout are prohibited.

B. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.

C. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Verify that finished walls are in plane to ensure proper door alignment.

3.2 PREPARATION

A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

3.3 INSTALLATION

A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.

B. Coordinate frame anchor placement with wall construction.

C. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.

D. Install door hardware as specified in Section 087100.

1. Comply with recommended practice for hardware placement of doors and frames in accordance with ANSI/SDI A250.6 or NAAMM HMMA 861.

E. Touch up damaged factory finishes.

3.4 TOLERANCES

A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.

B. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.5 ADJUSTING

A. Adjust for smooth and balanced door movement.

END OF SECTION 081113

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SECTION 083100 - ACCESS DOORS AND PANELS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Ceiling-mounted access units.

1.2 SUBMITTALS

A. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.

B. Shop Drawings: Indicate exact position of each access door and/or panel unit.

C. Manufacturer's Installation Instructions: Indicate installation requirements.

D. Manufacturer's qualification statement.

E. Project Record Documents: Record actual locations of each access unit.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.

PART 2 - PRODUCTS

2.1 ACCESS DOORS AND PANELS ASSEMBLIES

A. Ceiling-Mounted Units with Return Air Grille:

1. Panel Material: Aluminum.
2. Size - GWB Ceilings: 12 by 12 inches.

2.2 WALL- AND CEILING-MOUNTED ACCESS UNITS

A. Manufacturers:

B. Wall- and Ceiling-Mounted Units: Factory-fabricated door and frame, fully assembled units with corner joints welded, filled and ground flush; square and without rack or warp; coordinate requirements with type of installation assembly being used for each unit.

1. Style: Recessed door panel for infill with wall/ceiling finish.

a. Gypsum Board Mounting Criteria: Use drywall bead type frame.

2. Door Style: Single thickness with rolled or turned in edges.
3. Heavy-Duty Frames: 14-gauge, 0.0747-inch minimum thickness.
4. Door Panels to Receive Wall/Ceiling Finish: Surface recessed 1/2" inch back from GWB face.
5. Aluminum Finish: Polyester powder coat.
6. Hardware:

a. Hinges for Non-Fire-Rated Units: Concealed, constant force closure spring type.
b. Latch/Lock: Tamperproof tool-operated cam latch.
c. Gasketing: Extruded neoprene, around perimeter of door panel.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that rough openings are correctly sized and located.

B. Begin installation only after substrates have been properly prepared, and if the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to proceeding with this work.

B. Prepare surfaces using methods recommended by manufacturer for applicable substrates in accordance with project conditions.

3.3 INSTALLATION

A. Install units in accordance with manufacturer's instructions.

B. Install frames plumb and level in openings, and secure units rigidly in place.

C. Position units to provide convenient access to concealed equipment when necessary.

END OF SECTION 083100

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SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Hardware for hollow metal doors.

B. Thresholds.

C. Weatherstripping and gasketing.

1.2 RELATED REQUIREMENTS

A. Section 081113 - Hollow Metal Doors and Frames.

1.3 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. BHMA A156.1 - Standard for Butts and Hinges; 2021.

C. BHMA A156.2 - Bored and Preassembled Locks and Latches; 2022.

D. BHMA A156.4 - Door Controls - Closers; 2019.

E. BHMA A156.6 - Standard for Architectural Door Trim; 2021.

F. BHMA A156.7 - Template Hinge Dimensions; 2016.

G. BHMA A156.13 - Mortise Locks & Latches Series 1000; 2022.

H. BHMA A156.21 - Thresholds; 2019.

I. BHMA A156.22 - Standard for Gasketing; 2021.

J. BHMA A156.25 - Electrified Locking Devices; 2023.

K. BHMA A156.28 - Standard for Recommended Practices for Mechanical Keying Systems; 2018.

L. BHMA A156.115 - Hardware Preparation in Steel Doors and Steel Frames; 2016.

M. DHI (H&S) - Sequence and Format for the Hardware Schedule; 2019.

N. DHI (KSN) - Keying Systems and Nomenclature; 2019.

O. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

P. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.

Q. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

R. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2022.

S. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.

T. UL (DIR) - Online Certifications Directory; Current Edition.

U. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the manufacture, fabrication, and installation of products that door hardware is installed on.

B. Sequence installation to ensure facility services connections are achieved in an orderly and expeditious manner.

C. Preinstallation Meeting: Convene a preinstallation meeting one week prior to commencing work of this section; require attendance by affected installers and the following:

1. Architect.
2. Installer's Architectural Hardware Consultant (AHC).
3. Hardware Installer.
4. Owner's Security Consultant.

D. Furnish templates for door and frame preparation to manufacturers and fabricators of products requiring internal reinforcement for door hardware.

E. Keying Requirements Meeting:

1. Attendance Required:
2. Agenda:

    a. Establish keying requirements.
    b. Verify locksets and locking hardware are functionally correct for project requirements.
    c. Verify that keying and programming complies with project requirements.
    d. Establish keying submittal schedule and update requirements.

3. Incorporate "Keying Requirements Meeting" decisions into keying submittal upon review of door hardware keying system.
4. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.
5. Deliver established keying requirements to manufacturers.

1.5 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project, and includes construction details, material descriptions, finishes, and dimensions and profiles of individual components.

C. Shop Drawings - Door Hardware Schedule: A detailed listing that includes each item of hardware to be installed on each door.

1. Prepared by or under supervision of Architectural Hardware Consultant (AHC).
2. Comply with DHI (H&S) using door numbering scheme and hardware set numbers as indicated in Contract Documents.

a. Submit in vertical format.

3. Include complete description for each door listed.

D. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

E. Manufacturer's qualification statement.

F. Installer's qualification statement.

G. Supplier's qualification statement.

H. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.

I. Keying Schedule:

1. Submit three (3) copies of Keying Schedule in compliance with requirements established during Keying Requirements Meeting unless otherwise indicated.

J. Warranty: Submit manufacturer's warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

K. Project Record Documents: Record actual locations of concealed equipment, services, and conduit.

L. Maintenance Materials and Tools: Furnish the following for Owner's use in maintenance of project.

1. See Section 016000 - Product Requirements, for additional provisions.

1.6 QUALITY ASSURANCE

A. Standards for Fire-Rated Doors: Maintain one copy of each referenced standard on site, for use by Architect and Contractor.

B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.

C. Installer Qualifications: Company specializing in performing work of the type specified for commercial door hardware with at least three years of documented experience.

D. Supplier Qualifications: Company with certified Architectural Hardware Consultant (AHC) and Electrified Hardware Consultant (EHC) to assist in work of this section.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Package hardware items individually; label and identify each package with door opening code to match door hardware schedule.

1.8 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Manufacturer Warranty: Provide manufacturer warranty against defects in material and workmanship for period indicated, from Date of Substantial Completion. Complete forms in Owner's name and register with manufacturer.

1. Closers: Thirty five years, minimum.
2. Locksets and Cylinders: Three years, minimum.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Provide specified door hardware as required to make doors fully functional, compliant with applicable codes, and secure to extent indicated.

B. Provide individual items of single type, of same model, and by same manufacturer.

C. Closers:

1. Provide door closer on each exterior door, unless otherwise indicated.
2. Provide door closer on each fire-rated and smoke-rated door.

D. Drip Guards: Provide at head of outswinging exterior doors unless protected by roof or canopy directly overhead.

E. Weatherstripping and Gasketing:

1. Provide weatherstripping on each exterior door at head, jambs, and meeting stiles of door pairs, unless otherwise indicated.
2. Provide door bottom sweep on each exterior door, unless otherwise indicated.

F. Fasteners:

1. Provide fasteners of proper type, size, quantity, and finish that comply with commercially recognized standards for proposed applications.

    a. Aluminum fasteners are not permitted.
    b. Provide phillips flat-head screws with heads finished to match door surface hardware unless otherwise indicated.

2. Provide machine screws for attachment to reinforced hollow metal and aluminum frames.

    a. Self-drilling (Tek) type screws are not permitted.

3. Provide stainless steel machine screws and lead expansion shields for concrete and masonry substrates.
4. Provide wall grip inserts for hollow wall construction.
5. Fire-Resistance-Rated Applications: Comply with NFPA 80.

    a. Provide wood or machine screws for hinges mortised to doors or frames, strike plates to frames, and closers to doors and frames.
    b. Provide steel through bolts for attachment of surface mounted closers, hinges, or exit devices to door panels unless proper door blocking is provided.

2.2 PERFORMANCE REQUIREMENTS

A. Provide door hardware products that comply with the following requirements:

1. Applicable provisions of federal, state, and local codes.
2. Accessibility: ADA Standards and ICC A117.1.
3. Fire-Resistance-Rated Doors: NFPA 80, listed and labeled by qualified testing agency for fire protection ratings indicated, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
4. Hardware Preparation for Steel Doors and Steel Frames: BHMA A156.115.

2.3 HINGES

A. Manufacturers: Conventional butt hinges.

1. ABH Mfg.
2. BEST; dormakaba Group: www.bestaccess.com/#sle.
3. Hager Companies.
4. McKinney, Assa Abloy Group.
5. Select Hinges.
6. Substitutions: See Section 016000 - Product Requirements.

B. Properties:

1. Butt Hinges: As applicable to each item specified.

a. Standard Weight Hinges: Minimum of two (2) permanently lubricated non-detachable bearings.
b. Template screw hole locations.
c. Bearing assembly installed after plating.
d. Bearings: Concealed fully hardened bearings.
e. Bearing Shells: Shapes consistent with barrels.
f. Pins: Easily seated, non-rising pins.
1) Fully plate hinge pins.
2) Non-Removable Pins: Slotted stainless steel screws.

g. UL 10C listed for fire-resistance-rated doors.

C. Sizes: See Door Hardware Schedule.

1. Hinge Widths: As required to clear surrounding trim.
2. Sufficient size to allow 180 degree swing of door.

D. Finishes: See Door Hardware Schedule.

1. Fully polish hinges; front, back, and barrel.

E. Grades:

1. Butt Hinges: Comply with BHMA A156.1 and BHMA A156.7 for templated hinges.

F. Material: Base metal as indicated for each item by BHMA material and finish designation.

G. Types:

1. Butt Hinges: Include full mortise hinges.

H. Options: As applicable to each item specified.

I. Quantities:

1. Butt Hinges: Three (3) hinges per leaves up to 90 inches (2286 mm) in height. Add one (1) for each additional 30 inches (762 mm) in height or fraction thereof.

    a. Hinge weight and size unless otherwise indicated in hardware sets:
        3) For doors up to 36 inches (914 mm) wide and up to 1-3/4 inches (44.5 mm) thick provide hinges with a minimum thickness of 0.134 inch (3.4 mm) and a minimum of 4-1/2 inches (114 mm) in height.
        4) For doors from 36 inches (914 mm) wide up to 42 inches (1067 mm) wide and up to 1-3/4 inches (44.5 mm) thick provide hinges with a minimum thickness of 0.145 inch (3.7 mm) and a minimum of 4-1/2 inches (114 mm) in height.
        5) For doors from 42 inches (1067 mm) wide up to 48 inches (1219 mm) wide and up to 1-3/4 inches (44.5 mm) thick provide hinges with a minimum thickness of 0.180 inch (4.6 mm) and a minimum of 5 inches (127 mm) in height.
        6) For doors greater than 1-3/4 inches (44.5 mm) thick provide hinges with a minimum thickness of 0.180 inch (4.6 mm) and a minimum of 5 inches (127 mm) in height.

J. Applications: At swinging doors.

1. Provide non-removable pins at out-swinging doors with locking hardware and all exterior doors.

K. Products:

1. Butt Hinges:

    a. Concealed bearing, five (5) knuckle.

2.4 BOLTS

A. Manufacturers:

1. Hager Companies.
2. McKinney, Assa Abloy Group.
3. Trimco: www.trimcohardware.com/#sle.
4. Substitutions: See Section 016000 - Product Requirements.

B. Properties:

1. Flush Bolts:

    a. Manual Flush Bolts: Manually latching upon closing of door leaf.
        7) Bolt Throw: 3/4 inch (19 mm), minimum.

2. Dustproof Strikes: For bolting into floor, provide except at metal thresholds.

C. Options:

1. Extension Bolts: In leading edge of door, one bolt into floor, one bolt into top of frame.

D. Products:

1. Manual flush bolts.

2.5 MORTISE LOCKS

A. Manufacturers:

1. BEST, dormakaba Group: www.bestaccess.com/#sle.
2. dormakaba; dormakaba Group: www.dormakaba.com/us-en/#sle.
3. Sargent, Assa Abloy Group.
4. Substitutions: See Section 016000 - Product Requirements.

B. Properties:

1. Mechanical Locks: Manufacturer's standard.

a. Fitting modified ANSI A115.1 door preparation.
b. Door Thickness Coordination Fitting 1-3/4 inch (44 mm) to 2-1/4 inch (57 mm) thick doors.
c. Latch: Solid, one-piece, anti-friction, self-lubricating stainless steel.
8) Latchbolt Throw: 3/4 inch (19 mm), minimum.

d. Auxiliary Deadlatch: One piece stainless steel, permanently lubricated.
e. Backset: 2-3/4 inch (70 mm).
f. Lever Trim:
9) Functionality: Allow the lever handle to move up to 45 degrees from horizontal position prior to engaging the latchbolt assembly.
10) Strength: Locksets outside locked lever designed to withstand minimum 1,400 inch-lbs. (158.2 Nm) of torque. In excess of that, a replaceable part will shear. Key from outside and/or inside lever will still operate lockset.
11) Spindle: Designed to prevent forced entry from attacking of lever.
12) Independent spring mechanism for each lever.
(a) Trim to be self-aligning and thru-bolted.
13) Handles: Made of forged or cast brass, bronze, or stainless steel construction. Levers that contain a hollow cavity are not acceptable.
14) Levers to operate a roller bearing spindle hub mechanism.

C. Finishes: See Door Hardware Schedule.

1. Core Faces: Match finish of lockset.

D. Grades:

E. Options:

1. Provide locksets made in a manufacturing facility to compliant with ISO 9001-Quality Management and ISO 14001-Environmental Management.

F. Products: Mortise locks, including standard and electrified types.

1. 40H.
2. 8200.
3. M100

2.6 SMARTLOCKS - STAND-ALONE

A. Manufacturers:

1. dormakaba; dormakaba Group: www.dormakaba.com/us-en/#sle.

B. Properties:

1. Fit ANSI A115.1 door preparation.
2. One-piece, 9/16 inch (14 mm) throw.
3. Weatherproof bezel and gasket provide protection for outdoor use.
4. Interchangeable core key by-pass where specified restricted keyway.
5. 4 AA batteries standard.
6. PowerPlex Technology: Self-powered electronic HID compatible proximity reader.

C. Grades:

1. Tested and approved for compliance with BHMA A156.2, Series 4000, Operational Grade.
2. UL listed for GYQS single point locks for use on 3 hour fire-resistance-rated, A label single doors (4’x10’) GYJB. Listing applies for both U.S. and Canada applications.
3. Tested and approved for compliance with BHMA A156.13, Series 1000, Operational Grade 1, Extra-Heavy Duty, Security Grade 2 and approved by UL 10C.
4. Complying with BHMA A156.25 and UL GYQS listed.
5. Complying with US FCC, Canadian FCC, and European EMC requirements.

D. Products:

1. 7900 PowerPlex.

2.7 COORDINATORS

A. Manufacturers:

1. Hager Companies.
2. McKinney, Assa Abloy Group.
3. Trimco: www.trimcohardware.com/#sle.

4. Substitutions: See Section 016000 - Product Requirements.

B. Properties:

1. General: Non-handed devices, with field-selectable active door leaf.
2. Coordinators: Devices on pairs of doors with closers and self-latching or automatic flush bolts installed.

a. Coordinator Operation: Only when inactive door is opened.

C. Grades:

D. Code Compliance: As required by authorities having jurisdiction in the State in which the Project is located.

1. Meet UL 10C for Positive Pressure.

E. Types:

1. Coordinators: Bar.

F. Installation:

1. Mounting: Provide necessary mounting brackets and filler bars to ensure proper installation of coordinator and related hardware.
2. Coordination: Properly sequence installation of other door hardware affected by placement of coordinators and carry bars.

G. Products:

1. 3090 Series.

2.8 CLOSERS

A. Manufacturers:

1. BEST, dormakaba Group www.bestaccess.com/#sle.
2. dormakaba; dormakaba Group: www.dormakaba.com/us-en/#sle.
3. Substitutions: See Section 016000 - Product Requirements.

B. Properties:

1. Surface Mounted Closers: Manufacturer's standard.

a. Construction: Single piece casted cast iron housing.
b. Maximum Projection from Face of Door: 2-7/16 inches (62 mm).
c. Mechanism: Separate, tamper-resistant, retention ring, self-regulating adjusting valves for closing and latching speeds, backcheck, advanced variable backcheck and optional delayed action feature.

15) All valve adjustment socket screw drives must be slotted hex not requiring special tools for maintenance or adjustments.
16) Spring adjustment screw must be hex key.
17) All valves must have mechanism to prevent oil leaks from over adjustment.
18) All closer adjustments must be front facing and adjustable without removing closer from installed surface.
19) Advanced Variable Backcheck: Backcheck positioning adjustment (POS)
    (a) Selectable adjustment to facilitate degree of backcheck engagement point:
        (1) Parallel arm mount: 50 degrees.
        (2) Regular arm and top jamb mount: Between 50 and 80 degrees.
    (b) Intensity of backcheck shall be fully adjustable with tamper resistant non-critical valve screw.
20) Spring Size:
    (a) Adjustable spring sizes 1-6 with +50% power increase capability.
    (b) Spring size indicator shall be easy to read, located front facing on the housing and adjustable without removal of housing from the installed surface.

d. Hydraulic: All-weather fluid.
e. Arm Assembly:
21) Construction: Stamped arms and forged hub.
22) Material: Steel.
23) Degree of Swing:
    (a) Parallel arm NHO mounting shall not limit opening angle and permit 180-degree door swing.
    (b) Regular arm NHO mounting shall not limit opening angle and permit 120-degree door swing.
    (c) Consult factory for non-standard templating.
24) Include hold-open, integral stop, or spring-loaded stop feature, as specified in Door Hardware Schedule.
25) Where obstructions limit opening angle and wall or floor stops are prohibited, provide “IS” or “S-IS” arms.

f. Covers:
26) Type:
    (a) Full. (standard)
27) Material:
    (a) Plastic. (standard)
28) Finish:
    (a) Painted. (standard)
29) Attachment: Two-point flange mounting, dual-clamp friction fit closer cover.

C. Grades:

1. Closers: Comply with BHMA A156.4, Grade 1.

a. Underwriters Laboratories Compliance:
30) Product Listing: UL (DIR) and ULC for use on fire-resistance-rated doors.
(a) CAN/ULC S-133 - Standard Method Of Tests For Door Closers Intended For Use With Swinging Doors.

b. Testing Standards Compliance: Meeting requirements of UL 10C for positive pressure.

D. Code Compliance: As required by authorities having jurisdiction in the State in which the Project is located.

E. Options:

1. Delayed action, adjustable with an independent valve.

F. Installation:

1. Mounting: Includes surface mounted installations.
2. Mount closers on non-public side of door and stair side of stair doors unless otherwise noted in hardware sets.
3. At out swinging exterior doors, mount closer on interior side of door.
4. Provide adapter plates, shim spacers, and blade stop spacers as required by frame and door conditions.
5. Where an overlapping astragal is included on pairs of swinging doors, provide coordinator to ensure door leaves close in proper order.

G. Products:

1. Surface Mounted:

a. 8900
b. EHD9000
c. HD8000

2.9 PROTECTION PLATES

A. Manufacturers:

1. Hager Companies.
2. McKinney, Assa Abloy Group.
3. Substitutions: See Section 016000 - Product Requirements.

B. Properties:

1. Plates:

a. Kick Plates: Provide along bottom edge of push side of every wood door with closer, except aluminum storefront and glass entry doors, unless otherwise indicated.
b. Edges: Beveled, on four (4) unless otherwise indicated.

C. Grades: Comply with BHMA A156.6.

D. Material: As indicated for each item by BHMA material and finish designation.

1. Metal Properties: Stainless steel.

E. Installation:

1. Fasteners: Countersunk screw fasteners

2.10 THRESHOLDS

A. Manufacturers:

1. Hager Companies.
2. National Guard Products, Inc: www.ngpinc.com/#sle.
3. Pemko, Assa Abloy Group.
4. Substitutions: See Section 016000 - Product Requirements.

B. Properties:

1. Threshold Surface: Fluted horizontal grooves across full width.

C. Grades: Thresholds: Comply with BHMA A156.21.

D. Types: As applicable to project conditions. Provide barrier-free type at every location where specified.

2.11 WEATHERSTRIPPING AND GASKETING

A. Manufacturers:

1. Hager Companies.
2. National Guard Products, Inc: www.ngpinc.com/#sle.
3. Pemko, Assa Abloy Group.
4. Substitutions: See Section 016000 - Product Requirements.

B. Properties:

1. Rigid, Housed, Perimeter Gasketing: Sponge silicone gasket material held in place by aluminum housing; fastened to frame stop with screws.
2. Door Sweeps: Silicone gasket material held in place by flat aluminum housing or flange; surface mounted to face of door with screws.

C. Grades: Comply with BHMA A156.22.

2.12 MISCELLANEOUS ITEMS

A. Manufacturers:

1. Hager Companies.
2. McKinney, Assa Abloy Group.
3. Trimco: www.trimcohardware.com/#sle.
4. Substitutions: See Section 016000 - Product Requirements.

B. Properties:

1. Coat Hooks: Provide on room side of door, screw fastened.

    a. Material: Brass.

C. Products:

1. Coat Hooks.

2.13 KEYS AND CORES

A. Manufacturers:

1. BEST, dormakaba Group: www.bestaccess.com/#sle.
2. Substitutions: Not permitted.

B. Properties: Complying with guidelines of BHMA A156.28.

1. Provide small format interchangeable core.
2. Provide Patented CORMAX keys and cores.
3. Provide keying information in compliance with DHI (KSN) standards.
4. Keying Schedule: Arrange for a keying meeting, with Architect, Owner and hardware supplier, and other involved parties to ensure locksets and locking hardware, are functionally correct and keying complies with project requirements.
5. Keying: Master keyed.
6. Include construction keying and control keying with removable core cylinders.
7. Supply keys in following quantities:

    a. Master Keys: 4 each.
    b. Construction Master Keys: 6 each.
    c. Construction Keys: 15 each.
    d. Construction Control Keys: 2 each.
    e. Control Keys if New System: 2 each.

8. Provide key collection envelopes, receipt cards, and index cards in quantity suitable to manage number of keys.

9. Deliver keys with identifying tags to Owner by security shipment direct from manufacturer.
10. Permanent Keys and Cores: Stamped with applicable key marking for identification. Do not include actual key cuts within visual key control marks or codes. Stamp permanent keys "Do Not Duplicate."
11. Include installation of permanent cores and return construction cores to hardware supplier. Construction cores and keys to remain property of hardware supplier.

C. Products:

1. Patented:

a. CORMAX.

2.14 FINISHES

A. Finishes: Identified in Hardware Sets.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that doors and frames are ready to receive this work; labeled, fire-rated doors and frames are properly installed, and dimensions are as indicated on shop drawings.

B. Correct all defects prior to proceeding with installation.

C. Verify that electric power is available to power operated devices and of correct characteristics.

3.2 INSTALLATION

A. Install hardware in accordance with manufacturer's instructions and applicable codes.

B. Install hardware using the manufacturer’s fasteners provided. Drill and tap all screw holes located in metallic materials. Do not use “Riv-Nuts” or similar products.

C. Install hardware on fire-rated doors and frames in accordance with applicable codes and NFPA 80.

D. Install hardware for smoke and draft control doors in accordance with NFPA 105.

E. Use templates provided by hardware item manufacturer.

F. Do not install surface mounted items until application of finishes to substrate are fully completed.

G. Wash down masonry walls and complete painting or staining of doors and frames.

H. Complete finish flooring prior to installation of thresholds.

I. Set exterior door thresholds with full-width bead of elastomeric sealant at each point of contact with floor providing a continuous weather seal; anchor thresholds with stainless steel countersunk screws.

J. Include in installation for existing doors and frames any necessary field modification and field preparation of doors and frames for new hardware. Provide necessary fillers, reinforcements, and fasteners for mounting new hardware and to cover existing door and frame preparations.

3.3 FIELD QUALITY CONTROL

A. Perform field inspection and testing under provisions of Section 014000 - Quality Requirements.

3.4 ADJUSTING

A. Adjust work under provisions of Section 017000 - Execution and Closeout Requirements.

B. Adjust hardware for smooth operation.

C. Adjust gasketing for complete, continuous seal; replace if unable to make complete seal.

3.5 CLEANING

A. Clean finished hardware in accordance with manufacturer's written instructions after final adjustments have been made.

B. Replace items that cannot be cleaned to manufacturer's level of finish quality at no additional cost.

3.6 PROTECTION

A. Protect finished Work under provisions of Section 017000 - Execution and Closeout Requirements.

B. Do not permit adjacent work to damage hardware or finish.

3.7 HARDWARE SCHEDULE

Manufacturer List

Code:	Name:
BE	BEST Access Systems
DM	Dorma
NA	National Guard
PX	ePlex/Powerplex
SH	dormakaba Commercial Hardware
ST	BEST Hinges and Sliding
SX	Simplex
TR	Trimco

Option List

Code:	Description:
CORMAX PATENTED KEYING	Cormax Patented Keying

Finish List

Code:	Description:
32D	Satin Stainless Steel
626	Satin Chromium Plated
689	Aluminum Painted
AL	Aluminum
Silver	Silver

HARDWARE SETS

Set #1
Doors: P01, P02

8	Hinges	CB191 4.5" x 4.5" NRP	32D	ST
1	Manual Flushbolt	3917-12	626	TR
1	Manual Flushbolt	3917-12ET	626	TR
1	Storeroom Lockset BE	45H-7D14H PATD CORMAX PATENTED KEYING		626
1	Coordinator	3094B2	Silver	TR
2	Closer w/ Stop	EHD9016 DS90	689	BE
2	Mounting Bracket	3095 / 3096 as req'd	Silver	TR
1	Dust Proof Strike	3910	626	TR
1	Gasketing	110 SA		NA
1	Drip Cap	16 A - 4" ODW		NA
1	Astragal	139 SP		NA
2	Door Sweep	200 SA		NA
1	Saddle Threshold	425	AL	NA

Set #2
Doors: R04, R05, R06, R08

4	Hinges	CB191 4.5" x 4.5" NRP	32D	ST
1	Storeroom Lockset BE	45H-7D14H PATD CORMAX PATENTED KEYING		626
1	Closer w/ Stop	EHD9016 DS90	689	BE
1	Gasketing	110 SA		NA
1	Drip Cap	16 A - 4" ODW		NA
1	Door Sweep	200 SA		NA
1	Saddle Threshold	425	AL	NA

Set #3
Doors: R01, R02, R03, R07

4	Hinges	CB191 4.5" x 4.5" NRP	32D	ST
1	Indicator Deadbolt	QDB285	626	SH
1	Smart Lockset	E79N2166LLBF00	626	PX
1	Permanent Core	1C Series	626	BE
1	Closer w/ Stop	EHD9016 DS90	689	BE
1	Coat & Hat Hook	3070-1	626	TR
1	Gasketing	110 SA		NA
1	Drip Cap	16 A - 4" ODW		NA
1	Door Sweep	200 SA		NA
1	Saddle Threshold	425	AL	NA

Set #4
Doors: C01

4	Hinges	CB191 4.5" x 4.5" NRP	32D	ST
1	Pushbutton Lockset	8146B-41	26D	SX
1	Permanent Core	1C Series	626	BE
1	Closer w/ Stop	EHD9016 DS90	689	BE
1	Gasketing	110 SA		NA
1	Drip Cap	16 A - 4" ODW		NA
1	Door Sweep	200 SA		NA
1	Saddle Threshold	425	AL	NA

Set #MISC

1	Software	KEYSCAN AURORA		DM

Opening List

Opening:	Hardware Set:
C01	4
P01	1
P02	1
R01	3
R02	3
R03	3
R04	2
R05	2
R06	2
R07	3
R08	2

END OF SECTION 087100

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SECTION 092116 - GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Metal stud wall framing.

B. Metal channel ceiling framing.

C. Cementitious backing board.

D. Gypsum wallboard.

E. Joint treatment and accessories.

1.2 REFERENCE STANDARDS

A. AISI S201 - North American Standard for Cold-Formed Steel Framing - Product Data 2017.

B. AISI S220 - North American Standard for Cold-Formed Steel Nonstructural Framing 2020.

C. AISI S240 - North American Standard for Cold-Formed Steel Structural Framing 2015, with Errata (2020).

D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2015.

E. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members 2015.

F. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories 2020.

G. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board 2017 (Reapproved 2022).

H. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products 2020.

I. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board 2020.

J. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs 2022.

K. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base 2019.

L. ASTM C1396/C1396M - Standard Specification for Gypsum Board 2017.

M. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber 2016.

N. GA-216 - Application and Finishing of Gypsum Panel Products 2021.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the installation of gypsum board assemblies with size, location, and installation of service utilities.

B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

C. Sequencing: Install service utilities in an orderly and expeditious manner.

1.4 SUBMITTALS

A. Product Data:

1. Provide data on metal framing, gypsum board, accessories, and joint finishing system.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Member of Steel Stud Manufacturers Association (SSMA): www.ssma.com/#sle.

B. Manufacturer Qualifications: Member of Supreme Steel Framing System Association (SSFSA): www.ssfsa.com/#sle.

C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store gypsum products and accessories indoors and keep above freezing. Elevate boards above floor, on nonwicking supports, in accordance with manufacturer's recommendations.

B. Store metal products to prevent corrosion.

PART 2 - PRODUCTS

2.1 GYPSUM BOARD ASSEMBLIES

A. Provide completed assemblies complying with ASTM C840 and GA-216.

B. Grid Suspension Systems: Provide grid suspension systems in accordance with ASTM C840 and GA-216.

2.2 METAL FRAMING MATERIALS

A. Material and Product Requirements Criteria: AISI S201.

B. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S220 or equivalent.

C. Nonstructural Framing System Components: AISI S220; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf.

1. Studs: C-shaped with knurled or embossed faces.
2. Runners: U shaped, sized to match studs.
3. Ceiling Channels: C-shaped.
4. Furring Members: Hat-shaped sections, minimum depth of 7/8 inch.

a. Products:

1) MBA Building Supplies; MBA Furring Channel: www.mbastuds.com/#sle.

D. Non-structural Framing Accessories:

1. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
2. Framing Connectors: ASTM A653/A653M G90 galvanized steel clips; secures cold rolled channel to wall studs for lateral bracing.

E. Grid Suspension Systems: Steel grid system of main tees and support bars connected to structure using hanging wire.

2.3 BOARD MATERIALS

A. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.

1. Application: Use for ceilings, unless otherwise indicated.
2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.

a. Mold resistant board is required at all locations.

3. Thickness:

a. Ceilings: 1/2 inch.

4. Mold-Resistant, Paper-Faced Products:

a. American Gypsum Company; M-Bloc: www.americangypsum.com/#sle.
b. CertainTeed Corporation; M2Tech 1/2" Moisture & Mold Resistant Drywall: www.certainteed.com/#sle.
c. USG Corporation; Sheetrock Brand EcoSmart Panels Mold Tough Firecode X 5/8 in. (15.9 mm): www.usg.com/#sle.

2.4 GYPSUM BOARD ACCESSORIES

A. Finishing Accessories: ASTM C1047, extruded aluminum alloy (6063 T5), unless noted otherwise.

1. Types: As detailed or required for finished appearance.
2. Special Shapes: In addition to conventional corner bead and control joints, provide U-bead at exposed panel edges.

B. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.

1. Fiberglass Tape: 2 inch wide, coated glass fiber tape for joints and corners, except as otherwise indicated.
2. Joint Compound: Setting type, field-mixed.

C. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inches in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion-resistant.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

3.2 FRAMING INSTALLATION

A. Metal Framing: Install in accordance with ASTM C1007AISI S220 and manufacturer's instructions.

B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.

1. Level ceiling system to a tolerance of 1/1200.
2. Laterally brace entire suspension system.

C. Studs: Space studs at 16 inches on center.

1. Extend partition framing to structure where indicated and to ceiling in other locations.
2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.

3.3 BOARD INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

B. Double-Layer, Nonrated: Use gypsum board for first layer, placed parallel to framing or furring members, with ends and edges occurring over firm bearing. Use glass mat faced gypsum board at exterior walls and at other locations as indicated. Place second layer perpendicular to framing or furring members. Offset joints of second layer from joints of first layer.

C. Exposed Gypsum Board in Interior Wet Areas: Seal joints, cut edges, and holes with water-resistant sealant.

D. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of nonrated double-layer assemblies, which may be installed by means of adhesive lamination.

E. Installation on Wood Framing: For rated assemblies, comply with requirements of listing authority. For nonrated assemblies, install as follows:

1. Single-Layer Applications: Screw attachment.

3.4 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.

B. Corner Beads: Install at external corners, using longest practical lengths.

C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

D. Decorative Trim: Install at locations shown on drawings and in accordance with manufacturer's instructions.

3.5 JOINT TREATMENT

A. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:

1. Level 4: Walls and ceilings to receive paint finish.
2. Level 1: Wall areas above finished ceilings, whether or not accessible in the completed construction.

B. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.

1. Feather coats of joint compound so that camber is maximum 1/32 inch.

3.6 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

3.7 PROTECTION

A. Protect installed gypsum board assemblies from subsequent construction operations.

END OF SECTION 092116

SECTION 093000 – TILING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Tile for wall applications.

B. Non-ceramic trim.

1.2 REFERENCE STANDARDS

A. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar 2017 (Reaffirmed 2022).

B. ANSI A108.1b - American National Standard Specifications for Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar 2017.

C. ANSI A108.1c - Contractor's Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar 1999 (Reaffirmed 2021).

D. ANSI A108.2 - American National Standard General Requirements: Materials, Environmental and Workmanship 2019.

E. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesive or Water Cleanable Tile-Setting Epoxy Adhesive 2019.

F. ANSI A108.5 - American National Standard Specifications for Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar 2021.

G. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grout Epoxy 1999 (Reaffirmed 2019).

H. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout 1999 (Reaffirmed 2019).

I. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout 1999 (Reaffirmed 2019).

J. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework 2017 (Reaffirmed 2022).

K. ANSI A108.12 - American National Standard for Installation of Ceramic Tile with EGP (Exterior Glue Plywood) Latex-Portland Cement Mortar 1999 (Reaffirmed 2019).

L. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone 2005 (Reaffirmed 2021).

M. ANSI A108.19 - American National Standard Specifications for Interior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs by the Thin-Bed Method Bonded with Modified Dry-Set Cement Mortar or Improved Modified Dry-Set Cement Mortar 2020.

N. ANSI A108.20 - American National Standard Specifications for Exterior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs 2020.

O. ANSI A118.3 - American National Standard Specifications for Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive 2021.

P. ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar 2019.

Q. ANSI A137.1 - American National Standard Specifications for Ceramic Tile 2022.

R. ASTM C373 - Standard Test Methods for Determination of Water Absorption and Associated Properties by Vacuum Method for Pressed Ceramic Tiles and Glass Tiles and Boil Method for Extruded Ceramic Tiles and Non-tile Fired Ceramic Whiteware Products 2018 (Reapproved 2023).

S. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation 2023.

T. TCNA (HB-GP) - Handbook for Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs Installation 2023.

1.3 SUBMITTALS

A. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting details.

B. Samples: Mount tile and apply grout on two plywood panels, minimum 18 by 18 inches in size illustrating pattern, color variations, and grout joint size variations.

C. Installer's Qualification Statement:

D. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 016000 - Product Requirements, for additional provisions.
2. Extra Tile: 1 percent of each size, color, and surface finish combination, but not less than two of each type.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.5 FIELD CONDITIONS

A. Maintain ambient and substrate temperature above 50 degrees F and below 100 degrees F during installation and curing of setting materials.

PART 2 - PRODUCTS

2.1 TILE

A. Porcelain Tile, Type PT1: ANSI A137.1 standard grade.

1. Moisture Absorption: 0 to 0.5 percent as tested in accordance with ASTM C373.
2. Size: 24 by 48 inch, nominal.
3. Thickness: 20mm.
4. Edges: Square.
5. Surface Finish: Unglazed.
6. Color(s): As indicated on drawings.
7. Pattern: As indicated on Drawings.
8. Products:

a. Creative Materials Corporation; Cascade Tile, Color – Grey. Finish – Honed

2.2 TRIM AND ACCESSORIES

A. Non-Ceramic Trim: Satin natural anodized extruded aluminum, style and dimensions to suit application, set with tile mortar or adhesive.

1. Applications:

a. Open edges of wall tile at location indicated.

2. Products:

a. Schluter-Systems; www.schluter.com/#sle.

2.3 SETTING MATERIALS

A. Provide setting and grout materials from same manufacturer.

B. Latex-Portland Cement Mortar Bond Coat: ANSI A118.4.

1. Applications: Use this type of bond coat where Large and Heavy Tile (LHT) mortar is indicated.
2. Products:

a. ARDEX Engineered Cements; ARDEX X 5: www.ardexamericas.com/#sle.
b. LATICRETE International, Inc; TRI-LITE: www.laticrete.com/#sle.
c. Mapei Corporation; Adesilex P10 Mosaic & Glass Tile: www.mapei.com/#sle.
d. Sika Corp; SikaTile 300 Set: www.sika.com/#sle.

2.4 GROUTS

A. Provide setting and grout materials from same manufacturer.

B. Manufacturers:

C. Epoxy Grout: ANSI A118.3 chemical resistant and water-cleanable epoxy grout.

1. Applications: at all interior locations.
2. Color(s): As selected by Architect from manufacturer's full line.
3. Products:

a. LATICRETE International, Inc; LATICRETE SPECTRALOCK PRO Premium Grout: www.laticrete.com/#sle.
b. Mapei Corporation; Kerapoxy CQ: www.mapei.com/#sle.
c. Sika Corp; SikaTile 825 Epoxy: www.sika.com/#sle.

2.5 Maintenance Materials

A. Tile Sealant: Gunnable, silicone, siliconized acrylic, or urethane sealant; moisture and mildew resistant type.

1. Applications: Between tile and plumbing fixtures.
2. Color(s): As selected by Architect from manufacturer's full line.
3. Products:

a. ARDEX Engineered Cements; ARDEX SX: www.ardexamericas.com/#sle.
b. LATICRETE International, Inc; LATICRETE LATASIL: www.laticrete.com/#sle.

c. Mapei Corporation; Mapesil T Plus: www.mapei.com/#sle.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.

B. Verify that required through-tile utilities are in correct location.

3.2 PREPARATION

A. Protect surrounding work from damage.

B. Vacuum clean surfaces and damp clean.

C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.

3.3 INSTALLATION - GENERAL

A. Install tile, thresholds, and stair treads and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.20, manufacturer's instructions, and TCNA (HB) or TCNA (HB-GP) recommendations, as applicable.

B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.

C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.

D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.

E. Form internal angles square and external angles bullnosed.

F. Install non-ceramic trim in accordance with manufacturer's instructions.

G. Sound tile after setting. Replace hollow sounding units.

H. Keep control and expansion joints free of mortar, grout, and adhesive.

I. Prior to grouting, allow installation to completely cure; minimum of 48 hours.

J. Grout tile joints unless otherwise indicated. Use standard grout unless otherwise indicated.

K. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

3.4 INSTALLATION - WALL TILE

A. Over cementitious backer units install in accordance with TCNA (HB) Method W223, organic adhesive.

B. Over interior concrete and masonry install in accordance with TCNA (HB) Method W202, thin-set with dry-set or latex-Portland cement bond coat.

3.5 CLEANING

A. Clean tile and grout surfaces.

3.6 PROTECTION

A. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION 093000

SECTION 099113 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:

1. Exposed surfaces of metal doors and frames.

D. Do Not Paint or Finish the Following Items:

1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
2. Items indicated to receive other finishes.
3. Items indicated to remain unfinished.
4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
5. Floors, unless specifically indicated.
6. Concealed pipes, ducts, and conduits.

1.2 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency current edition.

B. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials 2020.

C. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual Current Edition.

D. SSPC-SP 1 - Solvent Cleaning 2015, with Editorial Revision (2016).

E. SSPC-SP 2 - Hand Tool Cleaning 2018.

F. SSPC-SP 6 - Commercial Blast Cleaning 2007.

1.3 SUBMITTALS

A. Product Data: Provide complete list of products to be used, with the following information for each:

1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
2. MPI product number (e.g. MPI #47).
3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.

B. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.

1. Where sheen is specified, submit samples in only that sheen.
2. Paint color submittals will not be considered until color submittals for major materials not to be painted, such as masonry, have been approved.

C. Manufacturer's Instructions: Indicate special surface preparation procedures.

D. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 016000 - Product Requirements, for additional provisions.
2. Extra Paint and Finish Materials: 1 gallon of each color; from the same product run, store where directed.
3. Label each container with color in addition to the manufacturer's label.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum five years experience and approved by manufacturer.

1.5 MOCK-UPS

A. See Section 014000 - Quality Requirements, for general requirements for mock-up.

B. Provide door and frame assembly illustrating paint color, texture, and finish.

C. Locate where directed by Architect.

D. Mock-up may remain as part of the work.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.7 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the paint product manufacturer's temperature ranges.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply exterior paint and finishes during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.

D. Minimum Application Temperatures for Latex Paints: 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.

E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.

B. Paints:

1. Base Manufacturer: Benjamin Moore Company.
2. PPG Paints; www.ppgpaints.com/#sle.
3. Sherwin-Williams Company; www.sherwin-williams.com/#sle.

C. Primer Sealers: Same manufacturer as top coats.

2.2 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready-mixed, unless required to be a field-catalyzed paint.

1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
2. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
3. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
4. Supply each paint material in quantity required to complete entire project's work from a single production run.
5. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is described explicitly in manufacturer's product instructions.

B. Volatile Organic Compound (VOC) Content:

1. Provide paints and finishes that comply with the most stringent requirements specified in the following:

a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.

2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.

C. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.

D. Colors: As indicated in Color Schedule.

1. Allow for minimum of three colors for each system, unless otherwise indicated, without additional cost to Owner.
2. Extend colors to surface edges; colors may change at any edge as directed by Architect.

2.3 PAINT SYSTEMS - EXTERIOR

A. Paint E-OP - Exterior Surfaces scheduled to be Painted, Unless Otherwise Indicated: Including concrete masonry units, fiber cement siding, primed wood, and primed metal.

1. Two top coats and one coat primer.
2. Top Coat(s): Exterior Latex, High Performance Architectural; MPI #311 or 315.

B. Paint WE-OP-3A - Wood, Opaque, Alkyd, 3 Coat:

1. One coat of alkyd primer sealer.
2. Semi-gloss: Two coats of alkyd enamel.

C. Paint CE-OP-3A - Concrete Masonry, Opaque, Alkyd, 3 Coat:

1. One coat of block filler.
2. Flat: Two coats of alkyd enamel.

D. Paint ME-OP-3A - Ferrous Metals, Unprimed, Alkyd, 3 Coat:

1. One coat of alkyd primer.
2. Semi-gloss: Two coats of alkyd enamel.

E. Paint MgE-OP-3A - Galvanized Metals, Alkyd, 3 Coat:

1. One coat galvanize primer.
2. Semi-gloss: Two coats of alkyd enamel.

2.4 PRIMERS

A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.

1. Interior/Exterior Latex Block Filler; MPI #4.
2. Anti-Corrosive Alkyd Primer for Metal; MPI #79.
3. Alkyd/Oil Primer for Exterior Wood; MPI #5.

2.5 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

C. Test shop-applied primer for compatibility with subsequent cover materials.

D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:

1. Fiber Cement Siding: 12 percent.
2. Masonry, Concrete, and Concrete Masonry Units: 12 percent.
3. Exterior Wood: 15 percent, measured in accordance with ASTM D4442.

3.2 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.

D. Seal surfaces that might cause bleed through or staining of topcoat.

E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

F. Masonry: Paint at concrete block only. No brick is to be painted.

1. Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
2. Prepare surface as recommended by top coat manufacturer.

G. Fiber Cement Panels: Remove dirt, dust and other foreign matter with a stiff fiber brush. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.

H. Galvanized Surfaces:

1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
2. Prepare surface according to SSPC-SP 2.

I. Ferrous Metal:

1. Solvent clean according to SSPC-SP 1.

2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 Commercial Blast Cleaning. Protect from corrosion until coated.

J. Exterior Wood Surfaces to Receive Opaque Finish: Remove dust, grit, and foreign matter. Seal knots, pitch streaks, and sappy sections. Fill nail holes with tinted exterior calking compound after prime coat has been applied. Back prime concealed surfaces before installation.

1. At Trellis framing - lightly abraid sealer at top of wood and tips prior to applying primer.

K. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.3 APPLICATION

A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

B. Exterior Wood to Receive Opaque Finish: If final painting must be delayed more than 2 weeks after installation of woodwork, apply primer within 2 weeks and final coating within 4 weeks.

C. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

D. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

E. Apply each coat to uniform appearance.

F. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply additional coats until complete hide is achieved.

G. Sand wood and metal surfaces lightly between coats to achieve required finish.

H. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

I. Wood to Receive Transparent Finishes: Tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.

J. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.4 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for general requirements for field inspection.

3.5 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.6 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

3.7 SCHEDULE - PAINT SYSTEMS

A. Concrete, Concrete Masonry Units (CMU), Concrete Block: Finish surfaces exposed to view at interior or Pavilion storage rooms

1. Exterior: CE-OP-3A, flat.

B. Fiber Cement Siding: Finish surfaces exposed to view.

1. Wall Panels: FCE-OP-3L.

C. Wood: Finish tops of exposed framing at Trellis only.

1. Exterior Trim and Frames: WE-OP-3A, semi-gloss.

D. Steel Fabrications: Finish surfaces exposed to view and concealed surfaces where required to conform to performance requirements and resist corrosion.

1. Exterior: ME-OP-3A, gloss; apply finish to exposed and concealed surfaces before installation.

E. Aluminum: Finish surfaces exposed to view.

1. Exterior: MaE-OP-2A, semi-gloss.

F. Galvanized Steel: Finish surfaces exposed to view.

1. Exterior: MgE-OP-3A, gloss.

G. Shop-Primed Metal Items: Finish surfaces exposed to view.

1. Finish the following items:

    a. Metal fabrications at Compactor enclosure.

2. Exterior: ME-OP-2A, semi-gloss.

END OF SECTION 099113

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SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.

1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
2. Mechanical and Electrical:

    a. In finished areas, paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.

D. Do Not Paint or Finish the Following Items:

1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
2. Items indicated to receive other finishes.
3. Items indicated to remain unfinished.
4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
5. Stainless steel, anodized aluminum, bronze, terne-coated stainless steel, and lead items.
6. Floors, unless specifically indicated.
7. Brick, architectural concrete.
8. Concealed pipes, ducts, and conduits.

1.2 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency current edition.

B. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials 2020.

C. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association Current Edition.

D. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual Current Edition.

E. SSPC-SP 1 - Solvent Cleaning 2015, with Editorial Revision (2016).

F. SSPC-SP 2 - Hand Tool Cleaning 2018.

G. SSPC-SP 6 - Commercial Blast Cleaning 2007.

1.3 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide complete list of products to be used, with the following information for each:

1. Manufacturer's name, product name and/or catalog number, and general product category (e.g., "alkyd enamel").
2. MPI product number (e.g., MPI #47).
3. Cross-reference to specified paint system products to be used in project; include description of each system.

C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.

1. Where sheen is specified, submit samples in only that sheen.
2. Where sheen is not specified, discuss sheen options with Architect before preparing samples, to eliminate sheens not required.
3. Paint color submittals will not be considered until color submittals for major materials not to be painted, such as masonry, have been approved.

D. Manufacturer's Instructions: Indicate special surface preparation procedures.

E. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 016000 - Product Requirements, for additional provisions.
2. Extra Paint and Finish Materials: 1 gal of each color; from the same product run, store where directed.
3. Label each container with color in addition to the manufacturer's label.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum five years' experience and approved by manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.6 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply materials when relative humidity exceeds 85 percent, at temperatures less than 5 degrees F above the dew point, or to damp or wet surfaces.

D. Minimum Application Temperatures for Paints: 50 degrees F for interiors unless required otherwise by manufacturer's instructions.

E. Provide lighting level of 80 fc measured mid-height at substrate surface.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.

B. Paints:

1. Base Manufacturer: Benjamin Moore.

2. PPG Paints: www.ppgpaints.com/#sle.
3. Sherwin-Williams Company: www.sherwin-williams.com/#sle.

C. Primer Sealers: Same manufacturer as top coats.

2.2 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready-mixed, unless intended to be a field-catalyzed paint.

1. Where MPI paint numbers are specified, provide products listed in Master Painters Institute Approved Product List, current edition available at www.paintinfo.com, for specified MPI categories, except as otherwise indicated.
2. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
3. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
4. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
5. Supply each paint material in quantity required to complete entire project's work from a single production run.
6. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. Volatile Organic Compound (VOC) Content:

1. Provide paints and finishes that comply with the most stringent requirements specified in the following:

a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.

2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.

C. Flammability: Comply with applicable code for surface burning characteristics.

D. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.

E. Colors: To be selected from manufacturer's full range of available colors.

1. Final selection to be made by Architect after review of in-field mockups.
2. Allow for minimum of three colors for each system, unless otherwise indicated, without additional cost to Owner.

3. Extend colors to surface edges; colors may change at any edge as directed by Architect.
4. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling under which they are mounted.

2.3 PAINT SYSTEMS - INTERIOR

A. Paint I-OP - Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board, concrete masonry units, wood, uncoated steel, shop primed steel, and galvanized steel.

1. Two top coats and one coat primer.
2. Top Coat(s): High Performance Architectural Interior Latex; MPI #138, 139, 140, 141, or 142.

B. Paint I-OP-MD-WC - Medium Duty Vertical and Overhead: Including gypsum board, concrete masonry units, uncoated steel, shop primed steel, and galvanized steel.

1. Two top coats and one coat primer.
2. Top Coat(s): High Performance Architectural Interior Latex; MPI #138, 139, 140, or 141.

C. Paint WI-OP-3A - Wood, Opaque, Alkyd, 3 Coat:

1. One coat alkyd primer sealer.
2. Flat: Two coats of alkyd enamel.

D. Paint MI-OP-3A - Ferrous Metals, Unprimed, Alkyd, 3 Coat:

1. One coat of alkyd primer.
2. Semi-gloss: Two coats of alkyd enamel.

E. Paint MgI-OP-3A - Galvanized Metals, Alkyd, 3 Coat:

1. One coat galvanize primer.
2. Semi-gloss: Two coats of alkyd enamel.

F. Paint GI-OP-3A - Gypsum Board Ceilings, Alkyd, 3 Coat:

1. One coat of alkyd primer sealer.
2. Flat: Two coats of alkyd enamel.

2.4 PRIMERS

A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.

1. Alkali Resistant Water Based Primer; MPI #3.

2. Interior/Exterior Latex Block Filler; MPI #4.
3. Interior Rust-Inhibitive Water Based Primer; MPI #107.

2.5 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

D. Test shop-applied primer for compatibility with subsequent cover materials.

E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces is below the following maximums:

1. Gypsum Wallboard: 12 percent.
2. Masonry, Concrete, and Concrete Masonry Units: 12 percent.
3. Interior Wood: 15 percent, measured in accordance with ASTM D4442.

3.2 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

D. Seal surfaces that might cause bleed through or staining of topcoat.

E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

F. Concrete Masonry Units:

1. Remove efflorescence and chalk. Do not coat surfaces if moisture content, alkalinity of surfaces, or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
2. Prepare surface as recommended by top coat manufacturer.

G. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.

H. Galvanized Surfaces:

1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
2. Prepare surface according to SSPC-SP 2.

I. Ferrous Metal:

1. Solvent clean according to SSPC-SP 1.
2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 Commercial Blast Cleaning. Protect from corrosion until coated.

J. Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.

K. Metal Doors to be Painted: Paint whole door per Exterior Painting Specification

3.3 APPLICATION

A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

B. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

D. Apply each coat to uniform appearance in thicknesses specified by manufacturer.

E. Sand wood and metal surfaces lightly between coats to achieve required finish.

F. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

G. Wood to Receive Transparent Finishes: See Section 099300.

H. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.4 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.5 SCHEDULE - PAINT SYSTEMS

A. Concrete Masonry Units (CMU): Finish surfaces exposed to view.

1. Interior: CI-OP-3L, semi-gloss.

B. Gypsum Board: Finish surfaces exposed to view.

1. Interior Ceilings and Bulkheads: GI-OP-3L, flat.

C. Wood: Finish surfaces scheduled to be exposed to view only.

1. Interior Woodwork: WI-OP-3A, flat.

D. Steel Fabrications: Finish surfaces exposed to view and to concealed surfaces where required to conform to performance requirements and resist corrosion.

1. Interior: MI-OP-3L, gloss.

E. Galvanized Steel: Finish surfaces exposed to view, except as scheduled to remain bare galvanized.

1. Interior: MgI-OP-3L.

F. Shop-Primed Metal Items: Finish surfaces exposed to view.

1. Interior: MI-OP-2A.

END OF SECTION 099123

SECTION 099300 - STAINING AND TRANSPARENT FINISHING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Field application of stains.

B. Field application of transparent finishes.

1.2 REFERENCE STANDARDS

A. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials 2020.

B. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual Current Edition.

1.3 SUBMITTALS

A. Product Data: Provide complete list of products to be used, with the following information for each:

1. Manufacturer's name, product name and catalog number, and general product category.

B. Samples: Two samples on actual wood substrate to be finished, 24" in length minimum, indicating selected colors and sheens for each system, with specified coats cascaded.

C. Manufacturer's Instructions: Indicate special surface preparation procedures.

D. Maintenance Data: Submit data including finish schedule showing where each product, color, and finish was used, product technical data sheets, safety data sheets (SDS), care and cleaning instructions, touch-up procedures, and color samples of each color and finish used.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 016000 - Product Requirements for additional provisions.
2. Extra Stock Materials: Stain and transparent finish materials, 1 gal of each color and type; store where directed.

a. Label each container with color and type in addition to the manufacturer's label.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with at least three years of documented experience.

B. Applicator Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of stain or transparent finish, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Stain and Transparent Finish Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.6 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by manufacturer of stains and transparent finishes.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply materials when relative humidity exceeds 85 percent, at temperatures less than 5 degrees F above the dew point, or to damp or wet surfaces.

D. Minimum Application Temperature: 50 degrees F unless required otherwise by manufacturer's instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Provide finishes used in any individual system from the same manufacturer; no exceptions.

B. Transparent Finishes:

1. Sansin Corporation; www.sansin.com.

C. Stains:

1. Sansin Classic 3 part system.

2.2 STAINS AND TRANSPARENT FINISHES - GENERAL

A. Finishes:

1. Provide finishes capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
2. Provide materials compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
3. Supply each finish material in quantity required to complete entire project's work from a single production run.
4. Do not reduce, thin, or dilute finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. Flammability: Comply with applicable code for surface burning characteristics.

C. Colors: To be selected from manufacturer's full range of available colors.

1. Selection to be made by Architect after award of contract.

2.3 EXTERIOR STAIN AND TRANSPARENT FINISH SYSTEMS

A. Finish on Wood: Apply to all exposed wood framing at all structures unless noted.

1. 3 coat stain and sealer
2. Stain and Finish: Exterior stain and finish for wood, water based; MPI #16.

a. Products:

1) Sansin Classic - 1,2,3 system. .

3. Top Coat: Exterior clear water based varnish with UV inhibitor.

a. Products:

1) Sansin Classic Topcoat - color to be selected from full range. .

4. Top Coat Sheen:

a. Satin: MPI gloss level 4; use this sheen at all locations.

2.4 ACCESSORY MATERIALS

A. Accessory Materials: Cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of finished surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:

1. Wood: 15 percent, measured in accordance with ASTM D4442.

3.2 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

D. Seal surfaces that might cause bleed through or staining of topcoat.

E. Wood Surfaces to Receive Transparent Finish: Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after sealer has dried; sand lightly between coats. Prime concealed surfaces with gloss varnish reduced 25 percent with thinner.

3.3 APPLICATION

A. Apply products in accordance with manufacturer's written instructions.

B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

C. Apply each coat to uniform appearance in thicknesses specified by manufacturer.

D. If recommended by manufacturer, sand wood surfaces lightly between coats to achieve required finish.

E. Wood to Receive Transparent Finishes: Tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.

F. Reinstall items removed prior to finishing.

3.4 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.5 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION 099300

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SECTION 099600 - HIGH-PERFORMANCE COATINGS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. High performance coatings.

B. Surface preparation.

1.2 REFERENCE STANDARDS

A. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association Current Edition.

B. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual Current Edition.

C. SSPC-SP 1 - Solvent Cleaning 2015, with Editorial Revision (2016).

D. SSPC-SP 6 - Commercial Blast Cleaning 2007.

E. SSPC-SP 11 - Power-Tool Cleaning to Bare Metal 2020.

1.3 SUBMITTALS

A. Product Data: Provide complete list of all products to be used, with the following information for each:

1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
2. MPI product number (e.g. MPI #47).
3. Cross-reference to specified coating system(s) product is to be used in; include description of each system.

B. Samples: Submit two samples 8 by 8 inch in size illustrating colors available for selection.

C. Maintenance Data: Include cleaning procedures and repair and patching techniques.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Extra Coating Materials: 1 gallon of each type and color.

2. Label each container with manufacturer's name, product number, color number, and room names and numbers where used.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

B. Applicator Qualifications: Company specializing in performing the work of this section approved by manufacturer.

1.5 MOCK-UPS

A. See Section 014000 - Quality Requirements for general requirements for mock-ups.

B. Locate where directed.

C. Mock-up may remain as part of the work.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of coating, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Coating Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.7 FIELD CONDITIONS

A. Do not install materials when temperature is below 55 degrees F or above 90 degrees F.

B. Maintain this temperature range, 24 hours before, during, and 72 hours after installation of coating.

C. Restrict traffic from area where coating is being applied or is curing.

1.8 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion.

C. Warranty: Include coverage for bond to substrate.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Only materials (primers, coatings, etc.) listed in the latest edition of the MPI Approved Product List (APL) are acceptable for use on this project.

B. High-Performance Coatings:

1. Tnemec Company, Inc; www.tnemec.com/#sle.
2. Substitutions: Section 016000 - Product Requirements.

2.2 MATERIALS

A. Coatings - General: Provide complete multi-coat systems formulated and recommended by manufacturer for the applications indicated, in the thicknesses indicated; number of coats specified does not include primer or filler coat.

1. Lead Content: Not greater than 0.06 percent by weight of total nonvolatile content.
2. Colors: Selected from manufacturer's standard colors.

B. Epoxy Coating:

1. Number of coats: Two over primer/touch up.
2. Intermediate/First Coat(s): Inorganic Water Based Epoxy.

C. Fluoropolymer Coating:

1. Number of Coats: One.
2. Product Characteristics:

a. Comply with the performance requirements specified above for severe exposure.

3. Top Coat: Air Dry Fluoropolymer, One Component.

a. Sheen: Satin.
b. Finish: Metallic.
c. Products:

1) Tnemec Company, Inc; Series 1072V Fluoronar: www.tnemec.com/#sle.

D. Shellac: Pure, white type.

2.3 PRIMERS

A. Primers: Provide the following unless other primer is required or recommended by coating manufacturer.

1. Zinc Urethane Primer.

a. Products:

1) Tnemec Company, Inc; Series 90-97 TnemeZinc Primer: www.tnemec.com/#sle.

a) Touch up on site with Tnemec Series 94-H20 Hydro-Zinc

2.4 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of coated surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Do not begin application of coatings until substrates have been properly prepared.

C. Verify that substrate surfaces are ready to receive work as instructed by the coating manufacturer. Obtain and follow manufacturer's instructions for examination and testing of substrates.

D. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

E. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

F. Test shop-applied primer for compatibility with subsequent cover materials.

3.2 PREPARATION

A. Protect adjacent surfaces and materials not receiving coating from spatter and overspray; mask if necessary to provide adequate protection. Repair damage.

B. Clean surfaces of loose foreign matter.

C. Remove substances that would bleed through finished coatings. If unremovable, seal surface with shellac.

D. Remove finish hardware, fixture covers, and accessories and store.

E. Ferrous Metal:

1. Solvent clean according to SSPC-SP 1.
2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning", and protect from corrosion until coated.
4. In addition, for surfaces to be finished with with specified system, remove tight rust, and shop primer, if any to bare metal using power tools according to SSPC-SP 11 "Power Tool Cleaning to Bare Metal", and protect from corrosion until coated.

3.3 PRIMING

A. Apply primer to all surfaces, unless specifically not required by coating manufacturer. Apply in accordance with coating manufacturer's instructions.

3.4 COATING APPLICATION

A. Apply coatings in accordance with manufacturer's written instructions, to thicknesses specified and recommendations in MPI - Architectural Painting and Specification Manual.

B. Apply in uniform thickness coats, without runs, drips, pinholes, brush marks, or variations in color, texture, or finish. Finish edges, crevices, corners, and other changes in dimension with full coating thickness.

3.5 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

B. Clean surfaces immediately of overspray, splatter, and excess material.

C. After coating has cured, clean and replace finish hardware, fixtures, and fittings previously removed.

3.6 PROTECTION

A. Protect finished work from damage.

3.7 SCHEDULE

A. Exterior Ferrous Metal Railings and Handrails, Fences, Gates: Satin finish, shop applied to cleaned, bare metal; apply to exposed and concealed surfaces, and surfaces embedded in concrete as required to conform to performance requirements and resist corrosion.

B. Gates and Louvers, Above and Below Roof: High-heat-resistant coating.

END OF SECTION 099600

SECTION 101419 - DIMENSIONAL LETTER SIGNAGE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Dimensional letter signage.

1.2 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design 2010.

B. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.

1.3 SUBMITTALS

A. Shop Drawings:

1. Include dimensions, locations, elevations, materials, text and graphic layout, and attachment details.

B. Samples: Submit one sample of each type of dimensional letter sign of size similar to that required for project, indicating sign style, font, and method of attachment.

C. Verification Samples: Submit samples showing colors and finishes specified.

D. Manufacturer's Installation Instructions: Include installation templates and attachment devices.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Package dimensional letter signs as required to prevent damage before installation.

B. Store under cover and elevated above grade.

C. Store tape adhesive at a normal room temperature of 68 to 72 degrees F.

1.6 FIELD CONDITIONS

A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.

PART 2 - PRODUCTS

2.1 DIMENSIONAL LETTERS

A. Plastic Letters:

1. Material: Injection molded plastic.
2. Thickness: 1/8 inch minimum.
3. Letter Height: As indicated on drawings.
4. Text and Typeface:

    a. Character Font: As indicated on Drawings.

5. Finish: As selected by Architect from manufacturer's full range.
6. Color: As selected.
7. Mounting: Tape adhesive.

2.2 ACCESSORIES

A. Tape Adhesive: Double-sided tape, permanent adhesive.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

B. Notify Architect if conditions are not suitable for installation of signs; do not proceed until conditions are satisfactory.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install with horizontal edges level.

C. Locate dimensional letter signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.

D. Protect from damage until Final Completion; repair or replace damaged items.

END OF SECTION 101419

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SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Commercial toilet accessories.

B. Under-lavatory pipe supply covers.

C. Electric hand/hair dryers.

D. Diaper changing stations.

E. Utility room accessories.

1.2 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design 2010.

B. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service 2022.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2015.

D. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2023.

E. ASTM B86 - Standard Specification for Zinc and Zinc-Aluminum (ZA) Alloy Foundry and Die Castings 2023.

F. ASTM B456 - Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium 2017 (Reapproved 2022).

G. ASTM C1036 - Standard Specification for Flat Glass 2021.

H. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass 2018.

I. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror 2018.

J. ASTM C1822 - Standard Specification for Insulating Covers on Accessible Lavatory Piping 2021.

K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2016.

L. ASTM F2285 - Standard Consumer Safety Performance Specification for Diaper Changing Tables for Commercial Use 2022.

M. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi 2015, with Editorial Revision (2021).

N. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with the placement of internal wall reinforcement, concealed ceiling supports, and reinforcement of toilet partitions to receive anchor attachments.

1.4 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.

C. Samples: Submit two samples of finishes, illustrating color and finish.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Commercial Toilet Accessories:

1. Bradley Corporation: www.bradleycorp.com/#sle.

B. Under-Lavatory Pipe Supply Covers:

1. Plumberex Specialty Products, Inc: www.plumberex.com/#sle.

C. Diaper Changing Stations:

1. Basis of Design: Bradley Corporation; Model 962-11 - Surface Mounted Stainless Steel Baby Changing Station: www.bradleycorp.com/#sle.
2. Diaper Deck & Company: www.diaperdeck.com/#sle.
3. Koala Kare Products: www.koalabear.com/#sle.

2.2 MATERIALS

A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.

1. Grind welded joints smooth.
2. Fabricate units made of metal sheet of seamless sheets with flat surfaces.

B. Keys: Provide ten keys for each accessory to Owner; master key lockable accessories.

C. Stainless Steel Sheet: ASTM A666, Type 304.

D. Stainless Steel Tubing: ASTM A269/A269M, Grade TP304 or TP316.

E. Galvanized Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.

F. Zinc Alloy: Die cast, ASTM B86.

G. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.

H. Mirror Glass: Tempered safety glass, ASTM C1048; and ASTM C1036 Type I, Class 1, Quality Q2, with silvering as required.

I. Adhesive: Two component epoxy type, waterproof.

J. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.

2.3 FINISHES

A. Stainless Steel: Satin finish, unless otherwise noted.

B. Chrome/Nickel Plating: ASTM B456, SC 2, polished finish, unless otherwise noted.

C. Shop Primed Ferrous Metals: Pretreat and clean, spray apply one coat primer and bake.

2.4 COMMERCIAL TOILET ACCESSORIES

A. Toilet Paper Dispenser: Single roll, surface mounted bracket type, stainless steel, spindleless type for tension spring delivery designed to prevent theft of tissue roll.

B. Paper Towel Dispenser: Folded paper type, stainless steel, surface-mounted, with viewing slots on sides as refill indicator and tumbler lock.

1. Capacity: 300 C-fold minimum.
2. Products:

    a. Bradly Elvari Surface Mounted Towel Dispenser, Model 2B1.

C. Waste Receptacle: Stainless steel, freestanding style with swing top.

D. Manual Soap Dispenser: Liquid soap dispenser, wall-mounted, with stainless steel cover and window to gauge soap level, tumbler lock.

1. Minimum Capacity: 48 ounces.
2. Products:

    a. Bradley Elvari Manual Soap Dispenser, Surface Mounted, Model 6B1-11.

E. Mirrors: Stainless steel framed, 1/4 inch thick annealed float glass; ASTM C1036.

1. Annealed Float Glass: Silvering, protective and physical characteristics in compliance with ASTM C1503.
2. Size: As indicated on drawings.
3. Frame: 0.05 inchangle shapes, with mitered and welded and ground corners, and tamperproof hanging system; satin finish. See Drawings for detail. Mount to frame with structural tape.

F. Seat Cover Dispenser: Stainless steel, surface-mounted, reloading by concealed opening at base, tumbler lock.

1. Minimum capacity: 250 seat covers.
2. Products:

    a. Bradley, Elvari Seat Cover Dispenser, Surface Mounted, Model 5B1.

G. Grab Bars: Stainless steel, smooth surface.

1. Heavy Duty Grab Bars: Floor supports are acceptable if necessary to achieve load rating.

    a. Push/Pull Point Load: Minimum 1000 pound-force, minimum.
    b. Dimensions: 1-1/2 inch outside diameter, minimum 0.125 inch wall thickness, exposed flange mounting, 1-1/2 inch clearance between wall and inside of grab bar.
    c. Length and Configuration: As indicated on drawings.

H. Sanitary Napkin Disposal Unit: Stainless steel, surface-mounted, self-closing door, locking bottom panel with full-length stainless steel piano-type hinge, removable receptacle.

1. Products:

    a. Bradley Elvari Napkin Disposal, Surface Mounted, Model 4B2-11.

2.5 UNDER-LAVATORY PIPE AND SUPPLY COVERS

A. Under-Lavatory Pipe and Supply Covers:

1. Insulate exposed drainage piping, including hot, cold, and tempered water supplies under lavatories or sinks to comply with ADA Standards.
2. Exterior Surfaces: Smooth non-absorbent, non-abrasive surfaces.
3. Construction: 1/8 inch flexible PVC.

a. Surface Burning Characteristics: Flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
b. Comply with ASTM C1822, type indicated.
c. Comply with ICC A117.1.
d. Microbial and Fungal Resistance: Comply with ASTM G21.

4. Color: White.
5. Products:

a. Plumberex Specialty Products, Inc; Plumberex Handy-Shield Maxx: www.plumberex.com/#sle.

2.6 DIAPER CHANGING STATIONS

A. Diaper Changing Station: Wall-mounted folding diaper changing station for use in commercial toilet facilities, meeting or exceeding ASTM F2285.

1. Material: Stainless steel.
2. Mounting: Surface.
3. Minimum Rated Load: 250 pounds.

2.7 UTILITY ROOM ACCESSORIES

A. Mop and Broom Holder: 0.05 inch thick stainless steel, Type 304, hat-shaped channel.

1. Holders: Three spring-loaded rubber cam holders.
2. Length: 36 inches.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify exact location of accessories for installation.

C. Verify that field measurements are as indicated on drawings.

3.2 PREPARATION

A. Deliver inserts and rough-in frames to site for timely installation.

3.3 INSTALLATION

A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.

B. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.

3.4 PROTECTION

A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION 102800

SECTION 104300 - EMERGENCY AID SPECIALTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Automated external defibrillators (AEDs).

B. Automated external defibrillator (AED) cabinets.

C. Accessories.

1.2 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide AED operational features, color and finish, anchorage details, and installation instructions.

C. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.

D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.

E. Maintenance Data: Include test schedules and recertification requirements.

PART 2 - PRODUCTS

2.1 AUTOMATED EXTERNAL DEFIBRILLATORS (AEDs)

A. Automated External Defibrillators (AEDs) - General: FDA approval required.

1. Provide automated external defibrillators (AEDs) as indicated.

2.2 EMERGENCY AID CABINETS

A. Type: Automated external defibrillator (AED).

B. Cabinet Construction: Non-fire-rated.

1. Formed aluminum.

C. Cabinet Configuration: Surface mounted type.

1. Size to accommodate AED.
2. Trimless type.
3. Provide cabinet enclosure with right angle inside corners and seams, and with formed perimeter trim and door stiles.

D. Door: 0.036 inch metal thickness, reinforced for flatness and rigidity with wire pull handle and nylon catch. Hinge door for 180 degree opening with two butt hinges.

E. Door Glazing: Acrylic plastic, clear, 1/8 inch thick, flat shape and set in resilient channel glazing gasket.

F. Cabinet Mounting Hardware: Appropriate to cabinet, with predrilled holes for placement of anchors.

G. Fabrication: Weld, fill, and grind components smooth.

H. Finish of Cabinet Exterior Trim and Door: No.4 - Brushed stainless steel.

I. Finish of Door Pull or Handle: Stainless steel.

J. Finish of Cabinet Interior: White powder coat.

2.3 ACCESSORIES

A. Cabinet Door Signage: 'AED" decal, or vinyl self-adhering, prespaced black lettering and identifying graphic in accordance with authorities having jurisdiction (AHJ).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify rough openings for cabinet are correctly sized and located.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install cabinets plumb and level, at an ADA minimum height from finished floor to inside bottom of cabinet.

C. Secure rigidly in place.

D. Place AEDs in cabinets.

E. Cabinet Lettering:

1. Location: Face of door framing.

3.3 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust cabinet doors to operate smoothly without binding. Verify that alarms and integral locking devices operate properly.

C. On completion of cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes. Replace cabinets that cannot be restored to factory-finished appearance. Use materials and procedures recommended by cabinet manufacturer.

3.4 CLOSEOUT ACTIVITIES

A. Demonstrate proper operation of AED to Owner's designated representative.

END OF SECTION 104300

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SECTION 104400 - FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Fire extinguishers.

B. Accessories.

1.2 REFERENCE STANDARDS

A. NFPA 10 - Standard for Portable Fire Extinguishers 2022.

1.3 SUBMITTALS

A. See Section 013300, for submittal procedures.

1.4 FIELD CONDITIONS

A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 - PRODUCTS

2.1 FIRE EXTINGUISHERS

A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.

B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.

1. Class: A:B:C type.
2. Size: 20 pound.
3. Finish: Polished chrome.
4. Temperature range: Minus 65 degrees F to 120 degrees F.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify substrate for surface mounted hanger is adequate.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Secure rigidly in place.

3.3 SCHEDULES

A. Utility and storage rooms: ABC type as indicated above. Mounted on exposed wall bracket. Location to be determined in-field.

END OF SECTION 104400

SECTION 129300 - SITE FURNISHINGS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Quantity and location of site furnishings is indicated on the drawings. Site furnishings include, but are not limited to:

1. Bollards
2. Bicycle Rack
3. Benches and Bench Swings
4. Site Trash Receptacle /Recycling Receptacle
5. Shade Sails
6. Bistro Tables and Chairs

1.2 QUALITY ASSURANCE

A. Contractor shall procure only those items specified by the Owner’s Representative.

1.3 SUBMITTALS

A. Complete shop drawings of each item specified shall be submitted to the Owner’s Representative.

B. Contractor shall submit prior to purchase of site furnishings a balance of quantities to the Owner’s Representative of each site furnishing to ensure the quantities are per the Plans and according to the Owner’s direction. If the Contractor fails to submit a balance of quantities the Contractor shall pay for all additional cost of shipping, restocking and any other costs to correct the quantities at no cost to the Owner.

C. Where appropriate, and when approved by the Professional Designer, manufacturer's catalogue cuts may be substituted for shop drawings.

D. Submit assembly instruction drawings showing layout(s), connections, bolting and anchoring details as per manufacturer's standards.

E. A report of site furnishing parts consisting of recycled materials. Product specification data, providing test information for deflection and creep in accordance with ASTM D 648 and ASTM D 2990 for site furnishings which use plastic lumber as a component, shall be submitted. The data shall provide a comparison of deflection and creep measurements to other comparable materials.

PART 2 - PRODUCTS

2.1 REFER TO CONSTRUCTION DRAWINGS

A. “Furnishings Schedule” and details on Drawings.

PART 3 - EXECUTION

3.1 GENERAL

A. The Contractor shall verify that finished grades and other operations affecting mounting surfaces have been completed prior to the installation of site furnishings. Site furnishings shall be installed plumb and true, at locations indicated, in accordance with the approved manufacturer's instructions.

3.2 ASSEMBLY AND ERECTION OF COMPONENTS

A. Items shall be shipped knocked-down (KD) ready for site assembly. Packaged components shall be complete including all accessories and hardware. New parts shall be acquired from the manufacturer; substitute parts will not be accepted unless approved by the manufacturer. When the inspection of parts has been completed, the site furnishings shall be assembled and anchored according to manufacturer's instructions or as indicated. When site furnishings are assembled at the site, assembly shall not interfere with other operations or pedestrian and vehicular circulation.

3.3 ANCHORAGE, FASTENINGS AND CONNECTIONS

A. Furnish metal work, mounting bolts or hardware in ample time for securing into concrete or masonry as the work progresses. Provide anchorage where necessary for fastening furniture or furnishings securely in place. Provide, for anchorage not otherwise specified or indicated, slotted inserts, expansion shields, and power-driven fasteners, when approved for concrete; toggle bolts and through bolts for masonry; machine and carriage bolts for steel; through bolts, lag bolts, and screws for wood. Do not use wood plugs in any material. Provide non-ferrous attachments for non-ferrous metal. Make exposed fastenings of compatible materials, generally matching in color and finish the fastenings to which they are applied. Conceal fastenings where practicable.

3.4 TESTING

A. Each site furnishing shall be tested to determine a secure and correct installation. A correct installation shall be according to the manufacturer's recommendations and by the following procedure: The Contractor shall measure the physical dimensions and clearance of each installed site furnishing for compliance with manufacturer's recommendations and as indicated. Site furnishings which do not comply shall be

reinstalled. Fasteners and anchors determined to be non-compliant shall be replaced. A written report describing the results of the testing shall be provided.

3.5 LOCATION

A. Contractor shall locate and mark the locations of the site furnishings per the plan to be approved by the Owner's Representative prior to final mounting.

3.6 CLEAN UP

A. Clean work area of excess waste and remove and disposal of all construction debris and waste.

END OF SECTION 129300

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SECTION 224000 - PLUMBING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Include all necessary apparatus, excavating, controls, valves, and fittings required for a complete sanitary plumbing system.

B. Refer to Specification 23 0100 for additional general requirements.

1.2 UTILITIES AND SERVICES

A. Sanitary: Provide sanitary drainage, connect to sewer.

B. Water: Provide domestic water, connect to water mains.

1.3 TESTS

A. Test the plumbing system as required by the applicable plumbing code.

B. Test water piping for a continuous period of not less than four hours at a hydrostatic pressure of not less than one hundred twenty-five (125) pounds and make free from leaks. Completely remake leaky joints with piping dry. Retest system after leaks are corrected.

C. Plug all necessary openings in the drainage and vent piping systems and fill the entire system with water to the level of the highest vent stack above the roof. The system shall hold this water for 30 minutes without showing a drop in water level greater than 4 inches. Subject to approval of the Architect, the drainage system may be tested in sections.

1.4 STERILIZATION

A. Disinfect the potable water system in accordance with the Plumbing Code. After disinfection, send water samples to the Local Health Department for testing. Obtain approval of the Local Health Department before the system is placed into service.

B. Unless the Local Health Department requires otherwise, disinfect potable water piping upon completion of the installation by a mixture containing not less than 0.6 pound of high test calcium hypochlorite, or 2 pounds of chlorinated lime to each 1,000 gallons of water to provide not less than 50 ppm of available chlorine. Inject the mixture into the system and retain for not less than 24 hours, at which time the chlorine level shall be at

10ppm or greater. Then drain the system and flush with potable water until only a normal chlorine residual remains (0.2 ppm).

PART 2 - MATERIALS

2.1 PLUMBING MATERIALS

A. Potable Piping:

1. Plumbing for potable systems shall be lead-free per Public Law 99-339, Safe Drinking Water Act.
2. Lead-free is defined as no more than 0.2 percent lead in solder and solder flux, and no more than 8 percent lead in pipe and fittings.

B. Domestic Hot and Cold Water, Non-Potable Water, and Pressure Drain Piping:

1. Above Grade: Piping shall be Type L hard drawn coper tubing, ASTM B88, with wrought copper solder type fittings conforming to ANSI B16.22, or cast copper alloy solder joint fittings conforming to ANSI B16.18, or cast copper alloy flanged fittings Class 150 conforming to ANSI B16.24. Screwed joints in piping are restricted to pipe sizes 2” and smaller.

    a. Exception: Modifications to existing steel systems may use schedule 40, galvanized steel pipe, ASTM A53, Grade A or B, with 150 pound galvanized malleable iron screwed fittings conforming to ANSI B16.3.

2. CPVC PIPING:

    a. CPVC potable water pipe and fittings shall be extruded/molded from FlowGuard Gold® CPVC compounds manufactured by Lubrizol Advanced Materials.
    b. The pipe compound shall meet cell class 24448 and the fitting compound shall meet cell class 23447 as defined by ASTM D1784.
    c. Both the pipe and the fitting compounds shall be certified by NSF International for use with potable water and shall be from the same compound manufacturer.

3. Below Grade: Type K copper tubing shall be used. When piping is installed within a building and within or under a concrete slab, it shall be installed without joints. Where joints are unavoidable, they shall be brazed.

    a. Protective pipe covering shall be factory or field applied according to manufacturer’s written instructions.

        1) 2-1/2” or Larger: Products shall be Polyken No. 1027 primer and Polyken No. 930-35 tape coating, 35 mil, 21 kV dielectric strength, as manufacturer by Tyco Adhesives, Corrosion Protection Group. Minimum 1” overlap required.

2) 2” and Smaller: Products shall be 27 mil plastic sleeve protectors. LSP Products Group, Plasti-Sleeve or equivalent.

C. Soil, Waste, Drain, and Vent Piping: Cast iron soil pipe, fittings and connection shall comply with CISPI guidelines.

1. Below Grade: Piping shall be service weight hub and spigot (with gasket) coated cast iron and shall conform to ASTM A74 or schedule 40 PVC.
2. Above Grade: Piping shall be hubless cast iron pipe and fittings conforming to CISPI 301.

D. Natural Gas Piping:

1. Above Grade: Piping shall be schedule 40 black steel with threaded fittings. Piping and fittings shall conform to ASME B36.10M and ASTM A53/A53M.
2. Below Grade: Piping and fittings shall be high density polyethylene conforming to ASTM D2513. Tubing shall have a pressure rating of 100 PSI.

E. Roof Drain Leaders:

1. Below Grade: Leaders shall be service weight hub and spigot coated cast iron and shall conform to ASTM A74.
2. Above Grade: Hubless cast iron pipe and fittings conforming to CISPI 301.

F. Equipment Drains and Indirect Waste: DWV copper pipe with DWV wrought copper fittings in compliance with ANSI B16.29.

G. Laboratory/Process/Acid Waste and Vent Piping: For acid and caustic resistant drains.

1. From lab waste to neutralizing tank and vent piping: Pipe and fittings shall be flame retardant Schedule 40 Polypropylene (GF “Fuseal II” PPFR Group 1 63153 or Enfield “Enfusion” Type II-37206) or polyvinylidene fluoride (PVDF) (Fuseal 24/40 PVDF) or Spears Labwaste (CPVC). Polypropylene pipe shall conform to ASTM F1412 and ASTM D4101. The PVDF pipe shall conform to ASTM F1673, ASTM E84, and ASTME D3222. Joints and fittings shall be DWV electric fusion and made of the same material al the piping.
2. From neutralizing tank to sewer main: Pipe and fittings shall be per Soil, Waste, Drain, and Vent Piping above.
3. Connection to equipment and fixtures in accessible locations shall be made with mechanical joints.
4. Connection to existing systems of different materials shall be made with appropriate adapter provided by the Contractor.

2.2 PLUMBING FIXTURES

A. Provide plumbing fixtures complete with trim. All fixtures, trimmings, and stops shall be Grade “A” and shall be of one manufacturer. Plumbing fixtures and trim shall be as scheduled on the plans.

B. Plumbing fixtures for use by handicapped persons shall be in accordance with ANSI 117.1. Plumbing fixtures shall be low water consumption type: 1.28 gal/flush for water closets and 0.5 gal/flush for urinals.

C. Approved Manufacturers:

1. Fixtures: American Standard, Toto, or Kohler
2. Fittings: American Standard, Chicago Faucet, Kohler, T&S Brass, Speakman, Symmons, or Stern Williams
3. Flush Valves: Sloan or Delaney
4. Seats: Bemis, Beneke, Church, or Olsenite
5. Drinking Fountains: Elkay, Halsey Taylor, or Oasis
6. Stainless Steel Fixtures: Elkay, Just, or Advance Tabco
7. Molded Stone, Fiberglass & Plastic Enclosures: Aquaglass, Stern Williams, or Advance Tabco

2.3 WATER HEATERS

A. Water heaters shall be fully automatic, electric, UL Listed, complete with: insulation in accordance with ASHRAE 90A-80 (1982 requirements), glass-lined tank, coated steel jacket, adjustable thermostat, magnesium anode, and overheat control.

B. Water heaters shall be guaranteed by the manufacturer for a period not less than 3 years after start-up. Contractor shall furnish the manufacturer’s guarantee to the Owner.

C. Water heater shall have a combination temperature and pressure relief valve having the capacity to relieve the full capacity of the heating element on both temperature and pressure relief. Valve shall be Watts and shall be ASME rated.

D. Water heaters shall be Lochinvar, Rudd, A.O. Smith, or State.

2.4 FLOOR DRAINS

A. Drains shall be Jay R. Smith or the approved equal as manufactured by Zurn, Wade, or Josam. All drains shall be of the same manufacturer. Floor drains shall be provided with a trap primer valve and line, JR Smith 2699, connected to the nearest cold water line serving a plumbing fixture.

B. Floor drains in toilets and finished areas shall be JR Smith 2000 Series with 6” Type B square, adjustable strainer finished in satin nickel bronze; or equal products by Josam or Zurn. Provide vandal-proof secured tops. All floor drains shall be provided with a trap primer.

C. Floor drains in mechanical rooms and unfinished concrete floors shall be JR Smith 2131 Series with round 11-3/4” cast iron grate, sediment bucket, and deep-seal P-trap; or equal products by Josam or Zurn. Provide vandal-proof secured tops. All floor drains shall be provided with a trap primer.

2.5 CLEANOUTS

A. Cleanouts in cast iron soil pipe lines shall consist of cast iron ferrule and heavy brass cleanout plug with square head. Where piping is concealed in floors or walls, install cleanouts with countersunk plugs and covers in and near surface of floors or walls.

B. Cleanouts for floors shall be Josam Series 58360 with inside caulk outlet coated cast iron internal cleanout, brass rim, and Nikaloy scoriated cover plate for light traffic secured to plug by countersunk screw for installation flush with finished floor complete with carpet marker in carpeted areas. Cleanouts in walls shall be Josam Series 58610 with stainless steel covers.

C. Equal manufactured by Zurn or Wade.

2.6 WATER HAMMER ARRESTORS

A. Water hammer arrestors shall be selected and sized in strict accordance with Standard P.D.I. – WH201.

B. Arrestors shall be Josam 75000 or equal by Zure, JR Smith, or Wade.

2.7 WATER PRESSURE REDUCING VALVE

A. Where pressure of water service exceeds 70 PSI, a water pressure reducing valve shall be provided. Water pressure reducing valve for building shall be high capacity regulator Watts Series 223 rated 250 PSI inlet, set to 65 PSI outlet.

2.8 BACKFLOW PREVENTER

A. Watts LF909 water pressure backflow preventer of same size as pipe installed in. Complete with check valve, gate valves, and test cocks. Equal by Cla-Val or Cash Acme.

2.9 VALVES

A. Gate:

1. 2” and Smaller: Class 125, solder or threaded ends, bronze body, rising stem, screwed bonnet, and solid wedge. Nibco S-111 or Nibco T-111 or equivalent.
2. 2-1/2” and Larger: Class 125, flanged ends, OS&Y, iron body, bronze trim, rising stem, and solid wedge. Nibco F-617-0 or equivalent.

B. Ball:

1. 2” and Smaller: Bronze body, blowout-proof captive stem, double Teflon seats, full ported, stainless steel or chrome plated brass ball, two-piece, threaded or soldered

ends. Nibco T-585-70 or S-585-70. Or a three-piece bronze body, full port, stainless steel trim, with a blowout-proof stem. Nibco T or S-595-Y or equivalent.

2. 2-1/2" to 3": Two or three-piece bronze body, blowout-proof captive stainless steel stem, double Teflon seals and seats, full ported, stainless steel or chrome plated brass ball and threaded ends. Nibco T-585-70-66 or Nibco T-585-Y.
3. 4" and Larger: Class 150, flanged ends, carbon steel body with 316 stainless steel trim, uni-body design, full ported, blowout-proof captive stainless steel stem and ball, and Teflon seat. Nibco F-510-CS-R-66-FS.

C. Globe:

1. 2" and Smaller: Class 125, screwed ends, bronze body, inside screw, screw-in bonnet, renewable seat nad disc. Nibco T-211 or equivalent.
2. 2-1/2" and Larger: Class 125, iron body conforming to ASTM A126 Class B, bronze trim, flanged ends, bolted bonnet, bronze disc, replaceable seats. Nibco F-718-B or equivalent.

D. Butterfly:

1. 2-1/2" through 6": 200 PSI working pressure, ductile iron body, aluminum/bronze disc, stainless steel shaft, resilient seat, O-ring seals, lug type for dead-end service, level operator. Nibco LD-2000 series.
2. 8" and Larger: 150 or 200 PSI working pressure, ductile iron body, aluminum/bronze disc, stainless steel shaft, resilient seat, O-ring seals, lug type for dead-end service, gear operator. Nibco LD-1000 or LD-2000 series dependent on the application.

E. Check Valve:

1. 2" and Smaller: Class 125, threaded ends, bronze body, Y-pattern, renewable seat and disc, and screw cap. Nibco T-413 or equivalent.
2. 2-1/2" and Larger: Class 125, iron body, silent check, flanged ends, globe style, spring actuated, renewable seats and disc, bronze or 316 stainless steel trim. Nibco F-910 or equivalent.

F. Vertical Check:

1. 2" and Smaller: Class 125, threaded ends, bronze body, spring actuated, inline venrtical lift type, TFE seat ring. Nibco T-480-Y or equivalent.

G. Needle:

1. 1" and Smaller: Rated at 600 PSI and 300°F, positive shut-off for gauges, brass. Weiss Instruments 25NVBR or equivalent.

2.10 STRAINERS, FLANGES, AND UNIONS

A. Strainers:

1. 2” and Smaller: Threaded ends, cast bronze body with screwed cap, and 20-mesh 304 stainless steel screen for water service. Watts Series LF777S.
2. 2-1/2” and Larger: Flanged ends, cast iron body and bolted cap, 20-mesh stainless steel screen for water service. Watts Series 77F-DI-125.

B. Flanges:

1. 1-1/2” and Smaller: Class 150, forged steel, screwed, ANSI B16.5.
2. 2” and Larger: Class 150, forged steel welding neck, ANSI B16.5.
3. Copper Systems: Class 150, cast copper or bronze, ANSI B16.23 or ANSI 16.24.

C. Unions:

1. Piping unions shall be of the ground joint type constructed from materials equivalent in alloy composition and strength to other fittings prescribed with which they are used. Union pressure classes and end connections shall be the same as the fittings used in the lines with the unions.
2. Steel unions shall have hardened stainless steel seating surfaces on both faces.
3. Copper unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.11 FIBERGLASS PIPE INSULATION

A. Systems:

1. All domestic hot & cold water piping.
2. Horizontal storm piping and roof drain bodies

B. Insulation:

1. One-piece fibrous glass sectional pipe insulation with factory applied glass reinforced aluminum foil and white kraft paper flame retardant vapor barrier jacket, with self-sealing longitudinal jacket laps and butt strips; average thermal conductivity not to exceed 0.23 $\frac{BTU \cdot in}{hr \cdot ft^2 \cdot °F}$ at a mean temperature of 75°F. Insulation thickness shall be in accordance with IECC Table C403.2.10. Insulation shall have flame spread index not greater than 25 and a smoke developed index not greater than 50.

C. Insulation shall be:

1. Johns-Manville Micro-Lok HP, or,
2. Owens Corning SSL II

D. Insulating cement shall be:

1. Johns-Manville No. 301, or
2. 48 Insulations Quik-Set, or
3. Rockwood Mfg. Co. Delta-Maid One Shot

E. Vapor barrier coating shall be:

1. Foster Tite Fit 30-35, or
2. Vimasco 740, or
3. Insul-Coustic F.R.V.B. IC-501, or
4. Childers Cil-Perm CP-30

F. Breather coating shall be:

1. Foster Sealfas 30-36, or
2. Insul-Coustic Permsure IC-102, or
3. Vimasco 713, or
4. Childer Chil-Seal CP-50

2.12 PREMOLDED LAVATORY INSULATION

A. Exposed waste and water piping under lavatories for use by handicapped persons shall be insulated with molded flexible vinyl insulation, finished in light gray. Insulation shall be fastened with nylon fasteners. Lavatory insulation systems shall be Truebro Handi Lavi-Guard or equal by ProWrap by McGuire Mfr.

PART 3 - EXECUTION

3.1 GENERAL

A. Make connections to all fixtures, traps, and similar items. Place into operation all equipment.

B. Refer to architectural drawings for the exact location of fixtures and drains. Determine roughing dimensions from the manufacturer of the equipment furnished on the job.

3.2 PLUMBING FIXTURES

A. Grout between plumbing fixtures and walls and/or floors.

B. For connection of floor-outlet water closets, brass floor flanges shall be used. The joints between closet trap and flange shall be made tight with gaskets.

C. Connection of fixture traps from lavatories, drinking fountains, service sinks, etc. to cast iron shall be made with DWV type copper.

D. Seal, using sealant meeting requirements of Federal Specification TT-S-230, joint between urinals and wall and at water closet and floor.

3.3 DRAINS

A. Set floor drains with top flush with finished floor.

3.4 WATER HEATERS

A. Provide drain pan under water heater. Pipe relief valve discharge to drain pan. Pipe drain pan drain to floor drain, or to the nearest utility or janitor's sink. Do not make direct connection to drain.

3.5 CLEANOUTS

A. Provide cleanouts where required by the applicable plumbing code.

B. Cleanouts shall be the same size as pipe line in line sizes 4" and smaller. Pipe lines larger than 4" shall have 4" cleanouts.

C. Cleanouts installed outside buildings shall be same as in floors and shall be flush with grade and have a minimum 6" thick, 12"x12" concrete pad poured around cover. Cover shall be flush with top of concrete.

3.6 PRESSURE REDUCING VALVES

A. Provide for a pressure test of the water service. Where pressure exceeds 70 PSI, provide a pressure reducing station. Pressure reducing station shall include a pressure reducing valve, bypass with globe valve, pressure gauges, and isolation valves at entering and leaving sides.

3.7 BACKFLOW PREVENTER

A. Provide backflow preventer in incoming domestic water service where required by local codes or utility requirements.

B. Provide a full size copper drain line from unit to floor drain.

3.8 SOIL, WASTE, AND VENT PIPING INSTALLATION

A. Install Soil, Waste, and Vent piping in accordance with the International Plumbing Code (IPC).

B. All excavation and backfill shall be in accordance with 31 0000, "Earthwork."

3.9 POLYPROPYLENE AND PVDF PIPING INSTALLATION

A. General: Fusion and mechanical joints shall be installed by manufacturer certified experienced pipe fitters and as per the manufacturer's instructions. The Contractor shall provide all tools and equipment necessary for proper installation. The Contractor shall provide for supports and thermal expansion to meet the manufacturer's recommendations.

B. Horizontal Piping: Support horizontal piping at end of branches and at change of direction or elevation. Clamp piping to control thermal expansion per manufacturer's installation instructions.

C. Vertical Piping: Support risers with standard riser clamp or wall brackets.

D. Air Plenums: Piping installed in air plenums shall be installed with piping materials that have a flame/smoke rating of 25/50 or less per ASTM E84 or piping shall be wrapped with 3M Fire Barrier Plenum Wrap to meet a flame/smoke rating of 25/50 or less per ASTM E84.

3.10 APPLICATION OF PREFORMED FIBERGLASS PIPE INSULATION

A. Apply insulation to straight pipes and tubes as follows: Use preformed pipe insulation when able. Use pipe and tank insulation for larger diameter piping where preformed insulation is not available. To meet required thickness, apply multiple layers of insulation with longitudinal and end seams staggered.

1. Keep SSL adhesive and contact surfaces clean and free of dirt and moisture. Seal immediately once adhesive is exposed. Seal circumferential joints with a minimum 3" wide tape. Rub the longitudinal joints firmly with a squeegee and secure with two outward clinching staples evenly spaced in each 3 foot section of insulation.
2. Where vapor retarders are indicated: Seal staples and any penetrations in the insulation with vapor-retarder mastic. Apply vapor retarder to ends of insulation at intervals of 15-20 feet to form a vapor retarder between pipe insulation segments.
3. Taper the ends of insulation at terminations. Seal all raw edges of insulation with mastic.

B. Apply insulation to flanges as follows:

1. Apply preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation segments the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with a collar fabricated for preformed pipe insulation.
4. Fill all voids and seal all raw edges of insulation with vapor retarder mastic.

C. Apply insulation to fittings and elbows and mechanical grooved couplings as follows:

1. Apply mitered sections of pipe insulation, or fiberglass blanket insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire, tape, or bands.
2. Cover fittings with standard PVC fitting covers. Secure the fitting covers by wrapping the ends with minimum 1-1/2” wide PVC tape. Overlap a minimum of 2” and do not stretch the last 2” of tape. Secure the throat with a stainless steel tack.
3. On systems requiring a vapor barrier, seal the throat with vapor barrier mastic (the PVC fitting cover is to act as the vapor barrier).

D. Apply insulation to valves and specialties as follows:

1. Apply premolded pipe insulation sections of the same material as straight segments of pipe insulation, sized and cut to fit around the valve body, over the flanges, and around the bonnet. Fill all voids and seal all raw edges in insulation with vapor retarder mastic. Caulk around valve stem cutout.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to strainer basket without disturbing insulation.
3. Apply insulation to flanges as specified for flange insulation application.

END OF SECTION 224000

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SECTION 230100 – MECHANICAL GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 INTERPRETATION OF SPECIFICATIONS

A. General provisions and requirements apply throughout. Cross references or general provisions may be repeated for convenience or emphasis only.

B. Interpret the following as indicated:

1. “or equal”:

a. “in accordance with the General Conditions” or
b. “an equivalent with respect to style and function”

2. “approved”:

a. “approved or accepted by Governing Officials or the authorities having jurisdiction”

3. “provide”:

a. “furnish and install, connect, and test, and contract for the performance of same”

4. “wiring”:

a. “required conductors or cable and raceway system, including fittings, boxes, connections, supports, hardware, labeling, and miscellaneous related accessories”

5. “work”:

a. “materials completely provided. Which shall include all activities and services necessary to meet contract requirements, including inspection and replacement as specified of any defective element.”

6. “materials”:

a. “equipment and/or materials.”

7. “:”:

a. “shall be/have” Specifications following a colon are criteria which apply to the term proceeding the colon.

1.2 INSTRUCTIONS TO BIDDERS

A. Bidders are advised to visit the site and examine the existing conditions before submitting bids, as no allowance with be made for lack of knowledge of existing conditions where such conditions might reasonably be determined by observation.

1.3 SUBSTITUTIONS

A. Utilize only those materials specifically listed by the Contract Documents. Substitutions of alternative types of major materials will not be acceptable unless a written “prior” acceptance is obtained at least sever (7) working days before the Date for Submittal of Bids. Requests for prior acceptance of alternative materials must conform to the procedures for submitting shop drawings and product data.

B. The design and layout shown on the plans are based on the manufacturer indicated on the equipment schedule. If equipment other than that used as the basis of design is submitted for use on this project, it shall be the responsibility of the contractor, including costs for redesign of these systems. Submittals shall clearly indicate any required changes to the building systems affected by substitution of equipment.

1.4 GENERAL SCOPE OF WORK

A. The Contract Documents establish the basic systems designs and the detail design of the work, or establishment systems or materials performance criteria and minimum design requirements. In either case, certain aspects of the work or of the detail design are not established completely. Establish said work and details in accordance with industry norms and practice to suit the needs of the job. The work shall provide for complete systems and services unless otherwise specified herein.

B. The work covered by this specification shall include furnishing supervision, labor, supplies, materials, equipment, tools, services, taxes, and dollar costs required to construct and install the complete mechanical systems as specified herein and as shown by the plans and other relevant documents. Without limiting the generality thereof, the major items of the work are:

1. Utility connections and metering, including temporary connections.
2. Heating, Ventilation, and Air Conditioning systems.
3. Specialty systems as specified or shown by plans.
4. Special tools for maintenance or inspection of materials.
5. Necessary services and support work, including scaffolding, and hoisting.
6. Permits, inspection fees, approvals, licenses, registration, certifications, taxes, and specified or miscellaneous dollar costs.
7. Shop Drawings and Product Data Submittals as specified.
8. Inspections, tests, and systems and equipment demonstrations.
9. Specified or necessary documentation and notifications.
10. Materials transportation, delivery, handling, storage, protection, guarding, and inspecting.
11. Instruction of Owner’s Operating and Maintenance Personnel.

12. Temporary utility and site distribution system(s).
13. Demonstration of completion of the work.
14. Replacement of Defective Work.

1.5 CODES AND STANDARDS

A. The mechanical installation, equipment, materials, and workmanship shall as a minimum be in accordance with the requirements and recommendations of the applicable local codes and the following:

1. Heating, Ventilation, and Air Conditioning: NFPA 90A and NFPA 96, current edition.
2. Applicable federal, state, and local laws, codes, ordinances, and rulings of Governing Officials having jurisdiction.
3. Utility and service company regulations and requirements.

B. Codes and standards cited establish only the minimum requirements for the work. Where requirements of the contract Documents exceed requirements of the Codes and Standards, provide the work in accordance with the express requirements of the Contract Documents. Do not reduce the quality of the design or eliminate future capacity or options without acceptance by the Engineer, even if proposed changes meet minimum Code requirements.

C. The latest editions of the specifications, standards, and listings of the following organizations are made a part of this specification. Mechanical work, unless otherwise indicated, shall comply with their requirements and recommendations wherever applicable:

1. Underwriter’s Laboratories, Inc. (UL)
2. National Fire Protection Association (NFPA)
3. American National Standards Institute (ANSI)
4. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE)
5. Sheet Metal and Air Conditioning Contractors National Association (SMACNA)

D. Material shall be installed as required for the Seismic Rating of the area of the project. Submit installation details.

1.6 COMPLIANCE OF WORK WITH CODES AND ORDINANCES

A. Work shall comply with the requirements of local ordinances and Codes as modified and amended by Governing Officials having jurisdiction.

B. Notify the Architect in writing of any instance where any requirement of the Contract Documents is in conflict with any Code or ordinance, so that any required changes may be made in a timely manner and without the need for remedial work. Do not perform work contrary to Codes, ordinances, regulation, or rulings of Governing Officials.

1.7 RELATED WORK IN OTHER DIVISIONS

A. The following work is generally specified by other divisions of specifications, except for specific applications as called for by Division 23 specifications or plans:

1. Installation of building access panels and plaster frames.
2. Painting.

1.8 PERMITS AND COSTS

A. Obtain and pay for permits, assessments, taxes, fees, licenses, etc. necessary for the installation of the work. Deliver to the Owner all such certificates of inspection or occupancy issued by Governing Officials.

1.9 SHOP DRAWINGS AND PRODUCT DATA

A. Submit shop drawings and product data for review for major systems and materials, including, but not limited to:

1. Cleanouts
2. Domestic Water Heaters
3. Floor and Roof Drains
4. Plumbing Fixtures and Accessories
5. Plumbing Specialties
6. Fire Protection System Layout (at same scale as the mechanical floor plans)
7. Sprinkler Heads
8. Fire Protection System Appurtenances (compressors, valves, etc.)
9. Air Distribution Products and Accessories
10. Air Conditioning and Heating Units with coil, fan, filter, and compressor data
11. Dampers
12. Duct Lining
13. Ductwork and Accessories
14. Equipment Layout Drawings
15. Fans (with curves for fans with motors 1/2 HP and larger)
16. Flexible Ductwork
17. Insulation (duct and pipe)
18. Motor controls
19. Sheet Metal Work
20. Temperature Control System including control diagrams, control panel layouts, descriptions of operation and cuts of instruments
21. Valves and Piping Specialties

B. Prepare shop drawings giving locations for major equipment, ductwork, and piping, based on equipment to be installed (as ordered), and submit these for review. Shop drawings shall show the location and weight of each item of roof mounted equipment, roof openings, pads, sleeves, anchor bolts, etc. and shall be of a scale not less than that of the contract plans. The shop drawings shall give all clearances recommended by the manufacturer for the service or removal of equipment/materials.

C. Sheet metal shop drawings shall be submitted, based on field measurements of actual conditions and the equipment submitted and approved for this project. Sheet metal shop drawings shall clearly indicate all changes required to accommodate actual field conditions such as interference with structural or other building elements and systems.

D. Submittals shall include catalog cuts, bulletins, plates, drawings, diagrams, schedules, and any other information as necessary to indicate the relative characteristics, ratings, and capacities of the respective items of equipment.

E. Submittals shall be checked for accuracy and coordinated between the involved trades before submission for review and acceptance by the Engineer. Notify the Architect in writing where shop drawings indicate elevations of piping or ducts which would place pipe or duct below lighting fixtures or ceilings, or that would require the lowering of lighting fixtures or ceilings. The Architect shall likewise be notified of any other similar type conflict between materials as installed, or shown by plans or Shop Drawings.

F. Each shop drawing, product data sheet, catalog cutsheet, etc. submitted shall bear on its face an acceptance date and signature of the Contractor, indicating that the submission has been checked and accepted for installation by the Contractor.

G. Submit complete drawings and product data for any modified materials or proposed substitution of equivalent materials. When such materials are required or proposed, provide technical information on operating conditions, ratings, and capacity of the materials, including any and all related changes necessary or desirable to the basic design of any involved system in the facility. Where standard material (equipment) is modified to suit the conditions required, provide certification from the manufacturer of the required operating conditions, ratings, and capacities of the materials. Any submittal of alternate materials shall be in accordance with the General Conditions.

H. Submittals for review shall be fully in accordance with and consistent with the General Conditions, and with the requirements of the technical specifications and plans. Any technical exceptions shall be clearly and fully stated in one place.

I. The Engineer's review of shop drawings and product data shall not change the requirements of the contract documents, nor shall this review relieve the Contractor of full responsibility for any and all errors or omissions in said documentation.

J. Six (6) copies of each submittal shall be provided to the Architect for appropriate distribution and action. Four (4) copies of each submittal shall be returned to the Contractor. Three (3) copies of each final submittal shall be included in the project manuals.

K. Coordinate the structural, architectural and systems changes required for the mechanical equipment actually used on the project.

L. Submit a complete plan supports and restraints for the Seismic requirements of this zone.

1.10 DOCUMENTATION, MANUALS, AND RECORD PLANS

A. Prepare manuals containing certificates or letters of warranty or guarantee, operating and maintenance instructions and recommendations, test results, and other data specified herein, and deliver the manuals to the Owner's Representative upon completion of the work. These manuals shall include information on major materials (such as major equipment) and on special systems or materials. Any special tools required for service or repair shall be listed.

B. Manuals shall be ring binders with the name of the manual, project, Architect, Engineer and Contractor placed on the cover of each manual. Each manual shall contain a table of contents listing the items contained therein by number and name. Each item shall be properly indexed with a standard metal reinforced cover page tab, with item number and name printed on tab per se.

C. Installation, Operation, and Maintenance (IOM) Manuals for major materials (equipment) shall be provided in separate manuals, or sets of manuals, for each major system or item of material. These IOM Manuals shall contain detailed instructions for operation and maintenance of the major equipment, devices and materials requiring periodic inspection or service. IOM Manuals shall contain the following items of information:

1. Manufacturer’s maintenance and operation recommendations.
2. Final (corrected) shop drawings and product data information.

D. Make written certification to the Architect that tests, checks, verifications, and settings have been satisfactorily completed. Where any item cannot be certified as correct, make a written report of the relevant facts and test data.

E. Have bonds, guarantees, receipts, affidavits, etc., called for in the various specification articles prepared and signed in advance of final demonstration of completion and acceptance of the work. Deliver to the Architect at or before the time of inspection with a letter of transmittal, listing each item included.

F. On a set of contract documents, maintain an accurate record of all deviations made during the progress of the work from the contract documents (plans and specifications). Also, maintain an accurate as-built record of the dimensional locations of outside underground materials such as meters, valves, and incoming utility lines, piping, or conduits. The marked-up (record) documents shall be available on the site for inspection during normal working hours.

1.11 SCHEDULING AND CONDUCT OF THE WORK

A. Work shall be performed on schedule and in a manner as described by the Special Conditions of the Specifications and by Division 15 specifications. Plan, coordinate, and execute the work to meet building schedules and so as not to produce interference between the work of the various trades, or with any special job site construction.

B. Specified tests may be witnessed by the Architect or Engineer, at their option. Provide at least five (5) days' notice to the Architect of each test schedule, so that the Architect and Engineer may plan to attend the test if desired.

C. The Architect or Engineer may inspect the site at any time, at their option. In order that they may plan to inspect the job after the installation of major materials and before the materials are enclosed from ready view, notify Architect at least five (5) days in advance of the following construction milestones:

1. Underground piping installed, but prior to slab being placed or trenches backfilled.
2. Ductwork or piping installed, but before installation of walls or dropped ceilings, and before application of any insulation.

D. Work shall be performed within the access, security, proprietary, and housekeeping conditions specified.

1.12 TRANSPORTATION AND DELIVERY

A. Provide and pay for the transportation, storage and handling of materials. Materials shall be delivered to the job site in ample quantities to provide for the uninterrupted progress of work as scheduled. Where necessary, provide expedited or special shipping or handling of materials to prevent interruption of the overall job progress.

1.13 SPECIALIZED SERVICES

A. Provide any necessary specialized services, such as accredited direct factory representative, as may be required for survey, inspection, supervision, installation, calibration, test, placing of equipment into operation, or for trouble shooting during the period of replacement of defective work.

B. Provide for the installation of control systems and related low voltage (generally 50 volts or less) wiring for the building systems covered by Division 23 specifications. Control systems and wiring shall meet the requirements of Division 26 specifications.

1.14 GUARANTEES / WARRANTIES

A. Leave the entire mechanical system installed under this contract in proper working order. Replace any work or material which develops defects, except from ordinary wear and tear, within one (1) year from the date of beneficial acceptance by the Owner.

B. The materials of the mechanical systems shall have the manufacturer's and/or supplier's guarantee or warranty put into effect by execution and filing of any and all related papers. For one (1) year from the date of acceptance, obtain service or repair under the terms of any said guarantee or warranty in the Owner's behalf.

C. For a period of one (1) year from the date of acceptance, upon receipt of notification from the Architect of the failure of any material or workmanship, replace the failed material or workmanship, including removal and replacement, or repair.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Equipment and materials shall be new, of the best quality and grade of the relative quality established, of manufacturer's standard, established product line. Where applicable standards are established, shall conform to National Board of Fire Underwriter's requirements and bear the seal of approval of a recognized and approved testing agency, as accepted by the Engineer.

B. Once a product line has been established, it shall be consistently maintained throughout the entire installation.

C. Equipment and components that interact to form equipment assemblies and/or systems shall be of the same manufacturer to the greatest extent possible.

2.2 BUILDING ACCESS PANELS

A. Building access panels shall be of metal construction with hinged door and an inconspicuous frame. The size shall be as required to provide proper access for maintenance and service, with a minimum size of 18”x18”.

B. Access panels shall be Milcor "DW", or equal, for drywall locations and Milcor "K", or equal, elsewhere.

C. Access panels shall be “B” label where installed in rated walls.

2.3 PAINT

A. Paint used for touching up factory painted apparatus shall be top quality and selected to match the factory finish.

B. Cold galvanizing compound shall be Sherwin-Williams “Zinc-Clad Primer” or equal.

C. Rest Preventative paint shall be “Rust-Oleum” or equal.

2.4 ELECTRICAL MATERIALS

A. Electrical materials shall meet the requirements of Division 26 specifications.

PART 3 - EXECUTION

3.1 GENERAL DESIGN AND WORK

A. Read and study relevant documents, including Codes. Become familiar with the site, the scope of work and services, type of general construction, and the civil, structural, architectural, interior design, mechanical, electrical and special system plans and specifications.

B. Establish design and work details as necessary to provide for the complete installation of materials and the successful operation of systems. Notify the Engineer in writing and in a timely manner if responsibilities or directions are not clear, or if assistance is desired in determining the needs or requirements for any particular item.

3.2 INTERFERENCES AND COORDINATION

A. The plans showing mechanical work are generally diagrammatic in nature. The plans shall not be scaled for any dimension.

B. Coordinate the work with that of different trades so that interferences between the mechanical work and other work will be avoided. Refer to building plans for guidance as to dimensions, finished grades, ceiling heights, door swings, room finishes, location of ducts, pipes, equipment, outlets and similar details that are required, and coordinate final installation with work as actually installed. Outlets and connections for equipment or devices to be installed by different trades shall be coordinated to assure that the outlets and connections are properly sized and located with respect to the equipment served and the surrounding areas.

C. Offsets and fittings in lines, and adjustments to equipment and fixture locations, as accepted by the Owner's representative, shall be provided to accomplish the work in a satisfactory manner.

D. If interference develops, the Owner's representative shall decide which item of equipment, ductwork, piping, conduit, etc. must be relocated, regardless of the sequence of installation of the affected items.

3.3 SPACE REQUIREMENTS

A. Materials shall fit into the space provided in the building or property and shall be installed at such time and in such manner as to avoid damage to the building structure or property, as required by the job progress.

B. Materials requiring normal servicing or maintenance shall be made easily accessible, including associated connection devices, wiring and/or piping.

C. Ductwork, piping, raceways, and supports must be kept as close as possible to walls, floor slabs, columns, etc., so as to take up a minimum amount of space. Offsets and fittings required to accomplish this shall be furnished and installed.

D. Ductwork, piping or other such non-electrical materials shall not be located within 42-inches of switchboards, panelboards or motor control centers, including the space horizontally from the electrical equipment, and the space from floor to structural ceiling over electrical equipment.

3.4 WORKMANSHIP

A. Workmanship shall be of the highest quality and no substandard work will be accepted. Work shall be done by workmen skilled in the trade involved.

3.5 PROTECTION OF MATERIALS AND EQUIPMENT

A. Protect materials from the elements and other causes of damage during shipment, storage, and erection, until final acceptance by the Owner.

B. During construction, cover the fronts of equipment to prevent marring or defacing.

C. Open ends of ductwork, pipe, or conduit shall be closed with temporary closures or plugged when work is stopped, to prevent debris from entering.

D. Air handling systems shall have filters installed before any operation of the system. Exhaust fans may be protected using temporary filters cut from roll media and fastened over air inlets.

3.6 INSTALLATION OF MATERIALS

A. Materials shall be installed in accordance with the manufacturer's published recommendations for installation, in accordance with any listing restrictions of a certifying laboratory or agency, and in accordance with the requirements of involved Government Agencies or local Governing Officials.

B. Materials shall be set level, square and plumb, properly oriented, aligned and secured in the location indicated.

C. Lock washers shall be installed under nuts which bear on metal.

D. Surfaces to be painted shall be clean and free of dirt, dust, oil and rust.

E. Where galvanizing is broken during fabrication or installation (including tack welding), recoat exposed areas with cold galvanizing compound.

F. Exposed iron or steel materials such as ductwork, piping, conduits and supports (but not equipment, devices, and components), including those exterior to the building, where

exposed to view without removing ceilings or access panels shall be painted with one coat of rust inhibiting paint. The type and color of paint shall be acceptable to the Architect.

G. Materials and supports above ceilings, but visible through grilles or diffusers, etc., shall be painted flat black unless inappropriate due to listing restrictions or function.

3.7 BUILDING ACCESS PANELS

A. Building access panels shall be installed where required to provide access for service and maintenance for equipment, fans, heaters, ductwork, damper operators, valves, traps, instruments, etc., including associated connection devices, wiring and/or piping. In general, only one (1) access panel shall be provided for an item of equipment and associated connecting devices, wiring and/or piping. Where feasible one access panel may serve several items of equipment.

B. Access panel location and size shall be coordinated with materials/ equipment served to allow for installation, operation, inspection and maintenance as necessary, including testing and recalibrating. Access panels for fire dampers and/or duct smoke detectors shall allow resetting of the dampers and/or detectors. Coordinate the requirements between all involved trades.

C. Access panels are not required for materials above lay-in (push-up) ceiling systems.

3.8 SUPPORTING DEVICES AND MATERIALS

A. Necessary supports for properly mounting materials shall be provided. Supports shall provide adequate and rigid mounting for materials, unless otherwise indicated by plans or functionally required. Supports shall be fabricated and installed in a neat and workmanlike manner, and care shall be taken that at no time shall any portion of the building structure be overloaded or weakened in any manner.

B. Unless otherwise indicated, select and size foundations, supports, and fasteners.

3.9 CUTTING AND PATCHING

A. Coordinate with the various trades sufficiently ahead of the construction of any floor, wall, ceiling, roof, or other element, and identify openings, foundations, pads, curbs, and inserts that will be required for the work. Do not cut any structural member without having received written permission from the Architect.

3.10 CLEANING

A. Clean equipment, fixtures, devices and other materials furnished or set in place. Plaster, paint, stickers, rust, stains, and other foreign matter or discoloration shall be removed. Surfaces shall be polished and free of paint, oil, grease, and other dirt and debris. Touch

up or refinish materials which have been damaged or marred during the construction process.

3.11 LUBRICATION

A. After installation of equipment, motors and equipment components which were furnished or installed by the Contractor and require lubrication using oil, grease, or special type lubricant, shall be lubricated as recommended by the manufacturer.

3.12 MARKING AND LABELING

A. Provide marking and labeling for major items of equipment, controls, and materials.

3.13 CHECKS AND TESTS

A. Make tests as reasonably required by the Engineer to prove the integrity of the work, and leave the complete installation in first class condition and ready for operation.

B. Individual systems shall be thoroughly tested and demonstrated to meet full functional requirements.

C. See section 230593 for additional testing requirements.

3.14 DEMONSTRATION OF COMPLETION

A. The project shall be demonstrated to be completely installed and calibrated and suitable for acceptance by the Owner. Suitable acceptance inspections shall be performed to determine whether the Contractor has completed the work in a proper and workmanlike manner, that he has installed the work in accordance with the intent of the plans and specifications, that the installation is apparently safe for use by building occupants, including operating personnel, and that in the Architect and Engineer's opinion the work is satisfactory for the Owner to accept.

3.15 INSTRUCTIONS TO OPERATING PERSONNEL

A. Instruct Facility Operating Personnel in the safe and correct procedures for cleaning, checking, logging, lubricating, testing, trouble shooting and operating of equipment and systems. The instructions shall be conducted at the job site by qualified personnel of the Contractor, Supplier, or Manufacturer, and shall include reviewing the operation instructions and maintenance recommendations with qualified Facility Operating Personnel.

END OF SECTION 230100

SECTION 230593 – TEST, ADJUST, AND BALANCE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Perform testing, adjustment, and start-up of mechanical systems as described herein.

B. Testing and balancing shall be performed by an independent test and balance agency that specializes in and whose business is limited to testing and balancing of air conditioning systems. The Engineer, acting for the Owner, shall approve this agency, which shall be one fully certified by AABC or NEBB.

C. Testing and balancing agency, as part of its contract, shall act as authorized inspection agency, responsible to the Engineer and Owner, and shall, during the test and balance, list all items that are not installed correctly, require correction, or have not been installed in accordance with contract documents.

D. Testing and balancing shall be performed in complete accordance with AABC National Standards, 1982, 4th Edition.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide all instruments, equipment, materials, and recording devices necessary for tests and adjustments.

PART 3 - EXECUTION

3.1 GENERAL

A. Perform initial test and balance immediately after equipment has been started up and before building is occupied.

B. After initial test and balance has been completed, the test and balance agency shall re-balance the systems based on space temperatures, under actual occupied conditions, to provide CONSTANT even temperatures in each area. The control settings shall also be adjusted to achieve comfort in the spaces, and prevent one unit from "fighting" the other units.

C. Installation shall not be considered complete until final reports by agency have been submitted and approved by the Consulting Engineer.

3.2 AIR BALANCE:

A. Test system with fan speed set to maximum conditions. Make pitot tube traverse of main supply, exhaust and return ducts; determine CFM at fans and adjust fans to design CFM.

B. Test and record system static pressure at fan suction and discharge.

C. Test and record cooling apparatus entering and leaving air temperatures, dry bulb, and wet bulb.

D. Test, balance, adjust, and tabulate the air quantities of all supply, return, exhaust, and outside air ducts and air terminal devices within 10% of indicated values.

E. Adjust flow patterns from air terminal units to minimize drafts as equipment permits.

3.3 CONTROL PERFORMANCE CHECK

A. The results produced by the operation of automatic controls shall be checked by the testing agency; controls requiring adjustment shall be listed and reported to the Contractor. This does not reduce the responsibility of the Contractor for the checking and adjustment specified under the Temperature Control Section.

3.4 REPORTS

A. Reports shall be certified by the testing engineer that the methods used and the results obtained are as specified herein.

B. The test and balance contractor shall, as part of its responsibility, submit written reports of all mechanical system deficiencies to the Project Manager for action.

C. The final records of readings, calculations and adjustments shall be submitted to the Architect. The final report shall include a single line system schematic diagram indicating the location of testing points referenced in the report. Provide five (5) copies prior to final inspection.

END OF SECTION 230100

SECTION 230700 – HVAC INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide insulation for ductwork furnished under this division.

B. Provide insulation for piping furnished under this division.

1.2 QUALITY ASSURANCE

A. Products of the manufacturers listed under PRODUCTS will be acceptable for use for the specific functions noted. Adhesives, sealers, vapor barriers and coatings shall be compatible with the materials to which they are applied, and shall not corrode, soften or otherwise attack such material in either the wet or dry state.

B. Material shall be applied subject to their temperature limits. Application of insulating materials or finishes shall be in accordance with manufacturer's published recommendations unless otherwise specified herein.

C. Insulation shall be applied by experienced workers regularly employed for this type of work.

1.3 RATING

A. Insulation and accessories such as adhesives, mastics, cements, tape and jackets, unless specifically excepted, shall have a flame spread rating of not more than 25 and a smoke developed rating of not more than 50. Materials which are field applied may be tested individually.

B. Flame Spread and Smoke Developed Ratings shall be determined by Method of Test of Surface Burning Characteristics of Building Materials, NFPA 255, ASTM E84, UL 723.

C. Products or their shipping cartons shall bear a label indicating the flame and smoke rating do not exceed above requirements.

D. Treatment of jackets or facings to impart flame and smoke safety shall be permanent. Water soluble, fugitive, or corrosive treatments shall not be used to meet RATING criteria.

E. Certify in writing prior to installation, that products to be used will meet RATING criteria.

F. The perm rating for vapor barriers shall be not more than 0.05 perms and the rating for adhesives, coatings and mastics shall be not more than 0.25 perms.

PART 2 - PRODUCTS

2.1 FIBERGLASS BLANKET INSULATION FOR DUCTWORK

A. Systems:

1. Unconditioned outside air ductwork.
2. Makeup air ductwork.
3. Concealed supply air ductwork.

B. Blanket type insulation:

1. K-value not to exceed 0.27 $\frac{BTU \cdot in}{hr \cdot ft^2 \cdot °F}$
2. at a mean temperature of 75°F.
3. Minimum density of 0.75 $\frac{lb}{ft^3}$
4. 2” thick.

C. Insulation shall be:

1. Johns-Manville Microlite FSK Faced Wrap, or
2. Owens Corning Fiberglass Faced Duct Wrap FRK 25, Series ED-100, or
3. Certainteed Ultralite Duct Wrap Type IV

D. Fire retardant adhesive for securing insulation to ductwork and for sealing 2” facing flange at circumferential joints shall be:

1. Benjamin Foster 85-20, or
2. Insul-Coustic IC-225, or
3. Vimasco 733, or
4. Childers CP-82, or
5. Eplux Cadalar 400

E. 3-inch wide foil reinforced kraft tape shall be:

1. Arno C-430, or
2. Fason 0822, or
3. Nashua FSK

2.2 FIBERGLASS LINER FOR DUCTWORK

A. Systems:

1. Supply ductwork exposed in the space.

2. Supply ductwork for the first 10’ from the air handling unit, or through the second elbow, counting the one which turns the duct horizontally from the air handling unit.
3. Return & transfer air ductwork

B. Duct liner:

1. Fibrous glass type with one side coated with a black fire-retardant compound
2. K-value not to exceed 0.27 $\frac{BTU \cdot in}{hr \cdot ft^2 \cdot °F}$ at a mean temperature of 75°F
3. Minimum density of 0.75 $\frac{lb}{ft^3}$
4. 2” thick.

C. Duct liner shall be:

1. Johns-Manville Microlite, or
2. Owens Corning Aeroflex Type 150, or
3. Certainteed Ultralite #150

D. Fire retardant adhesive for securing insulation to ductwork and for sealing 2” facing flange at circumferential joints shall be:

1. Benjamin Foster 85-20, or
2. Insul-Coustic IC-225, or
3. Vimasco 733, or
4. Childers CP-82, or
5. Eplux Cadalar 400

2.3 PIPING INSULATION

A. Systems:

1. Condensate piping.
2. Refrigerant piping.

B. Piping insulation installed inside the building, except for refrigerant suction service:

1. Fiberglass preformed pipe insulation with a white all-service jacket/vapor barrier.
2. K-value not to exceed 0.23 $\frac{BTU \cdot in}{hr \cdot ft^2 \cdot °F}$ at a mean temperature of 70°F
3. For pipes smaller than 2”, insulation shall be 1” thick
4. For pipes 2“ to 4”, insulation shall be 1-1/2” thick
5. For pipes larger than 4”, insulation shall be 2” thick

C. Piping insulation installed outside the building, except for refrigerant suction service:

1. Prefabricated 2 $\frac{lb}{ft^3}$ polyisocyanurate insulation, Trymer 9501 or approved equal, with waterproof mastic and glass fiber jacket finished with an aluminum jacket with waterproof silicone joints

2. K-value not to exceed 0.14 $\frac{BTU \cdot in}{hr \cdot ft^2 \cdot °F}$ at a mean temperature of 70°F
3. For pipes smaller than 4”, insulation shall be 1” thick
4. For pipes 4” and larger, insulation shall be 1-1/2” thick

D. Piping for refrigerant suction service and other services as specified or noted:

1. Closed-cell insulation
2. 1/2” thick
3. Basis of design:

    a. AP Armaflex 25/50, or
    b. K-FLEX INSUL-TUBE

E. Insulation shall be continuous over all valve bodies, fittings, and wall & floor penetrations. Do not insulate unions on hot water piping, nor instruments, gauges, valve handwheels, etc. on any piping.

F. All piping insulation covering water-carrying piping which is exposed to the weather and subject to bursting from freezing temperatures shall be oversized to accommodate heating cables.

PART 3 - EXECUTION

3.1 APPLICATION OF FIBERGLASS BLANKET DUCT INSULATION

A. Wrap insulation around ducts with circumferential joints butted and longitudinal joints overlapped a minimum of 2”. Adhere insulation to ducts with 4" strips at 8" on center of fire-retardant adhesive; additionally, for ducts over 24” wide, impale insulation on the bottom of the ducts on metal pins, on maximum 18” centers, welded to the duct and secure with speed washers. On circumferential joints, seal the 2" flange on the insulation facing with fire retardant adhesive and tape with 3" foil reinforced kraft tape; tape terminations of insulation at fire dampers, flexible connections and ends of ducts to the duct with 3" wide foil reinforced kraft tape. Seal penetrations and punctures in insulation facing with foil reinforced kraft tape and fire-retardant vapor barrier coating.

B. Mark insulation in such a manner to allow easy inspection after installation.

C. Apply insulation to standing seams and other projections in ductwork or casings so that at least 1/4" of insulation covers such projections.

D. Where ductwork is lined, no external ductwork insulation is required.

E. Where unlined duct and lined duct connect, the external insulation shall overlap lined section a minimum distance of 4”.

3.2 APPLICATION OF FIBERGLASS DUCT LINER

A. Cut duct liner to provide overlapped and compressed longitudinal corner joints. Install liner with black coated surface facing the air stream. Adhere duct liner to the ductwork interior with a 100% coverage of the sheet metal surfaces using a fire-retardant adhesive; adhesive shall be applied by spraying. Coat all exposed leading edges and all transverse joints with fire retardant adhesive. In addition, secure liner using metal pins welded to the duct and speed washers. Spacing of metal pin shall be in accordance with the current edition of SMACNA HVAC Duct Construction Standards – Metal and Flexible.

B. Protect exposed edges of the lining by 24 gauge galvanized "Z" shapes installed at the edge of the lining, extending over flat side of lining 1/2 from edge.

3.3 APPLICATION OF PREFORMED PIPE INSULATION

A. Indoor piping:

1. Preformed pipe insulation with all-service jackets shall have all longitudinal joints lapped by a minimum of 2” and sealed with fire-retardant adhesive. Butt joints shall be sealed with 3” wide tape similar to the insulation vapor-barrier jacket and secured with adhesive. All elbows shall be insulated with preformed fitted insulation equal to the thickness specified for the adjacent piping insulation. As an alternative, provide fitting covers meeting NFPA/UL 25/50 ratings; stuff all covers with fiberglass insulation having characteristics equal to adjacent pipe insulation.

B. Outdoor piping:

1. Pre-fabricated pipe insulation for exterior water-carrying pipe shall have insulation secured on with copper wire with ends twisted and turned into the insulation. Over the insulation, apply mastic to a minimum 1/4” thickness and draw in, while mastic is wet, glass fiber cloth. Finish with aluminum jacket with waterproof silicone caulk joints. All water-carrying piping subject to freezing weather shall have self-regulating electric heat tracing.

3.4 APPLICATION OF CLOSED-CELL PIPE INSULATION

A. The insulation shall be installed by the slip-on method; slitting of the insulation is prohibited and shall be cause for rejection. All elbows shall be mitered and all such joints and butt joints shall be tightly made and glued.

B. All insulation installed outdoors shall be coated with a glossy white, ultraviolet protective coating applied in two coats.

END OF SECTION 230700

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SECTION 233000 – DUCTWORK AND AIR DISTRIBUTION

PART 1 - GENERAL

1.1 DUCTWORK

A. SMACNA Standards referred to hereinafter shall mean standards published by the Sheet Metal and Air Conditioning Contractor's National Association, Inc.

B. Except where indicated otherwise, duct construction and installation shall conform to the recommendations of the SMACNA manual for Low Pressure Duct Construction Standards. Ductwork shall be constructed and sealed as required for a 2" static pressure rating, Seal Class "C", in the previously referenced standard.

C. Ductwork as indicated is diagrammatic only and does not show all necessary offsets, hangers, and accessories. All such items required for a completed system shall be furnished by the Contractor.

D. Sizes shown for lined ductwork are clear inside dimensions and sheet metal dimensions shall be increased to allow for thickness of lining.

1.2 AIR DISTRIBUTION

A. Select products to provide full coverage of areas served without objectionable noise or draft. Products shall be selected for noise levels not in excess of NC-30. Air distribution products shall be tested and rated in an Air Diffusion Council Certified Laboratory. Unless indicated otherwise, all air distribution products shall be furnished by one manufacturer, who shall catalog a full line of both steel and aluminum air distribution devices.

PART 2 - PRODUCTS

2.1 DUCTWORK

A. Supply, outside air, return, transfer and restroom exhaust ductwork shall be constructed of galvanized steel sheets of lock form quality per ASTM A653 with a G90 zinc coating (0.90 oz/ft2 both sides), unless otherwise shown on the contract documents. Sheets shall be free of pits, blisters, slivers, and ungalvanized spots.

B. Grease exhaust ductwork shall be constructed of 16 gauge black steel. Ducts shall have longitudinally welded seams and welded or flanged joints and connections to equipment or accessories. Grease exhaust ducts shall slope a minimum of ¼" per foot toward the kitchen hood. 12"x12" clean outs shall be provided at a minimum of 10' intervals in addition to all changes in direction. All grease exhaust duct shall be inspected by means

of a “light test” in addition to other tests required by the local authority. The “light test” shall consist of passing a 100 watt light within the ductwork while inspecting the exterior of the ductwork, welds and flanged joints for any light escaping.

C. Lab and dish exhaust ductwork shall be constructed of Type 316L stainless steel sheet per ASTM A480 and ASTM A240 with a finished surfaced No. 4 for exposed locations, and No. 2B for concealed locations. Ducts shall have longitudinally welded seams and welded or flanged joints and connections to equipment or accessories.

D. Angles, rivets, nuts and bolts used in the construction, bracing, or hanging of ducts shall be of the same material as the duct in which installed.

E. Low pressure ductwork, ductwork that is installed downstream of a low pressure air moving device or terminal unit, shall be fabricated to meet minimum 2” w.g. internal pressure.

F. Medium pressure ductwork, ductwork that is installed between an air moving device and terminal units, shall be fabricated to meet minimum 4” w.g. internal pressure.

G. Return air ductwork shall be fabricated to meet minimum 1” w.g. internal pressure.

H. Lab exhaust ductwork shall be fabricated to meet minimum negative 4” w.g. or the maximum negative pressure the associated exhaust fan is capable of, whichever is lower.

I. Restroom exhaust and dish exhaust ductwork shall be fabricated to meet minimum negative 2” w.g. or the maximum negative pressure the associated exhaust fan is capable of, whichever is lower.

J. Exposed sheet metal shall be constructed of "paint grip" type galvanized steel.

K. Longitudinal seams at corners of rectangular ducts shall be Pittsburgh type or button punch snap lock with locks preferably on the tops and bottoms of ducts, not on the sides.

L. All duct panels for rectangular ducts over eighteen (18) inches in either height or width shall be cross broken, except as noted and/or specified. Duct panels in which grilles, diffusers or access doors are to be installed shall not be cross broken unless the distance from the edge of the grille, diffuser or access door to the edge of the panel exceeds eighteen (18) inches, in which case this portion of the panel shall be cross broken. The area to which the grille, diffuser or access door is attached shall be left flat. Ducts which are specified to be finished with rigid insulation shall not be cross broken.

M. Low pressure elbows shall be full radius type or square type with turning vanes. Where elbows have a different size inlet and outlet, turning vanes shall be single thickness type with extensions on the leaving side. Turning vanes shall be installed with vanes parallel to the elbow.

N. Medium pressure elbows shall be full radius type, no exceptions. Turning vanes are strictly prohibited in medium pressure ductwork.

O. Tee connections on branch ducts shall be the radius tap in type. Branch take offs from trunk ducts shall be similar to SMACNA Plate 2 5, except that adjustable splitter damper shall be provided at these points or SMACNA Plate 26, Fig. B with adjustable vanes.

P. Sheetmetal air plenums and partitions shall be constructed of 18 ga. galvanized steel and 1-1/2" x 1-1/2" x 1/4" galvanized steel angles.

2.2 HANGER & SUPPORTS

A. Hangers and supports for ductwork shall be in accordance with SMACNA standards.

B. Hangers and supports for hood exhaust system shall consist of either angles under the duct or clips welded to the duct supported by rods secured to the structure.

2.3 FLEXIBLE CONNECTIONS

A. Flexible connections in rectangular ducts shall be weatherproof minimum 20 oz. Ventglas as manufactured by Vent Fabrics, Inc., Eigin Mfg., or Duro Dyne Corp. Flexible connections shall be not less than six (6) inches long and shall have suitable metal collar frame at each end with allowance of at least two (2) inch slack in fabric to eliminate vibration transmission. Flexible connections exposed to the weather shall be constructed of at least two layers of fabric, and shall be watertight. Provide flexible connections to ductwork at the air handling unit.

2.4 DUCT CLOSURE COLLARS

A. Provide duct collars where ducts pass through masonry walls and partitions which extend full height to the underside of the structure and shall be fabricated from 22 gauge galvanized steel sheet. Provide duct collar on both sides of walls and partitions, except where registers and grilles are installed. Install flanges tight against the wall. Pack the space between the duct and the wall with fiberglass blanket insulation.

2.5 FLEXIBLE DUCT

A. Flexible duct shall be insulated, with a flame spread rating not over 25 and a developed smoke rating not over 50. Inner sleeves shall be fiberglass or Tedlar covered spring steel. Insulation shall be no less than 1" thick fiberglass with a vapor barrier jacket.

B. Flexible duct shall be rated for 6.0 in-w.c.

C. Flexible duct shall be connected with circumferential compression clamps consisting of either screw driven, slotted stainless steel bands or ratcheted nylon straps.

D. Flexible duct shall be:

1. Clevaflex, or

2. Genflex, or
3. Flexmaster, or
4. Thermaflex or
5. Wiremold

2.6 SPIN-IN FITTINGS

A. Spin-in fittings shall consist of a round galvanized sheet metal collar with a groove designed to allow the fitting to screw into a mating hold. Spin-in fittings shall have an extractor and manual balancing damper with a locking quadrant operator. Spin-in fittings on the inlet side of variable volume boxes shall be bell mouth type, without dampers or extractors.

B. Spin-in fittings shall be mounted with the extractor facing into the airstream. After insulation, a galvanized sheet metal strap shall be screwed to the duct and the fitting to ensure permanent, proper positioning of the fitting.

2.7 AIR DISTRIBUTION DEVICES

A. Air distribution devices shall be as scheduled on the drawings.

B. Diffusers shall be complete with pattern adjustment device, straightening vanes and volume control dampers. Diffuser backplate shall transition smoothly from neck size to full face size. Straightening vanes and dampers are not required where diffusers are attached to round flexible ductwork. Internal parts of diffusers shall be secured so that they can be removed and assembled without special tools.

C. Grilles and registers with borders shall have felt or rubber gaskets cemented to the back face and holding screws not over 18 inches on centers around the perimeter. Grilles passing air through partitions shall be as described for wall return grilles, 1 for each side partition.

D. Frame types of diffusers and ceiling return grilles shall match ceiling type(s) as indicated on architectural drawings. Diffusers and ceiling return grilles in lay in ceilings shall be sized to lay in a nominal 24”x24” grid opening.

E. Registers shall be same as grilles with opposed blade damper.

F. Finish shall be off white baked enamel unless otherwise indicated. Aluminum construction, linear diffusers and bar grilles: exposed surfaces to be clear anodized aluminum, interiors to be flat black.

G. Air distribution devices shall be:

1. Anemostat, or
2. Carnes, or
3. Krueger, or
4. Metalaire, or

5. Price, or
6. Titus, or
7. Tuttle & Bailey

2.8 DUCT AND PLENUM ACCESS DOORS

A. Doors:

1. Double wall construction of not less than 24 gauge galvanized steel sheet, with 1" thick neoprene coated fiberglass insulation between the walls.
2. A continuous hinge on one side and cam latch with striker plate on the other side
3. Height over 12 inches: not less than 2 cam latches with striker plates.

B. Door Frames:

1. Not less than 22 gauge galvanized steel
2. Knock over edges for securing to duct.

C. Door Assembly:

1. Double gasketed to provide seals from the door to the frame and from the frame to duct.

D. Size:

1. To allow proper access to intended device
2. Minimum 12" x 16", except as indicated on the drawings.

2.9 MANUAL DAMPERS AND DAMPER HARDWARE

A. Splitter Dampers:

1. Constructed of not less than 20 gauge galvanized steel sheet.
2. The length of the damper blade shall be the same as the width of the widest duct section at the split, but in no case shall be blade length be less than 12 inches.

B. Manual Volume Control Dampers:

1. Single blade butterfly dampers:

    a. Use in ducts up to and including 18"x12" size
    b. Constructed of not less than 16 gauge galvanized steel blade mounted in a galvanized steel frame.
    c. For rectangular dampers, the top and bottom edges of the blade shall be crimped to stiffen the blade.
    d. Provide an extended rod to permit installation of a damper regulator.

2. Multi louver dampers:

a. Use in ducts larger than 18"x12", in either or both dimensions.
b. Opposed blade type, constructed of not less than 16 gauge galvanized steel blades mounted in a galvanized steel channel frame. Blade spacing shall not exceed 6", and the top and bottom edges of the blades shall be crimped to stiffen the blades. Damper blades shall be interconnected by rods and linkages to provide simultaneous operation of all blades. Damper shall be provided with an extended rod to permit installation of a damper regulator.

3. Dampers for outside air intake or relief:

a. Edge and jamb seals
b. Rated at less than 1% leakage when tested at 2" water.

2.10 FIRE DAMPERS

A. Fire Dampers:

1. Factory fabricated curtain type
2. Constructed and tested in accordance with UL 555
3. Rated for 1-1/2 hour unless noted otherwise
4. Manufacturer: provide instructions for installation conforming to manner in which dampers were approved by UL

B. Frames:

1. Connected to ductwork: “B” frame
2. In transfer openings in wall shall be “A” frame

C. Fusible link rating:

1. In supply ducts: 160°F
2. In return ducts: 135°F
3. In other locations: approximately 50°F above maximum temperature normally encountered with system in operation or shutdown

D. Basis of Design:

1. Ruskin, or
2. Greenheck, or
3. Nailor, or
4. Hart

PART 3 - EXECUTION

3.1 SHEET METAL WORK – GENERAL

A. Access panels shall be installed on entering side of all turning vanes, fire dampers, control dampers and other locations where cleaning, oiling, inspection or maintenance are required. Access doors shall be located in bottom or side of ducts for ease of access.

B. Provide supplemental stiffening on ducts and apparatus casings to prevent drumming and to provide a structurally sound assembly.

C. Interior of ducts shall be smooth with joints caulked or sealed with duct sealer. The entire air system shall be rigid, free from rattles and air noises.

D. Ductwork connections to unit shall be arranged to avoid restricting access to panels which must be removed for servicing or cleaning of unit.

E. Paint exposed sheet metal with two coats of paint in a color and type selected by the architect.

F. Provide auxiliary frames set flush with the plaster line for outlets in plaster.

G. Install exposed ductwork in finished areas tight to structure.

H. Ductwork exposed in the space shall be painted with two coats of paint, in a color to be selected by the Interior Designer.

I. Branch takeoffs to flexible ducts shall be made using spin in fittings. Branch take-offs shall not be located in the following locations: within 5 ft. downstream of an elbow, within 3 ft. of another take-off.

3.2 HANGERS AND SUPPORTS

A. Duct hangers and support shall be in accordance with Section V (pages 5-1 through and including page 5-13) HANGERS AND SUPPORTS of the referenced SMACNA Standard, except:

1. Hangers shall be spaced no greater than 8’-0” on center
2. For rectangular ducts: with longest dimensions up through 60" hangers shall be the galvanized steel strap type; with longest dimension 61" and larger, hangers shall be trapeze type constructed of galvanized steel angles with round hanger rods. Sizes for strap hangers and trapeze angles and rods shall be based on duct size as scheduled in the SMACNA Standard, Table 5-1 (page 5-8) for strap hangers and Table 5-3 (pages 5-10) for trapeze hangers.

B. Hangers for ducts suspended directly from the structure shall be screwed or "pop" riveted to the bottom and sides of the duct and secured to the structure by inserts, expansion shield bolts, beam clamps, welding, or bolting. Drive anchors shall not be installed in any

location which will weaken the existing building. Install supplementary steel as required to bridge between joists and all supports shall be at joist panel points.

3.3 3.03 FLEXIBLE DUCTWORK

A. Install flexible ductwork in a fully extended condition, free of sags and kinks using the minimum length required to make connection. Maximum length of flexible duct shall be eight feet.

B. Support on a maximum of 4' centers with bands of 1" minimum width or wire through grommets furnished in seam of jacket.

3.4 GRILLES, REGISTERS, AND DIFFUSERS

A. Secure sidewall grilles and registers to duct with galvanized sheet metal screws.

B. Wall return and relief grilles installed above eye level shall have blades positioned so that inside of duct or the adjacent space will not be visible through the grille.

3.5 FIRE DAMPERS

A. Provide fire dampers in all duct and air transfer openings of fire rated walls, ceilings, and floors. Install damper in sleeve and install unit in wall using retaining angles. The installation shall be in accordance with the manufacturer's recommendation for complying with UL label.

B. Duct shall be connected to sleeve using slip type joints on top and bottom and a drive slip on each side so that duct can breakaway leaving damper and sleeve in wall or floor.

C. After installation prove damper operation by removing link and operating damper.

END OF SECTION 233000

SECTION 260100 - ELECTRICAL GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 INTERPRETATION OF SPECIFICATIONS

A. General provisions and requirements apply throughout. Cross references or general provisions may be repeated for convenience or emphasis only.

B. Interpret the following as indicated:

1. Or equal: "In accordance with the General Conditions, or Aan equivalent with respect to style and function.
2. Approved: Approved or accepted by Governing Officials or the authorities having jurisdiction.
3. Provide: Furnish and install, connect, and test, and contract for the performance of same.
4. Wiring: Required conductors or cable and raceway system, including fittings, boxes, connectors, supports, hardware, labeling, and miscellaneous related accessories.
5. Work: Materials completely provided, which shall include all activities and services necessary to meet contract requirements, including inspection and replacement as specified of any defective element.
6. Materials: Equipment and/or materials.
7. A : Specifications following a colon are criteria which apply to the term preceding the colon.

1.2 SCOPE OF WORK

A. Install electrical work covered by the below specifications and approved drawings. Provide material, labor transportation, tools, supervision, etc., necessary to complete the total electrical job. Items not specifically mentioned herein which are obviously necessary to make a complete working installation shall be provided, including any necessary field engineering and/or detail drawings required. Submit drawings for approval as provided for Shop Drawings.

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

1. Interior and exterior electrical system for lighting, power and secondary service entrance.
2. Empty conduits for telephone and misc. systems.
3. Power connections to equipment specified in specifications and approved drawings.
4. Temporary power as required for the project.

1.3 CODES AND FEES

A. Work shall be done in accordance with the requirements of the locally adopted edition of the National Electrical Code, NFPA #70 and local and state codes and regulations of utility company providing service.

B. Obtain and pay for all permits and inspections required by the building and safety codes, and ordinances, and the rules and regulations of any legal body having jurisdiction.

C. Electrical items covered by this specification shall be UL labeled and listed for the purpose.

1.4 DRAWINGS

A. The drawings indicate the general arrangement of electrical equipment. Review architectural drawings for door swings, cabinets, counters and other built-in equipment; conditions indicated on architectural plans shall govern for this work. Coordinate installation of electrical equipment with the structural and mechanical equipment and access thereto. Coordinate installation of recessed electrical equipment with concealed ductwork and piping, and wall thickness.

B. Do not scale drawings. Dimensions for layout of equipment shall be obtained from architectural and/or mechanical unless specifically indicated on electrical drawings.

C. Discrepancies shown on different drawings, between drawings and specifications or between documents and field conditions shall be promptly brought to the attention of the Architect.

1.5 SHOP DRAWINGS

A. Submit for review by the architect a complete schedule and data of materials and equipment to be incorporated in the work. Submittals shall be supported by descriptive materials, such as catalog sheets, product data sheets, diagrams, performance curves, and charts published by the manufacturer, to show conformance to specification and drawing requirements, model numbers alone will not be acceptable. Data submitted for review shall contain all information required to indicate compliance with equipment specified. Complete electrical characteristics shall be provided for all equipment. Submittals for lighting fixtures shall include photometric data. The architect reserves the right to require sample of any equipment to be submitted for approval.

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

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

D. All submittals shall be made at one time. Submittals will not be reviewed until all of the submittals listed below have been received. Submittals shall be made for each of the following items:

Lighting Fixtures
Disconnect Switches Panelboards
Circuit Breakers Wiring Devices

1.6 RECORD DRAWINGS

A. At the time of final inspection, provide three (3) sets of complete data on electrical equipment used in the project and as-built drawings reflecting all field changes. This data shall be in bound form and shall include the following items:

1. Test results required by these specifications.
2. Panelboard shop drawings and circuit directories reflecting all field changes.
3. Data sheets indicating electrical characteristics of all devices and equipment.

1.7 EQUIPMENT CONNECTIONS

A. Connect equipment requiring electrical connections under this section of these specifications. Where electrical connections to equipment require specific locations, obtain such locations from shop drawings. Do not scale drawings for location of conduit stub-ups or boxes mounted in wall or floor to serve specific equipment, unless dimensioned on approved electrical drawings.

B. Electrical circuits to equipment furnished under other sections of these specifications are based on design loads. If actual equipment furnished has loads other than design loads, electrical circuits and protective devices shall be revised to be compatible with equipment furnished at no additional cost to the owner.

C. Equipment furnished under other divisions of these specifications to be connected under this section of the specifications shall consist of, but not be limited to, the following:

1. Electrical equipment for heating, ventilating and air conditioning systems.

D. Examine other sections of these specifications, where equipment requiring electrical service is specified. Become fully aware of the scope of the work under this section of these specifications requiring electrical service and connections to equipment specified elsewhere.

1.8 MECHANICAL SYSTEMS

A. Review plumbing and HVAC drawings and Division 23 of these specifications for mechanical equipment requiring electrical service. Provide service to and make connections to all such mechanical equipment requiring electrical service.

B. Examine the nameplate data for equipment actually furnished on the project. If equipment has loads other than those indicated, control equipment and feeders shall be adjusted in size accordingly. Such adjustment shall be subject to the approval of the architect.

C. Regardless of the drawing information, provide a NEMA 5-20R duplex receptacle at each indoor air handling unit above ceiling for use of condensate pump connection. Provide and extend #12 circuit wires from the receptacle to the nearest receptacle below floor.

D. Regardless of the drawing information, provide minimum of (1) NEMA 5-20R weatherproof covered GFCI duplex receptacle at each outdoor mechanical equipment yard on grade or above roof. Receptacle must be located within 25’ from any HVAC equipment. Provide and extend #12 circuit wires from the receptacle to the nearest receptacle.

1.9 COORDINATION

A. Coordinate electrical activities with other trades so as to avoid delays, interferences, and any unnecessary work.

1.10 GUARANTEE

A. Contractor for Work under this Division shall be fully responsible for determining in advance of purchase that equipment and materials proposed for installation shall fit into the confines of the space indicated, and shall allow sufficient Code clearance for maintenance and service of all electrical equipment including that of other Trades.

B. No equipment including piping and ductwork shall be installed over or in this Code required clearance space.

C. The electrical drawings are schematic, and are not intended to show the exact location of conduit, outlets, etc., nor are they intended to show all conduit and conductors which are required and which shall be provided. Exact locations of electrical equipment, outlets, conduit, etc., shall be coordinated with all other Trades so that there will be no interference between mechanical equipment, piping, ducts, etc.

D. In general, complete circuit work including all conduit and wire is not indicated; however, circuit numbers are indicated for all outlets and equipment. Where circuitry is shown, the installation shall be as indicated. Where complete circuitry is not shown, outlets and equipment shall be connected together with the shortest run allowed by the building structure. Conduit fill and conductors installed in the same raceway shall be derated and be conformed to the NEC requirement. Three (3) phase and single (1) phase circuit homeruns shall not be combined.

E. All single phase electrical circuit homerun shall have individual phase and neutral conductors regardless whether to combine multiple circuit homerun. Only shared ground conductor is allowed.

F. The Contractor shall refer to the architectural, structural, and mechanical plans and details for dimensions, and shall fit his work to conform to the details of building construction. The right is reserved to relocate switches, receptacles, ceiling outlets, or other systems outlets a maximum of 10'-0" from its location as shown before it is permanently installed, without incurring additional expense to the Owner. Attention is called to receptacle outlets for coordination with Architectural and Mechanical equipment. Do not install these devices behind such equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

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

B. Where substitution of materials alters space requirement indicated on the drawings, submit shop drawings indicating proposed layout of space, all equipment to be installed therein, and clearances between equipment.

C. Material shall be new and shall conform to the applicable standard or standards where such have been established for the particular material in question. Publications and standards of the organization listed below are applicable to materials specified herein.

1. American Society for Testing and Materials (ASTM)
2. Underwriters= Lab (UL)
3. National Electrical Manufacturer Association (NEMA)
4. Insulated Cable Engineers Association (ICEA)
5. Institute of Electrical and Electronic Engineers (IEEE)
6. Edison Electric Institute (EEI)
7. National Fire Protection Association (NFPA)
8. American Wood Preservers Association (AWPA)
9. American National Standards Institute (ANSI)

D. Material of the same type shall be the product of one manufacturer.

E. All cost incurred by the acceptance of substitutions shall be borne by the contractor. Proof for substitution shall be by the contractor.

PART 3 - EXECUTION

3.1 WORKMANSHIP

A. Work shall be neatly, orderly, and securely installed with conduits, panels, boxes, switches, etc., perpendicular and/or parallel with the principle structural members.

Exposed raceways shall be offset where they enter surface mounted equipment. Wiring installed in panels and other enclosures shall be looped and laced and not wadded or bundled.

3.2 TESTS

A. At final inspection, a test will be made and the entire system shall be shown to be in proper working order as per these specifications and the approved drawings.

B. Provide instruments, labor and materials for any essential intermediate and final testing.

C. Equipment covers (i.e., panelboard trims, motor controls, device plates, and junction box covers) shall be removed, as directed, for inspection of internal wiring. All circuits throughout project shall be energized and shall be tested for operation and equipment connections in compliance with contract requirements. Accessible ceiling shall be removed, as directed, for inspection of equipment installed above ceilings.

3.3 IDENTIFICATION

A. Identify each device such as circuit breakers, panelboards, controllers, etc. with enamel or lacquer letters using machine cut stencils with 2" minimum letters, unless otherwise noted.

B. Identify circuits contained within junction boxes on the cover of all junction boxes.

C. Provide a white finish, black core Bakelite nameplate for 480/277 volt electrical equipment.

D. Provide a black finish, white core Bakelite nameplate for 208/120 volt electrical equipment.

E. Provide a red finish, white core Bakelite nameplate for all emergency electrical equipment.

F. Bakelite nameplates shall have 5/16" high engraved letters.

G. Provide engraved laminated job identification nameplate with 3/8" high letters, 4"x8" minimum, centered on main service equipment.

H. Nameplate shall be same finish at all equipment.

I. Each distribution type panelboard shall have engraved nameplates for each branch circuit feeder identifying load served.

J. Each branch circuit panelboard shall be provided with a directory frame on inside of cabinet door. A neat, carefully typewritten, directory card, identifying each branch circuit served by each such panel shall be placed in the frame, under clear plastic cover. Spares shall be noted in pencil.

K. Nameplates for surface or recessed mounted equipment shall be installed on the exterior of the equipment with screws.

L. Provide Electrical Safety Arc Flash Warning label conforming to NEC 70E on all electrical panelboards, Transformers, and distribution equipment.

M. Available fault current and method of electrical equipment protection labels must be clearly identified on the service panel “MDP” as required per NEC 110.24(A) and NEC 110.22.

3.4 CLEANING AND PAINTING

A. Oil, dirt, grease, and other foreign materials shall be removed from all raceways, fittings, boxes, panelboard trims, and cabinets to provide a clean surface for painting. Scratched or marred surfaces of lighting fixtures, panelboard and cabinet trims, switchboard, or other equipment enclosures shall be touched up with paint furnished by the equipment manufacturers specifically for that purpose. Painting in general is specified under other sections of the specifications.

B. Trim covers for flush-mounted panelboards, telephone cabinets, pull boxes, junction boxes and control cabinets shall not be painted unless specifically required by the architect. Where such painting is required, trim covers shall be removed for painting. Under no conditions shall locks, latches or exposed trim clamps be painted.

C. Unless specifically indicated to the contrary, all painting shall be done under the "Painting" section of these specifications.

END OF SECTION 260100

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SECTION 260910 -OCCUPANCY SENSORS

PART 1 - GENERAL

1.1 SUMMARY

A. The Occupancy Sensor system shall sense the presence of human activity within the desired space and fully control the “On” / “Off” function of the lights.

B. Sensing technologies shall be completely passive meaning that they will not emit any radiation that is known to interfere with certain types of hearing aides, or electronic devices such as electronic white board readers. Acceptable programmable shall be Passive Infrared (PIR), and/or PIR/Microphonic Passive Dual Technology (PDT) or Ultrasonic. Microwave based sensing technologies shall not be accepted.

C. Time Delay settings shall be factory set at 10 minutes, and shall not be field adjusted unless specifically instructed by Architect. This delay selection is based on lamp life vs. energy savings and sensor performance. Automatic adjustments to this delay period by the sensor shall not be permitted.

D. In high humidity or cold environments, the sensors must be conformably coated and rated for condensing humidity and -40 degree Fahrenheit (and Celsius) operation.

E. Installer, in accordance with manufacturer’s recommendation, shall determine final sensor location. All sensors shall have non-adjustable factory calibrated sensitivity for maximum performance. Time Delay and Photocell field adjustments shall be provided as needed.

F. The installing contractor shall be responsible for a complete and functional system in accordance with all applicable local and national codes.

G. All applicable products must be UL Listed or other acceptable national testing organization.

1.2 APPROVED MANUFACTURER AND SUBSTITUTIONS

A. Acceptable Manufacturers:

1. Hubbell
2. Sensor Switch
3. The Watt Stopper, Inc.
4. Lutron

B. Substitutions must be submitted no less than 5 days prior to bid date. An AutoCAD drawing of the facility showing coverage patterns and technical data must be provided

with substitution request. All substitutions must clearly identify any and all exceptions to the specifications with a detailed explanation as to the exception. If substitution is approved, the contractor shall bear the responsibility of a fully functional system to the owner's and Architect's satisfaction.

1.3 DESIGN / PERFORMANCE REQUIREMENTS

A. System shall conform to requirements of NFPA 70.

B. System, components, and installation shall comply with NEMA Guide Publication WD7 – Occupancy Motion Sensors

C. System shall comply with FCC emission standards specified in part 15, sub-part J for commercial and residential application.

D. System shall be listed under UL sections 916 and/or 508.

1.4 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Catalog sheets and specifications.
2. Ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
3. Storage and handling requirements and recommendations.
4. Installation instructions.

B. Shop Drawings: Wiring diagrams for the various components of the System specified including:

1. Composite wiring and/or schematic diagram of each control circuit as proposed to be installed.
2. Show location of all devices, including at minimum sensors, load controllers, and switches/dimmers for each area on reflected ceiling plans.
3. Provide room/area details including products and sequence of operation for each room or area. Illustrate typical acceptable room/area connection topologies.
4. Network riser diagram including floor and building level details. Include network cable specification. Illustrate points of connection to integrated systems. Coordinate integration with mechanical and/or other trades.

C. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

D. Closeout Submittals:

1. Project Record Documents: Record actual installed locations and settings for lighting control devices.
2. Operation and Maintenance Manual:

a. Include approved Shop Drawings and Product Data.
b. Include Sequence of Operation, identifying operation for each room or space.
c. Include manufacturer's maintenance information.
d. Operation and Maintenance Data: Include detailed information on device programming and setup.

3. Include startup and test reports.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing of centralized and distributed lighting control systems with a minimum of 10 years documented experience.

B. Installer Qualifications: Company certified by the manufacturer and specializing in installation of networked lighting control products with minimum three years documented experience.

C. System Components: Demonstrate that individual components have undergone quality control and testing prior to shipping.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.7 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

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

1. Ambient temperature: 32 to 104 degrees F (0 to 40 degrees C).
2. Relative humidity: Maximum 90 percent, non-condensing.

1.8 WARRANTY

A. Products Warranty: Manufacturer shall provide a 5 year limited warranty on products within this installation, except where otherwise noted, and consisting of a one for one device replacement.

PART 2 - PRODUCTS

2.1 INFRARED/ULTRASONIC CEILING MOUNTED OCCUPANCY SENSOR

A. General: Provide a complete and operable multi-technology, passive infrared and ultrasonic occupancy sensor lighting control system in areas shown on the Drawings. Ceiling mounted sensors shall be designed to turn room lighting "on" immediately upon sensing a room occupant and to turn room lighting "off" if no room occupant is sensed for the entire period of the sensors off time delay, regardless of the shape of the room.

B. System Components: Occupancy sensor lighting control shall include, but not be limited to, all required sensors, transformers, interface controls and relays, wiring and bypass switches.

C. System requirements:

1. Sensors shall be self-contained, crystal-controlled ultrasonic motion detectors and infrared motion detectors which provide volumetric coverage without gaps in coverage within the controlled areas.
2. Sensors shall have built-in timing and load control driving circuitry. Housings shall be white impact resistant plastic.
3. Coverage of sensors shall remain constant after sensitivity control has been set. No automatic reduction in coverage shall occur when air conditioning or heating fans are operating or if sensor has turned off due to not sensing motion.
4. All sensors shall have easily accessible, user-adjustable controls for adjusting sensitivity of a sensor to its controlled area, and for adjusting "time to light off" delay. Time delay shall be made settable down to 5 minutes. Sensors must also include a time delay adjustment of one minute or less for sensor operation testing. Adjustment controls shall be recessed in order to limit tampering.
5. An internal bypass "manual-on" switch shall be provided for each sensor for use in the event of sensor failure. When the bypass switch is activated, lighting shall remain constantly "on" and on/off control shall divert to wall switches until sensor is replaced. Override shall be accomplished without the use of unit specific or special tools. The bypass control shall also be recessed to limit tampering.
6. Sensors operating frequency shall be crystal-controlled to within •0.01%, and all ultrasonic transducers must be protected from damage, to provide for long life and consistent and reliable performance.
7. Sensors shall be available with different operating frequencies in order to allow for individual control of adjacent areas, as required.
8. All sensors shall be provided with an indicator light to verify that motion is being detected and that the unit is operating.
9. Sensors shall be able to be wired in parallel to allow coverage of large areas.
10. All ceiling sensors shall have pigtailed plenum cable connectors for installation in plenum ceiling spaces.
11. Wall switches shall be provided with an override capability, for use in an emergency or during lamp changes, which shall be provided by a three position switch which allows selection of positive on, off, and automatic operation override switch to avoid excessive overrides to "on" to defeating energy savings.

12. All ceiling sensors shall be low voltage, have a rugged solid state design, and be designed and manufactured specifically for control of lighting for energy conservation.
13. All sensors shall be manufactured by the same company and shall be aesthetically compatible, i.e., from the same product line or generation of products.
14. Sensors shall be suitable for NEC 725, Class 2 wiring and use plenum cable where approved.
15. Sensors shall be suitable for use with electronic and energy saving ballasts.

2.2 POWER PACKS

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

B. Power Pack shall securely mount to junction location through a threaded ½ inch chase nipple. Plastic clips into junction box shall not be accepted. All class 1 wiring shall pass through chase nipple into adjacent junction box without any exposure of wire leads. Note: UL Listing under Energy Management or Industrial Control Equipment automatically meets this requirement, whereas Appliance Control Listing does not meet this safety requirement.

C. When required by local code, Power Pack must install inside standard electrical enclosure and provide UL recognized support to junction box. All class 1 wiring is to pass through chase nipple into adjacent junction box without any exposure of wire leads.

D. Power Pack shall incorporate a Class 1 relay and an A/C electronic switching device. The A/C electronic switching device shall make and break the load, while the relay shall carry the current in the On condition. This system shall provide full 20 amp switching of all load types, and be rated for 400,000 cycles.

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

PART 3 - EXECUTION

3.1 PREPARATION

A. Do not begin installation until measurements have been verified and work areas have been properly prepared.

B. If preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 INSTALLATION

A. Install system in accordance with the approved system shop drawings and manufacturer's instructions.

B. It shall be the equipment manufacturers/contractors' responsibility to provide the quantity of motion sensors required for complete and proper volumetric coverage without gaps within the range of coverage of controlled areas. Rooms shall have 100% volumetric coverage to completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the room. The locations and quantities of sensors shown on the Drawings are diagrammatic and indicate only rooms which are to be provided with sensors. The equipment manufacturer/ contractor shall provide additional sensors if required to properly and completely cover the respective room. Proper judgment must be exercised in executing the work so as to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components. Where conflicts occur additional sensor shall be provided.

C. All line voltage connections shall be tagged to indicate circuit and switched legs.

D. Test all devices to ensure proper communication.

E. Calibrate all sensor time delays and sensitivity to guarantee proper detection of occupants and energy savings. Adjust time delay so that controlled area remains lighted while occupied.

F. Provide written or computer-generated documentation on the configuration of the system including room by room description including:

1. Sensor parameters, time delays, sensitivities, and daylighting setpoints.
2. Sequence of operation, (e.g. manual ON, Auto OFF. etc.)
3. Load Parameters (e.g. blink warning, etc.)

G. Post start-up tuning - Adjust sensor time delays and sensitivities to meet the Owner's requirements 30 days from beneficial occupancy. Provide a detailed report to the Architect / Owner of post start-up activity.

H. Tighten all panel Class I conductors from both circuit breaker and to loads to torque ratings as marked on enclosure UL label.

I. All Class II cabling shall enter enclosures from within low-voltage wiring areas and shall remain within those areas. No Class I conductors shall enter a low-voltage area.

J. Run separate neutrals for any phase dimmed branch load circuit. Different types of dimming loads shall have separate neutral.

K. Verify all non-panel-based lighting loads to be free from short circuits prior to connection to room controllers.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Notify Architect and Manufacturer in writing a minimum of 3 weeks prior to system start-up and testing.

B. Tests and Inspections: Manufacturer's service representative shall perform the following inspections and prepare reports.

1. Verify Class I and II wiring connections are terminated properly by validating system performance.
2. Set IP addresses and other network settings of system front end hardware per facilities IT instructions.
3. Verify / complete task programming for all switches, dimmers, time clocks, and sensors.
4. Verify that the control of each space complies with the Sequence of Operation.
5. Correct any system issues and retest.

C. Provide a report in table format with drawings, or using a software file that can be opened in the manufacturer's system software including each room or space that has lighting control installed. Indicate the following:

1. Date of test or inspection.
2. Loads per space, or Fixture Address identification.
3. Quantity and Type of each device installed.
4. Reports providing each device's settings.

3.4 DEMONSTRATION AND TRAINING

A. Before Substantial Completion, arrange and provide a one-day Owner instruction period to designated Owner personnel. Set-up, starting of the lighting control system and Owner instruction includes:

1. Confirmation of entire system operation and communication to each device.
2. Confirmation of operation of individual relays, switches, and sensors.
3. Confirmation of system Programming, photocell settings, override settings, etc.
4. Provide training to cover installation, programming, operation, and troubleshooting of the lighting control system.

END OF SECTION 260910

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SECTION 261000 - BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 GENERAL

A. Provide complete conduit system including boxes, fittings and supports. Leave empty conduits with fiber polyline pull cord. Conceal conduits except in unfinished spaces such as areas without ceilings. Type MC cable shall be used for wiring concealed in walls serving receptacles and switches. The MC wiring shall be extended from junction boxes mounted above the ceilings.

1.2 RACEWAYS:

A. Install conduits per the below requirements:

1. Intermediate Metal Conduit (IMC): ferrous galvanized conduit.
2. Comply with Article #342 of the National Electrical Code.
3. Rigid steel conduit: ferrous galvanized conduit.
4. Comply with Article #344 of the National Electrical Code.
5. Electrical Metallic Tubing (EMT): ferrous galvanized conduit.
6. Comply with Article #358 of the National Electrical Code.
7. Liquid tight flexible metal conduit.
8. Comply with Article #350 of the National Electrical Code.
9. Flexible metal conduit.
10. Comply with Article #348 of the National Electrical Code.
11. Rigid nonmetallic conduit: Polyvinyl Chloride Schedule 40 (PVC) conduit.
12. Comply with Article #352 of the National Electrical Code.

B. Coordinate raceways with the mechanical ductwork and plumbing work installed in the job.

1.3 OUTLETS:

A. Location of Outlets: located diagrammatically on the drawings. Refer to the architectural and mechanical plans for the exact location of outlets. Locate outlets so that they will be symmetrical with architectural details. Locate power outlets to serve the equipment. The location of any outlet may be moved ten feet before it has been installed without additional expense to the owner.

1.4 SIGNS:

A. Provide identification to the following electrical equipment with permanently attached phenolic plates with 1/4" white engraved lettering on the face of each, attached with two sheet metal screws. Plates must use color code identification. Identification plates also, shall identify the panel name and branch of the electrical system.

B. Main switchboard and individual devices installed therein:

1. Panelboards
2. Safety Switches and Disconnects
3. Shunt Trip Pushbutton
4. Main Service Disconnects

PART 2 - PRODUCTS

2.1 CONDUCTORS:

A. Conductors: Copper, 600 volt type THHN/THWN insulation except where noted on drawings. Conductors installed where fixtures are used as raceway shall be 90oC Type THHN or XHHN.

B. Branch circuits: minimum #12 AWG solid copper except for motor leads, which shall be a minimum #12 AWG stranded copper, unless otherwise noted on drawings.

C. Color code three phase system branch circuit and feeder conductors: No. 8 AWG and smaller as follows:

1. 208Y/120 volt
2. Phase A: Black
3. Phase B: Red
4. Phase C: Blue
5. Neutral: White
6. Ground: Green

D. MC Cable: Copper conductors with THHN insulation, steel armor, green grounding conductor, 600 volt.

2.2 PULLBOXES:

A. Pull boxes: code gauge galvanized sheet steel, per Article 314 of the National Electrical Code, for the number, size and position of conduits entering the box, size of box and maximum number of conductors in a box.

2.3 OUTLET BOXES:

A. Provide outlet boxes for each lighting fixture and for each device. Boxes shall not be smaller than specifically indicated herein and shall be larger if required by Article 314 of the National Electrical Code for the number and size of conductors installed. Where lighting fixtures are installed in continuous rows, only one outlet box shall be required unless otherwise noted on drawings.

2.4 RECEPTACLES AND WALL SWITCHES:

A. Receptacles and wall switches: the type and size indicated on the drawings. Equal by Bryant, Eagle or P & S.

1. Switches shall be 20 Amp 120/277 volt specification grade. Number of poles: as indicated on drawings.
2. Duplex outlets shall be 20 Amp 125 volt AC 3 wire specification grade straight blade.
3. Single outlets shall be 20 Amp 125 volt AC 3 wire specifications grade straight blade.

B. Device plates: one piece single or multi-gang type selected to match the specific device or combination of devices. Devices flush mounted in exposed masonry construction shall be jumbo type. Device plates for surface mounted devices shall be used with the type of outlet or outlet box in which the device is mounted. Provide devices installed in areas exposed to the weather with a weatherproof device plate. Cover plates shall be metal unless indicated differently on contract documents.

C. Finishes: Finish of Switch handles and receptacles shall be color per the architect/interior designer.

PART 3 - EXECUTION

3.1 GENERAL

A. Type MC cable shall be used for all branch circuit wiring in inaccessible areas and above accessible ceilings. EMT steel conduit shall be used for all branch circuit homeruns and feeders.

B. MC cable shall be run from homerun junction boxes to devices, switches, and light fixtures in inaccessible areas.

C. Rigid steel conduit shall be used for raceways run exposed on exterior of building, in slabs on grade, or in poured concrete walls or columns.

D. Non-Metallic Conduit shall be used for raceways run underground and where non-metallic conduit or plastic conduit (PVC) is specified herein or shown on the drawings.

E. All conduit and MC cable shall be run concealed unless otherwise directed or indicated on the drawings. Concealed conduit shall be run in walls and above ceilings.

F. Conduit shall be run below grade or in the slab where indicated.

G. MC cable shall not be installed exposed.

3.2 RACEWAYS

A. Install exposed conduits parallel or at right angles to existing walls, ceilings, and structural members. Support exposed conduits at not more than ten foot intervals and within three feet of outlets, junction boxes, cabinets and fittings. Support individual runs of conduits by one hole conduit straps. Support groups of conduits on 2" x 2" fourteen gauge channel. Kindorf, Unistrut, or Powers, suspended from structure with 3/8" threaded steel rods with spring steel conduit supporters. Attach rods to structure with swivel type clamps. Support individual runs of exposed conduits attached to structural steel by beam clamps. Where conduits must pass through structural members obtain approval of architect with respect to location and size of hole prior to drilling.

B. Support concealed branch circuit conduits at intervals not exceeding ten feet and within three feet of each outlet, junction box, cabinet or fitting. Attach individual branch circuit conduits to structural steel members with spring steel type conduit clips and to non-metallic structural members with one hole conduit straps. Where branch circuit conduits must be suspended below structure, support conduits by trapeze type support of exposed conduits. Attach concealed feeder conduits larger than one inch trade diameter above ceiling to structure on intervals not exceeding twelve feet with conduit beam clamps, one hole conduit straps or trapeze type support in accordance with conditions encountered. Do not attach conduits to channels of ceiling suspension system or suspension wires.

C. Attach conduit support device to structure with wood screws on wood, toggle bolts on hollow masonry, lead shield on solid masonry and machine bolts, clamps, or spring steel clips on steel. Nails are not acceptable.

D. Attach rigid conduit to sheet metal enclosures with two bonding type lock nuts and insulated bushing. EMT connectors and couplings shall be steel set screw type. Connectors shall be of the insulated throat type. Terminate rigid conduit stub ups not attached to enclosure with steel insulated throat, grounding type bushing. Connectors and couplings shall be approved for the purpose.

E. Provide expansion fittings in feeder conduits where conduits pass through building expansion joints. Conduits penetrating rated fire walls or rated fire floors shall be installed with devices to maintain the fire rating of the wall or floor penetrated. Contractor shall caulk holes on both sides of smoke walls where conduits penetrate.

F. Support conduit on the roof by clamping to premanufactured polyethylene blocks with integral standard strut channel.

G. Protect conduits against dirt, plaster, and foreign debris with conduit plugs. Plugs shall remain in place until masonry work is complete.

H. Seal conduits entering buildings from below grade with fiber and insulating electrical putty to prevent entrance of moisture.

I. Use conduit seals where noted on drawings and per Article #300-5 and #300-7 of the National Electrical Code. Crouse-Hinds Type "EYS", Appleton Type "EYF" or O.Z. Gedney Type "EY" or "EYA".

J. Flexible conduit shall comply with the above and below specifications.

1. Use flexible conduit connection to vibrating equipment, electric duct heaters, unit heaters and rotating machinery, and for connection from junction box to corresponding recessed lighting fixture.
2. Flexible liquidtight conduit connecting motors, duct heaters, unit heaters and other electrical equipment subject to vibration shall not exceed eighteen inches in length.
3. Flexible metal conduit from outlet box to recessed lighting fixture shall not exceed six feet in length.
4. Flexible conduit used for other than connections to lighting fixtures shall not be less than one-half inch trade size and in no case shall flexible conduit size be less than permitted by the National Electrical Code for the number and size of conductors to be installed therein. Three-eights inch flexible conduit may be used for connection to lighting fixtures providing conduit fill requirements of National Electrical Code are not exceeded.
5. Maintain ground continuity through flexible conduit with green equipment grounding conductor; do not use flexible conduit for ground continuity.
6. When exposed to weather, when specifically indicated, or when installed in areas subject to moisture, flexible conduit shall be liquidtight type.
7. Connectors for flexible conduit shall be the insulated throat type. When used with liquid type flexible conduit, connectors shall be of the screw-in ground cone type.

K. All raceways installed in the service shop shall be concealed behind walls.

L. If a conduit is required to be installed exposed due to owner changes after construction of wall and cavity is not accessible, explosion proof fittings shall be installed on both ends of exposed raceway stub-ups from underground in the service shop area conforming to National Electrical Code, Article 511. Continuous exposed GRC raceway unbroken exiting shop floor to 30” AFF before any coupling or connector to box may be exempted conforming to 511.3.

M. Explosion proof fittings shall be used for underground electrical raceway system in the service shop areas conforming to National Electrical Code, Article 511.

N. If a conduit is required to be installed exposed due to owner changes after construction of wall and cavity is not accessible, surface electrical raceway system in the service shop areas installed below 10’-0” above finished floor shall be rigid galvanized raceway system.

O. All feeders in rigid conduit 3/4” and larger or having conductors #6 and larger terminating in switchboards, panelboards, pull boxes, tap boxes and similar boxes shall have nylon insulated grounding bushings.

P. Conduits below service shop areas shall be IMC or threaded rigid metal conduit per 511.8.

Q. Conduits and junction boxes in service shops, service drives and compressor rooms shall not be installed within 18” of the ceiling.

3.3 PULL OR JUNCTION BOXES:

A. Provide pull boxes where specifically indicated and where required to facilitate the installation of conductors. Install pull boxes exposed only in unfinished spaces, unless otherwise specifically indicated, and install to be fully accessible.

B. Where pull boxes are installed in finished spaces, boxes shall be flush mounted, with trim, hinged door and flush latch and lock to match panel trim for flush mounted electrical panel. Surface mounted boxes shall be Type "FD" with blank covers.

C. Pull boxes required for horizontal feeders containing more than one feeder shall be provided with reinforced flange and removable 12 gauge 2" x 2" galvanized channel for support of conductors. Wood supports within pull boxes are not acceptable.

D. Splices shall not be permitted in pull boxes except when specifically approved in writing by the architect or where specifically shown on the drawings. Where splices are permitted, splices shall be made with splicing sleeves attached to conductors with hydraulic crimping tool. Split bolt connectors are not acceptable for splices within pull boxes.

E. Feeders within pull boxes shall be individually laced with nylon tie straps of the type with enlarged tab to permit identification of each feeder within pull box.

F. Minimum pull or junction box size shall be 4 11/16" square by 2 1/8" deep.

G. Mark on the coverplate of the junction box the circuit numbers of the circuits in that box. Marking may be made with permanent markers, in legible writing.

3.4 OUTLET BOXES:

A. Outlet boxes for surface mounted and pendant mounted lighting fixtures shall be 4" octagon boxes, 1-1/2" deep.

B. Outlet boxes for flush mounted lighting fixtures shall be 4" square boxes 2 1/8" deep, with blank cover installed adjacent to fixture. Box shall be accessible when fixture is removed. Connection to fixture shall be with flexible conduit and fixture wire.

C. Outlet boxes for switches, receptacles and wall mounted junction boxes shall be 4" square boxes 2-1/2" deep with square edge cover. Where only one conduit enters box, 3 2" deep single gang switch box may be used. Outlet boxes shall be set to within 1/8" of finished wall.

D. Outlet boxes for switches and receptacles in exposed wiring system shall be AFD@ boxes with matching device plate.

E. Outlet boxes for individual switches, and receptacles flush mounted in exposed concrete block shall be single gang masonry boxes 3 2" deep, set to within 1/8" of finished block.

F. Where special purpose device specified requires larger outlet box than specified herein, provide outlet box suitable for specific device. These outlet boxes shall be of the same type as specified herein for the specific installation required.

G. Where low voltage device is to be installed in common outlet box with line voltage device, provide metal barrier within outlet box to establish two separate compartments.

H. Outlet boxes used for support of surface mounted incandescent lighting fixtures shall be provided with fixture stud. Boxes shall be supported by light weight channel spanning between and attached to main ceiling support member. Attach channel to ceiling support members with galvanized tie wire or nylon tie straps.

I. Outlet boxes shall not be used for support of fluorescent fixtures, boxes shall be used only as junction boxes.

J. Outlet boxes for use with communication, alarm and signal systems are specified with specific systems.

K. Review architectural and interior drawings for areas where outlets occur within specific architectural or structural features and install outlets as shown on architectural drawings, or, if not shown, accurately center and align boxes within the architectural feature or detail.

L. Unless otherwise indicated or specified, switches and receptacles shall be mounted with middle of device, the distances indicated herein, above the finished floor except where finished walls are exposed concrete block, in which case height shall be adjusted to allow outlet box for device to be mounted at block joint. Review architectural drawings for any device requiring specific location. Mounting heights for devices shall be as follows (unless noted otherwise):

1. Wall Switches: 46" (42” if above counter or other obstruction)
2. Wall Receptacles: 18"
3. Receptacles above counter tops: 4" above back splash with major axis horizontal
4. Telephone and Computer Outlets: 18"

M. Devices shall be mounted within outlet boxes to allow device plates to be in contact with wall on sides. Devices shall be accurately aligned with major axis of device parallel to adjacent predominate building feature.

N. Wall switches shall be installed on the strike side of doors.

O. Unless otherwise noted on Drawings, wall outlet boxes in the service shop area shall be installed at 44” AFF. Service shop is classified as any place or location that vehicle will be serviced without ventilation provided, including but not limited to Service Bays, Details, Carwash Tunnel, Fluid/Compressor Rooms, etc. that must conform to NEC 511.

3.5 CONDUCTORS:

A. Feeder and branch circuit conductors No. 6 AWG and larger shall be phase identified in each accessible enclosure by 1" wide plastic tape attached to conductors in a readily visible location. Tape colors shall match color requirements specified herein.

B. Branch circuit conductors shall be connected as indicated on the drawings. Common neutrals and ground wires may be pulled in conduits where only opposite phase conductors are run. Conduits shall have a ground wire pulled and shall comply with Article 250 of the National Electrical Code.

C. Conductors within enclosures, i.e., panels, terminal cabinets, control cabinets shall be grouped and laced with nylon tie straps. Conductors within pull boxes shall be grouped and identified with nylon tie straps with circuit identification tag.

D. Splices in conductors shall be made only within junction boxes, wiring troughs and other enclosures as permitted by the National Electrical Code. Do not splice conductors in panelboards, safety switches, or motor control enclosures. Splices in conductors No. 10 AWG or smaller shall be made with Skotchlok insulated spring connectors, Ideal wing nuts, or Ideal steel crimp connectors with wrap-cap insulating caps. Splices in conductors No. 8 AWG and larger shall be made with split bolt connectors taped with No. 88 plastic electrical tape or Ideal Type GP or GT tap connectors and insulating cover unless splices are specifically indicated to be made with crimping sleeve applied to conductors with hydraulic operated crimping tool.

E. Conductors used only for 120 volt control wiring systems shall be minimum No. 14 AWG stranded type MTW 600 volt insulation. Control conductors to be J.I.C. color coded. Where control conductors terminate on terminal strip, make termination with lug applied to conductor with crimping tool.

F. Maintain phase rotation established at service equipment throughout entire project.

G. Pull Wires: 500# minimum test continuous fiber polyline.

H. All conductors shall be copper. Aluminum conductors are not permitted.

END OF SECTION 261000

SECTION 264000 - ELECTRICAL DISTRIBUTION EQUIPMENT

PART 1 - GENERAL

1.1 GENERAL

A. Provide electrical distribution equipment as specified, scheduled or indicated on the approved drawing and these specifications.

PART 2 - PRODUCTS

2.1 PANELBOARDS

A. Panelboards: bolt-in circuit breaker type with a rated main breaker or rated main lugs only as noted on drawings. Interrupting capacity as shown on plans. Multiple breaker shall be common trip type only. Provide GFCI (Ground Fault Circuit Interrupter) breakers where indicated. Panels shall be fully rated, no series ratings are acceptable.

B. End and side gutter shall have minimum clearance as required by the NEC. Depth shall be 5 3/4" minimum.

C. Approved manufacturers are: Square D, Cutler Hammer, and ABB-General Electric.

D. Main lugs of panels or main circuit breaker shall be UL listed for copper or aluminum conductors. Lugs shall be of the proper range for feeder conductors indicated on the drawings.

E. Panels throughout project shall be keyed alike.

F. Provide circuit breakers with trip rating class and poles as indicated on the drawings. Class indicated is designation according to Federal Specification W-C-375b and indicates the frame size and interrupting rating required. Operation of multiple breakers shall be by single handle; tie handles are not acceptable.

G. Circuit breakers used for the control of discharge lighting shall be designated for the purpose and bear the marking "SWD".

2.2 DISCONNECT SWITCHES

A. Provide Heavy Duty, Load Break type Fusible or Non-Fusible disconnect switches for all motors located out of sight of motor controller and where specifically indicated on the drawings. Disconnect switches shall disconnect all underground conductors. When exposed to weather, enclosure shall be NEMA 3R (Raintight); otherwise, enclosure shall

be NEMA-1. Switches shall be installed to be fully accessible in accordance with Article 110-26 of the National Electrical Code.

B. Disconnect switches for single phase motors shall be horsepower rated, motor switches without overload protection, voltage rating as per motor nameplate voltage or greater.

C. Fusible disconnect switch shall disconnect all ungrounded conductors and shall be supplied with the proper sized fuse clips and fuses. Fuse size over frame size will be noted on drawings. Fuses shall be current limiting low peak dual element Type RK-1 fuses.

D. Disconnect switches shall be Square D, Siemens - ITE or Cutler Hammer. All disconnect switches shall be identified in accordance with the "Identification" section of these specifications and Article 110-22 of the National Electrical Code.

2.3 BACKBOARDS

A. Provide backboards for all panels and power distribution equipment and as required by the local inspectors.

B. Backboards: be made of 3/4" FRP grade plywood, supported by an angle iron frame painted light gray.

PART 3 - EXECUTION

3.1 MANUFACTURERS' RECOMMENDATIONS

A. Install electrical distribution equipment in accordance with the manufacturer's recommendations and these specifications.

3.2 PANELBOARDS

A. Identify each circuit protective device with numeral designation, cross referenced with typewritten circuit directory on interior of panel door. Include a copy of each panel directory, reflecting all field changes, in the bound data provided at the time of final inspection.

B. Circuit breakers shall be numbered and connected to panel bus in the following sequence: Circuit 1, Phase A; Circuit 3, Phase B; Circuit 5, Phase C. Where bus diagrams are indicated on the drawings, breakers shall be positioned in panel to conform to diagrams; otherwise, single pole breakers shall occupy top positions in panel with blank spaces in lower positions and two and three pole breakers in between.

C. Conductors within panels shall be grouped and laced with nylon tie straps. Splicing of conductors within panels is not acceptable. Only one conductor shall be installed under terminal of individual circuit breaker.

3.3 FLOOR MOUNTED EQUIPMENT

A. Provide a 4" high concrete housekeeping pad beneath all floor mounted electrical equipment. This pad shall extend 6" beyond the electrical equipment in all directions. All exterior edges on the concrete pad shall be beveled.

B. Enclosure shall be secured to floor by a minimum of four (4) anchoring devices for equipment up to 24” deep and 36” wide and by a minimum of six (6) anchoring devices for larger equipment. Refer to manufacturer recommendation for anchoring.

END OF SECTION 264000

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SECTION 264500 - GROUNDING

PART 1 - GENERAL

1.1 GROUNDING:

A. Grounding shall comply with Article 250 of the National Electrical Code, state and local codes, and the requirements of the utility company serving the site.

B. The building electrical system shall be a grounded wye supplemented with equipment grounding systems. Non-current carrying parts of the electrical system i.e., raceways, equipment enclosures and frames, junction and outlet boxes, machine frames and other conductive items in close proximity with electrical circuits, shall be grounded to provide a low impedance path for potential ground faults.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Ground rods shall be 3/4" copperweld sectional rods 10'-0" in length. Top of the ground rod shall be twelve (12) inches below finished grade. Connection to the ground rod shall be made by chemical weld process. Resistance to ground shall not exceed twenty-five (25) ohms.

B. Grounding conductor: copper sized in accordance with Articles 250-66 of the National Electrical Code.

PART 3 - EXECUTION

3.1 GROUNDING:

A. Ground the neutral conductor of the building electrical system to the metal cold water system and to the ground rod system. Make connections with ground clamp. Install conductor in PVC conduit to point of ground connection. Make connection to the metal cold water pipe of the main metal water line entering the building or the first metal portion of the water line within the building. Install jumper around water meter by approved methods.

B. Provide each panelboard with a copper equipment grounding bar brazed or riveted to the associated enclosures or cabinet and an insulated neutral bar. Braze the related feeder and branch circuit grounding conductors to the grounding bar or connected with pressure connector. The initial panelboard of each separate system served from a system source

or dry type transformer shall have an insulated neutral bar interconnected with the grounding bar to establish the system common ground point.

C. Ground motors by drilling and tapping the bottom of the motor junction box and attaching the conductor to the box with a round head bolt used for no other purpose. Conductor attachment shall be through the use of a lug attached to conductor with crimping tool.

D. Install a grounding conductor in power and lighting conduit installations. All circuit grounding conductors shall be sized per Article 250 of the National Electrical Code.

E. Upon completion of the ground rod installation, test the system by the Afall of potential@ measuring method using a ground resistance test meter and two auxiliary electrodes driven into the earth, interconnected through the meter with the ground rod installation being tested. Placement of the auxiliary electrodes shall be in accordance with operating instructions of the test meter, but in no case shall be placed within the effective resistance area of the system being tested. The effective resistance area shall be considered twice the ground rod length of the ground rod(s) driven. The test shall not be taken within forty-eight (48) hours of rainfall and shall include the data tested and the lowest reading recorded. Test results shall be forwarded, in writing, immediately to the engineer.

END OF SECTION 264500

SECTION 265000 – LIGHTING FIXTURES

PART 1 - GENERAL

1.1 GENERAL

A. Select lighting fixtures from those fixtures included in the fixture schedule. Request for fixtures other than those listed in the fixtures schedule must be submitted in writing at least ten working days prior to opening of bids to the architect with copy to engineer.

B. Request for fixture substitution must be accompanied by construction specifications, photometric test data including foot lambert reading, and complete dimensions. Data for exterior lighting luminaries must also contain isocandle curves and average lumen distribution data.

C. Select fixtures from the fixture schedule not only by catalog number, but with consideration to mounting, number and types of lamps, and reference notes as contained in the fixture schedule and/or drawings.

D. Lamps shall be provided for fixtures in accordance with fixture schedule and/or manufacturer=s recommendations.

E. Plaster frames shall be provided for recessed fixtures as required when installed into gyp ceilings.

F. Verify fixture numbers, before placing order, to assure that fixtures will be furnished with proper frames, fitting, and devices for installation in the ceiling system which is to be installed.

PART 2 - PRODUCTS

2.1 BALLASTS

A. Ballasts provided with fixtures shall be ETL-CBM approved, high power factor, with UL label. Ballasts for rapid start lamps shall be Premium Class P. Ballasts for T-8 lamps shall be electronic. Ballasts shall be for the voltage of the circuit to which connected. Ballasts shall be provided for fluorescent and high intensity discharge lamps. Ballasts shall not be less than or equal to 10% THD.

B. Fluorescent fixtures exposed to outside temperatures shall be provided with 0 degree ballasts.

2.2 LAMPS

A. Provide all lamps for lights on this project. All lamps to be 3500K unless otherwise noted.

B. Lamps shall be Philips, Sylvania or ABB/General Electric.

2.3 LED SOURCES

A. LED light sources shall be rated for operation between -40 degrees Celsius and 50 degree Celsius.

B. Provide CCT (Correlated Color Temperature) as specified in fixture schedule included within contract documents.

C. Fixture CRI (Color Rendering Index) shall meet or exceed that specified in fixture schedule included within contract documents. Where no CRI is scheduled, CRI shall be 80 or greater.

2.4 LED DRIVERS

A. All drivers shall have an operating efficiency meeting or exceeding that of 85%.

B. All drivers shall have a minimum starting temperature of at least -40 degrees Celsius.

C. All drivers shall have a voltage input and phase of that specified in fixture schedule included within contract documents.

D. All drivers shall be rated for operation at 60Hz.

E. All drivers shall have a power factor greater than that of 0.9.

F. All drivers shall have a THD (Total Harmonic Distortion) not exceeding that of 20%.

2.5 LED FIXTURES

A. LED fixtures shall come equipped with integral heat dissipation systems.

B. LED fixtures shall have a minimum service life of 55,000 hours at ambient 25 degrees Celsius operating temperature.

C. LED fixtures shall have LED sources and drivers that are accessible from the exposed side of the fixture and do not require removal of fixture for LED source and/or driver repair/replacement.

PART 3 - EXECUTION

3.1 GENERAL

A. Install lighting fixtures in accordance with the manufacturer's recommendations, as herein specified, or as indicted on the drawings.

B. Hang fluorescent fixtures suspended from ceiling joist by means of fixture chain and approved light support supplied by light manufacturer. Two supports are required for each four (4) foot fixture.

C. Surface and wall mounted emergency lights are to be hung as per approved manufacturers methods for each light.

D. Ceiling grids shall not be used for the sole support of recessed, lay-in type fixtures. Each lay-in type, recessed fixture shall be independently supported from the structure by two #10 hanger wires installed on diagonal corners of the fixture.

E. Provide integral test switch as part of the fixture for lighting fixtures with emergency battery units. Do not use remote test switches.

F. Provide U.L. "FR" Label for recessed lighting fixtures mounted in fire rated ceilings. Construct a fire rated enclosure around the fixture housings using fire rated acoustical ceiling tile.

END OF SECTION 265000

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SECTION 267500 - MISC. SYSTEMS

PART 1 - GENERAL

1.1 SCOPE

A. Provide empty conduit systems as indicated on the drawings and as required by the Data Systems provider.

PART 2 - PRODUCTS

2.1 CONDUIT

A. Conduit shall be as specified under Section 261000, BASIC MATERIALS AND METHODS.

2.2 OUTLET BOXES

A. Outlet boxes shall be as specified under Section 261000, BASIC MATERIALS AND METHODS.

2.3 BACKBOARD

A. Backboards shall be U.S. Plywood or approved equal of minimum 3/4 inch thickness, grade A/D minimum, and installed with good side exposed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Conduits shall contain a nylon pull wire.

B. Provide pullboxes with blank cover plate minimum every 100 feet as directed by Telephone Company.

C. The telephone service shall be installed as indicated on the drawings. Coordinate with the Telephone Company so that the entire system is installed in accordance with the Telephone Company standards and policies.

D. Permanently and securely install backboards and paint with two coats of gray paint on both sides prior to the installation of any equipment.

E. Provide (1) #6 AWG ground wire to each telephone backboard location. The wire shall be connected to the electrical building grounding system.

END OF SECTION 267500

SECTION 311000 – SITE CLEARING

PART 1 - GENERAL

1.1 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.
7. Temporary erosion- and sedimentation-control measures.

1.2 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.

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 defined by a circle concentric with each tree with a radius 1.5 times the diameter of the drip line unless otherwise indicated.

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

1.3 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.

1.4 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.

B. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

C. State of Georgia Notice of Intent (NOI): Contractor shall apply for and have in place an active NOI and Construction Best Management Practices Plan (CBMPP) for the subject project prior to beginning site clearing activities.

1.5 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. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.

C. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

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

E. 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.

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

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

H. 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.

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 or to be relocated. 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.

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.

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 Architect.

3.4 EXISTING UTILITIES

A. Owner will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing, when requested by Contractor.

1. Verify that utilities have been disconnected and capped before proceeding with site clearing.

B. Locate, identify, disconnect, and seal or cap utilities indicated to be removed.

1. Arrange with utility companies to shut off indicated utilities.
2. Owner will arrange to shut off indicated utilities when requested by Contractor.

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

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

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.

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

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

C. 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.
4. Stockpile surplus topsoil to allow for respreading deeper topsoil.

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.

B. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 311000

SECTION 312000 – EARTH MOVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Preparing subgrades for slabs-on-grade walks pavements turf and grasses and plants.
2. Excavating and backfilling for buildings and structures.
3. Drainage course for concrete slabs-on-grade.
4. Subbase course for concrete walks pavements.
5. Subbase course and base course for asphalt paving.
6. Subsurface drainage backfill for walls and trenches.
7. Excavating and backfilling trenches for utilities and pits for buried utility structures.
8. Retain subparagraph below if elevator work includes in-ground cylinder but cylinder excavation (normally part of elevator work) is not part of elevator work.
9. Excavating well hole to accommodate elevator-cylinder assembly.

1.2 UNIT PRICES

A. All excavation is to be unclassified to the “Cut Line” regardless of material encountered.

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 or subgrade 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. Underslab capillary break/leveling 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 Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.
2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by 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, base course, drainage fill, underslab leveling course, or topsoil materials.

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

L. Cut Line: In a cut section, the cut line shall be defined as subgrade elevation or elevation required by other specified hold down, over excavation, trench excavation, subgrade stabilization etc. In a fill section, the cut line shall be defined as the elevation achieved upon completion of all topsoil stripping, grubbing operations, etc. as approved by the owner's onsite geotechnical engineer prior to placing fill material.

M. Subgrade Stabilization: Stabilization of the top 24" of the final subgrade via moisture conditioning and re-compacting of the existing fill or undercutting and replacement of unsuitable materials encountered. This work shall be performed as a part of the base bid contract amount and the allowances established above shall not apply.

1.4 ACTION SUBMITTALS

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

1. Geotextiles.
2. Controlled low-strength material, including design mixture.

B. Samples for Verification: For the following products, in sizes indicated below:

1. Geotextile: 12 by 12 inches.
2. Warning Tape: 12 inches long; of each color.

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. Pre-excavation 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. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

1.7 PROJECT CONDITIONS

A. The contractor shall utilize the recommendations prepared in United Consulting's Geotechnical Report for the City of Tucker Parks and Recreation dated October 23, 2023, and addendum #1 dated March 18, 2024. The specifications shown herein shall serve as supplemental guidance for general site improvements in which the Geotechnical Report does not cover.

B. 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.

C. Utility Locator Service: Notify utility locator service 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. 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.

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

G. 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 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

1. Liquid Limit: 50.
2. Plasticity Index: 25.
3. Maximum dry density greater than 95 pcf.
4. Moisture content: within 3% of optimum per ASTM D-698.

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 3 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: 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. 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.

H. Underslab: Leveling/Capillary Break Course: 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.

I. 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.

J. Sand: ASTM C 33; fine aggregate.

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

2.2 GEOTEXTILES

A. Subsurface Drainage Geotextile: Nonwoven 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. Survivability: Class 2; AASHTO M 288.
2. Grab Tensile Strength: 157 lbf; ASTM D 4632.
3. Sewn Seam Strength: 142 lbf; ASTM D 4632.
4. Tear Strength: 56 lbf; ASTM D 4533.
5. Puncture Strength: 56 lbf; ASTM D 4833.
6. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
7. Permittivity: 0.2 per second, minimum; ASTM D 4491.
8. 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:

2.3 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; colored as follows:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.

4. Blue: Water systems.
5. Green: Sewer systems.

B. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

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 EXPLOSIVES

A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavation to the “Cut Line” shall be unclassified regardless of materials encountered.

B. The contractor should anticipate encountering unsuitable materials including, but not limited to, medium to low consistency fill material, alluvium, etc, both above and below the cut line elevations. Unsuitable material encountered above the cut line shall be removed from the project site as a part of the unclassified base bid amount. Unsuitable material encountered below the cut line elevation shall be undercut and replaced as a part of the quantity allowance/unit prices previously established.

C. Due to limited available working space surrounding the existing and proposed buildings, the contractor must be prepared to construct temporary shoring systems as necessary to install basement walls, utilities, etc. in order to comply with the intent of the design plans. These shoring systems shall be total design build systems provided by the contractor as needed to accommodate his phasing of the work.

D. Where Rock is encountered within 18” of subgrade in paving areas and 36” of subgrade in the building pad area, the cut line shall be 18” below subgrade in paving areas and 36” below subgrade in the building pad area. This over excavation shall be backfilled with select fill material at the direction of the onsite geotechnical engineer.

3.5 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms and sides of excavations to required lines and grades to leave solid base to receive other work and to permit clearance around the reinforcing steel.

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.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

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

3.7 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.

1. Clearance: As indicated.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. For pipes and conduit less than 6 inches in nominal diameter, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe or conduit circumference. Fill depressions with tamped sand backfill.
3. For flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support conduit on an undisturbed subgrade.
4. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

D. Trench Bottoms: Excavate trenches 4 inches deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.

1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

E. Trenches in Tree- and Plant-Protection Zones:

1. Hand-excavate 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. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.

3.8 SUBGRADE INSPECTION

A. Test pits shall be performed per the recommendations of the geotechnical report.

B. Notify Architect when excavations have reached required subgrade.

C. If Geotechnical Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

D. 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 Architect, and replace with compacted backfill or fill as directed.

E. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.

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

3.9 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 Architect.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

3.10 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.

3.11 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.

3.12 UTILITY TRENCH BACKFILL

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

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Section 033001 "Cast-in-Place Concrete - Sitework."

D. Backfill voids with satisfactory soil while removing shoring and bracing.

E. Place and compact initial backfill of subbase material, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.

1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing. Systematic compaction of utility trench backfill and around all below ground structures such as manholes, junction boxes, etc., will be required even if crushed stone is used.

F. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to a height of 12 inches over the pipe or conduit. Coordinate backfilling with utilities testing.

G. Place and compact final backfill of satisfactory soil to final subgrade elevation.

H. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.13 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 and pavements, use satisfactory soil material.
3. Under steps and ramps, use engineered fill.
4. Under building slabs, use engineered fill.
5. Under footings and foundations, use engineered fill.

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

3.14 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 3 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 3 percent and is too wet to compact to specified dry unit weight.

3.15 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.

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 698:

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 92 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.

3.16 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 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.

3.17 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 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 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.

3.18 BASE COURSES UNDER PAVEMENTS AND WALKS

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

B. On prepared subgrade, place 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. Place base course material over subbase course under hot-mix asphalt pavement.
3. Shape base course to required crown elevations and cross-slope grades.
4. Place base course 6 inches or less in compacted thickness in a single layer.
5. Place 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.
6. Compact base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 98 percent of maximum dry unit weight according to ASTM D 1557.

C. Pavement Shoulders: Place shoulders along edges of base course to prevent lateral movement. Construct shoulders, at least 12 inches wide, of satisfactory soil materials and compact simultaneously with each base layer to not less than 98 percent of maximum dry unit weight according to ASTM D 1557.

3.19 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

A. Place drainage course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:

1. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
2. Place drainage course 6 inches or less in compacted thickness in a single layer.
3. Place drainage 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.
4. Compact each layer of drainage course to required cross sections and thicknesses to not less than 98 percent of maximum dry unit weight according to ASTM D 698.

3.20 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
2. Determine that fill material and maximum lift thickness comply with requirements.
3. Determine, at the required frequency, that in-place density of compacted fill complies with requirements.

B. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections. The testing agency will be engaged solely for

the benefit of the owner, and consequently, testing reports generated by the testing agency will be for the sole benefit of the owner. Because quality control is such an important concern, contractors and subcontractors shall develop their own plans and retain their own personnel to achieve it. The testing agency will non be responsible for the contractor's construction methods or for site safety.

C. 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.

D. 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 Architect.

E. 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.

F. 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.

3.21 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 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.

3.22 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.

B. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Architect.

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

END OF SECTION 312000

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SECTION 312301 - EXCAVATING, BACKFILLING, AND COMPACTING FOR STRUCTURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Section includes the excavation, backfilling and compacting required for the structures shown in the Contract Drawings.

1.2 RELATED SECTIONS

A. Section 013330 - Structural Submittals.

B. Section 014525 - Structural Testing/Inspection Agency Services.

1.3 REFERENCES

A. ASTM D422 - Standard Test Method for Particle-Size Analysis of Soils.

B. ASTM D698 - Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3).

C. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.

D. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

E. ASTM D4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

1.4 DEFINITIONS

A. Granular subbase: Granular fill directly beneath slabs-on-grade.

B. Backfill: Fill immediately behind foundation elements or retaining walls.

C. Structural fill: Fill under the structure other than the granular subbase.

1.5 SUBMITTALS

A. Upon request, submit soil test reports performed by the Structural Testing/Inspection Agency.

1.6 QUALITY ASSURANCE

A. Structural Testing/Inspection Agency shall perform the following quality related items:

1. Verify structural fill complies with specifications.
2. Determine particle size, liquid limit, plastic limit, plasticity index and maximum density of each type of soil.
3. Observe proofrolling.
4. Perform a sufficient number of field density tests to verify compaction of structural fill. As a minimum, perform one test per lift for every 2500 square feet of fill placed.
5. Verify foundation bearing capacity.
6. Verify quantities of material removed and quantities of material placed where Unit Prices are involved.

1.7 SURVEY

A. Prior to construction, have structure location staked and certified by a licensed surveyor. If discrepancies between actual lines and elevations exist, notify Design Professional before proceeding with layout of structure.

1.8 SUBSURFACE CONDITIONS

A. Copies of a subsurface investigation of the site will be made available upon request. The data is not intended as a representation or warranty of the continuity of such conditions. Owner will not be responsible for interpretation or conclusions drawn therefrom by the Contractor. The data is made available for the convenience of the Contractor and is not guaranteed to represent all conditions that may be encountered.

B. Contractor may examine the site and make his own subsurface explorations at no additional cost to the Owner. Notify Owner prior to making any subsurface explorations.

1.9 EXISTING UTILITIES

A. Locate existing underground utilities by careful hand excavation. If utilities are to remain in place, provide protection from damage during construction operations.

B. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Do not interrupt existing utility service facilities occupied and used by Owner or others, unless written permission is given by the Design Professional and then only after temporary utility services have been provided.

C. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult the Design Professional immediately for directions.

D. Repair damaged utilities to satisfaction of utility owner.

1.10 NOTICE

A. Notify the Design Professional 48 hours prior to the beginning of any excavation work.

PART 2 - PRODUCTS

2.1 GRANULAR SUBBASE

A. Granular subbase shall be sound and free-draining, such as sand, gravel or crushed stone with less than 10% passing the 200 sieve. Maximum diameter shall be 1-1/2 inches.

2.2 BACKFILL

A. Backfill shall meet the requirements of the granular subbase.

2.3 STRUCTURAL FILL

A. Structural fill shall have a plasticity index less than 30.

B. Structural fill shall be free of organics, debris and deleterious materials.

C. Structural fill shall have a maximum particle size of four inches with no more than 30 percent greater than 3/4"inch.

2.4 GEOTEXTILE FABRIC

A. Geotextile fabric shall be a non-woven fabric such as Trevira 1112 as manufactured by Hoechst Cleanese Corporation or approved equal.

B. Securing pins shall be 18-inch long, 3/16-inch diameter steel bars, pointed at one end and fabricated with a head to retain a steel washer having a minimum outside diameter of 1.5 inches.

PART 3 - EXECUTION

3.1 STRIPPING

A. Strip vegetation, topsoil, roots, and other unsuitable material to a depth determined by the Structural Testing/Inspection Agency but not less than one foot, nor less than 10 feet outside the perimeter of the structure.

B. Stockpile sufficient amounts of topsoil as required to cover areas to be landscaped with a minimum of six inches of material.

3.2 EXCAVATION

A. Excavation shall be considered unclassified.

B. Perform excavation to the depths and limits on the Drawings and as specified herein.

C. Do not excavate to full depth when there is probability of frost forming or ground freezing in excavation before concrete is placed.

D. Under-cut the entire building area to a minimum of 6 feet below the bottom of footing elevation and extending a minimum of 4 feet outside perimeter walls of all structures at the base of the cut.

E. Positive drainage should be maintained at all times to prevent saturation of exposed soils in case of sudden rains.

F. Ground water may be encountered during the foundation excavation. Provide a system for controlling the ground water to a level at least three feet below the lowest point of the excavation.

G. Keep excavations dry by sloping ground away from holes and trenches.

3.3 PROOFROLLING

A. After stripping or excavation and before any fill placement, fill areas shall be proofrolled with a minimum of two coverages of a loaded dump truck or scraper in each of two perpendicular directions.

B. Areas found to be soft or pumping shall have the soft soil removed and replaced with structural fill and compacted as outlined herein.

3.4 PLACEMENT OF STRUCTURAL FILL

A. Do not place structural fill on subgrade that contains frost, mud or is frozen.

B. Structural fill shall be placed and compacted in 8 -inch thick loose layers.

C. Compact structural fill to 98 percent of the maximum dry density as measured by Standard Proctor, ASTM D698, with water content within +3_/-2 percent of the optimum moisture content.

3.5 PLACEMENT OF GEOTEXTILE FABRIC

A. Geotextile fabric shall be installed in the areas designated on the Contract Drawings.

B. Lap fabric edges a minimum of 18 inches.

C. Securing pins shall be used when necessary to ensure proper anchoring of the geotextile fabric.

3.6 PLACEMENT OF GRANULAR SUBBASE

A. Do not place granular subbase on subgrade that contains frost, mud or is frozen.

B. Compact granular subbase to 95 percent of the maximum dry density as measured by Standard Proctor, ASTM D698, with the water content within +3/-2 percent of the optimum moisture content.

3.7 PLACEMENT OF BACKFILL

A. Backfill behind wall shall be placed in layers of six inches.

B. Compact backfill behind walls to 95 percent of the maximum dry density as measured by Standard Proctor, ASTM D698, with water content within +3/-2 percent of the optimum moisture content.

3.8 CLEAN UP

A. Remove excess excavated materials from job site and upon completion leave site in clean condition.

END OF SECTION 312301

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SECTION 312319.16 - DEWATERING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Section includes construction dewatering. Contractor shall be responsible for dewatering system during construction.

1.2 SUBMITTALS

A. Submit work plan in accordance with Section 013300.

B. Shop Drawings: For dewatering system, prepared by or under the supervision of a qualified professional engineer.

1. Include plans, elevations, sections, and details.
2. Show arrangement, locations, and details of wells and well points; locations of risers, headers, filters, pumps, power units, and discharge lines; and means of discharge, control of sediment, and disposal of water.
3. Include layouts of piezometers and flow-measuring devices for monitoring performance of dewatering system.
4. Include written plan for dewatering operations including sequence of well and well-point placement coordinated with excavation shoring and bracings and control procedures to be adopted if dewatering problems arise.

C. Qualification Data: For installer.

D. Field quality-control reports.

E. Existing Conditions: Using photographs, show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by dewatering operations. Submit before Work begins.

F. Record Drawings: Identify locations and depths of capped wells and well points and other abandoned-in-place dewatering equipment.

1.3 QUALITY ASSURANCE

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

1.4 FIELD CONDITIONS

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

1. Make additional test borings and conduct other exploratory operations necessary for dewatering according to the performance requirements.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.

1. Design dewatering system, including comprehensive engineering analysis by a qualified professional engineer.
2. Continuously monitor and maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, prevention of flooding in excavation, and prevention of damage to subgrades and permanent structures.
3. Prevent surface water from entering excavations by grading, dikes, or other means.
4. Accomplish dewatering without damaging existing buildings, structures, and site improvements adjacent to excavation.
5. Remove dewatering system when no longer required for construction unless otherwise instructed by Owner/Engineer.
6. Regulatory Requirements: Comply with governing EPA notification regulations before beginning dewatering. Comply with water and debris-disposal regulations of authorities having jurisdiction.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.

1. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding site or surrounding area.

2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.

B. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

C. Provide temporary grading to facilitate dewatering and control of surface water.

D. Protect and maintain temporary erosion and sedimentation controls, which are specified in other applicable sections of these specifications, during dewatering operations.

3.2 INSTALLATION

A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.

1. Space well points or wells at intervals required to provide sufficient dewatering.
2. Use filters or other means to prevent pumping of fine sands or silts from the subsurface.

B. Place dewatering system into operation to lower water to specified levels before excavating below ground-water level.

C. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.

D. Provide standby equipment on-site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails.

3.3 OPERATION

A. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed or until dewatering is no longer required.

B. Operate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.

1. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.

2. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.
3. Maintain piezometric water level a minimum of 24 inches below bottom of excavation.

C. Dispose of water and sediment removed in conformance with the Georgia Stormwater Conservation Commission “GSWCC” NPDES requirements. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others.

D. Remove dewatering system from Project site on completion of dewatering if required. Plug or fill well holes with sand or cut off and cap wells a minimum of 36 inches below overlying construction.

3.4 FIELD QUALITY CONTROL

A. Observation Wells: Provide observation wells or piezometers, take measurements, and maintain at least the minimum number indicated; additional observation wells may be required by authorities having jurisdiction.

1. Observe and record daily elevation of ground water and piezometric water levels in observation wells.
2. Repair or replace, within 24 hours, observation wells that become inactive, damaged, or destroyed. In areas where observation wells are not functioning properly, suspend construction activities until reliable observations can be made. Add or remove water from observation-well risers to demonstrate that observation wells are functioning properly.
3. Fill observation wells, remove piezometers, and fill holes when dewatering is completed.

B. Survey-Work Benchmarks: Resurvey benchmarks regularly during dewatering and maintain an accurate log of surveyed elevations for comparison with original elevations. Promptly notify Engineer if changes in elevations occur or if cracks, sags, or other damage is evident in adjacent construction.

C. Provide continual observation to ensure that subsurface soils are not being removed by the dewatering operation.

D. Prepare reports of observations.

3.5 PROTECTION

A. Protect and maintain dewatering system during dewatering operations.

B. Promptly repair damages to adjacent facilities caused by dewatering.

1. Dispose of strippings that are unsuitable for topsoil or that exceed quantity required for topsoil offsite.
2. Stockpile topsoil in sufficient quantity to meet Project needs. Dispose of excess strippings as specified for clearing and grubbing.

END OF SECTION 312319.16

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SECTION 312333 – TRENCHING AND BACKFILLING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Clearing and grubbing.

B. Excavation and disposal of all wet and dry materials (including rock) encountered that must be removed for construction purposes.

C. Sheeting, shoring, bracing, and timbering.

D. Dewatering of trenches and other excavations.

E. Pipe bedding.

F. Backfilling and tamping of trenches, foundations, and other structures.

1.2 DEFINITIONS

A. Degree of Compaction: Degree of compaction is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D698, for general soil types, abbreviated as percent laboratory maximum density.

B. Hard Materials: Weathered rock, dense consolidated deposits, or conglomerate materials which are not included in the definition of "rock" but which usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

C. Rock: Solid homogeneous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also large boulders, buried masonry, or concrete other than pavement.

1.3 SUBMITTALS

A. The following shall be submitted in accordance with Section 013300:

B. Preconstruction Submittals - Submit 15 days prior to starting work:

1. Shoring and Sheeting Plan (if required).
2. Dewatering work plan (if required).

C. Test Reports – Submit copies of all laboratory and field test reports within 24 hours of the completion of the test.

1. Borrow Site Testing: Fill and backfill test.
2. Select material test.
3. Porous fill test for capillary water barrier.
4. Density tests.
5. Moisture Content Tests.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Perform in a manner to prevent contamination or segregation of materials.

1.5 REQUIREMENTS FOR OFF SITE SOIL

A. Soils brought in from off site for use as backfill shall be tested for petroleum hydrocarbons, BTEX, PCBs and HW characteristics (including toxicity, ignitability, corrosivity, and reactivity). Backfill shall not contain concentrations of these analytes above the appropriate State and/or EPA criteria, and shall pass the tests for HW characteristics. Determine petroleum hydrocarbon concentrations by using appropriate State protocols. Determine BTEX concentrations by using EPA SW-846.3-3 Method 5035/8260B. Perform complete TCLP in accordance with EPA SW-846.3-3 Method 1311. Perform HW characteristic tests for ignitability, corrosivity, and reactivity in accordance with accepted standard methods. Perform PCB testing in accordance with accepted standard methods for sampling and analysis of bulk solid samples. Provide borrow site testing for petroleum hydrocarbons and BTEX from a grab sample of material from the area most likely to be contaminated at the borrow site (as indicated by visual or olfactory evidence), with at least one test from each borrow site. For each borrow site, provide borrow site testing for HW characteristics from a composite sample of material, collected in accordance with standard soil sampling techniques. Do not bring material onsite until tests results have been received and approved by the Owner.

1.6 FIELD MEASUREMENTS

A. Verify that survey benchmark and intended elevations for the Work are as shown on the drawings.

1.7 COORDINATION

A. Verify work associated with lower elevation utilities is complete before placing higher elevation utilities.

1.8 QUALITY ASSURANCE

A. Shoring and Sheeting Plan: Submit drawings and calculations, certified by a registered professional engineer, describing the methods for shoring and sheeting of excavations. Drawings shall include material sizes and types, arrangement of members, and the sequence and method of installation and removal. Calculations shall include data and references used.

1. The Contractor is required to hire a Professional Geotechnical Engineer to provide inspection of excavations and soil/groundwater conditions throughout construction. The Geotechnical Engineer shall be responsible for performing pre-construction and periodic site visits throughout construction to assess site conditions. The Geotechnical Engineer shall update the excavation, sheeting and dewatering plans as construction progresses to reflect changing conditions and shall submit an updated plan if necessary. A written report shall be submitted, at least monthly, informing the Contractor and Owner of the status of the plan and an accounting of the Contractor's adherence to the plan addressing any present or potential problems.

B. Dewatering Work Plan: Submit procedures for accomplishing dewatering work.

C. Utilities: Movement of construction machinery and equipment over pipes and utilities during construction shall be at the Contractor's risk. Report damage to utility lines or subsurface construction immediately to the Engineer.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. Satisfactory Materials: Any materials classified by ASTM D2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, or SP, free of debris, roots, wood, scrap material, vegetation, refuse, soft unsound particles, and frozen, deleterious, or objectionable materials. Unless specified otherwise, the maximum particle diameter shall be one-half the lift thickness at the intended location.

B. Unsatisfactory Materials: Materials which do not comply with the requirements for satisfactory materials. Unsatisfactory materials also include man-made fills, trash, refuse, or backfills from previous construction. Unsatisfactory material also includes material classified as satisfactory which contains root and other organic matter, frozen material, and stones larger than 3 inches. The Engineer shall be notified of any contaminated materials.

C. Backfill and Fill Material: Provide ASTM D2321 materials as listed in Tables 1, 2, and 3.

D. Topsoil: Provide as specified in Section 329200 – Lawns and Grasses.

2.2 UTILITY BEDDING MATERIAL

A. Provide ASTM D2321 materials as listed in Tables 1, 2, and 3.

2.3 BORROW

A. Obtain borrow materials required in excess of those furnished from excavations from sources outside of Owner's property.

2.4 BURIED WARNING AND IDENTIFICATION TAPE

A. Warning Tape for All Piping: Acid and alkali-resistant polyethylene plastic tape. Minimum thickness of tape shall be 0.003 inch. Provide tape on rolls, 3 inch minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Color and printing shall be permanent, unaffected by moisture or soil. Tape shall have a minimum strength of 1500 psi lengthwise, and 1250 psi crosswise, with a maximum 350 percent elongation.

Warning Tape Color Codes	
Red:	Electric
Yellow:	Gas, Oil; Dangerous Materials
Orange:	Telephone and Other Communications
Blue:	Potable Water Systems
Green:	Sewer Systems
White:	Steam Systems
Gray:	Compressed Air
Purple:	Non Potable, Reclaimed Water, Irrigation and Slurry lines

B. Tracer Wire for Non-Metallic Piping: Tracer wire shall be a #12 AWG (minimum) copper conductor, insulated with a minimum 30 mil, high-density, high molecular weight polyethylene (HDPE) insulation, and rated for direct burial use. HDPE insulation shall be RoHS compliant and utilize virgin grade material.

PART 3 - EXECUTION

3.1 PROTECTION

A. Shoring and Sheeting

1. Take special care to avoid damage wherever excavation is being done. Sufficiently sheet, shore, and brace the sides of all excavations to prevent slides, cave-ins, settlement, or movement of the banks and to maintain the specified

trench widths. Use solid sheets in wet, saturated, or flowing ground. All sheeting, shoring, and bracing shall have enough strength and rigidity to withstand the pressures exerted, to keep the walls of the excavation properly in place, and to protect all persons and property from injury or damage. Separate payment will not be made for sheeting, shoring, and bracing, which are considered an incidental part of the excavation work.

2. Wherever employees may be exposed to moving ground or cave-ins, shore and lay back exposed earth excavation surfaces more than 5 feet high to a stable slope, or else provide some equivalent means of protection. Effectively protect trenches less than 5 feet deep when examination of the ground indicates hazardous ground movement may be expected. Guard the walls and faces of all excavations in which employees are exposed to danger from moving ground by a shoring system, sloping of the ground, or some equivalent protection.
3. Trench excavation safety protection shall be accomplished as required by the most recent provisions of Part 1926, Subpart P - Excavations, Trenching, and Shoring of the Occupational Safety and Health Administration (OSHA) Standards and Interpretations, as may be amended. Comply with all OSHA standards in determining where and in what manner sheeting, shoring, and bracing are to be done. The sheeting, shoring, and bracing system shall be designed by a professional engineer licensed in the State of Georgia and shall be subject to approval by the Engineer. However, such approval does not relieve the Contractor of the sole responsibility for the safety of all employees, the effectiveness of the system, and any damages or injuries resulting from the lack or inadequacy of sheeting, shoring, and bracing.
4. Where excavations are made adjacent to existing buildings or structures or in paved streets or alleys, take particular care to sheet, shore, and brace the sides of the excavation so as to prevent any undermining of or settlement beneath such structures or pavement. Underpin adjacent structures wherever necessary, with the approval of the Engineer.
5. Do not leave sheeting, shoring, or bracing materials in place unless this is called for by the Drawings, ordered by the Engineer, or deemed necessary or advisable for the safety or protection of the new or existing work or features. Remove these materials in such a manner that the new structure or any existing structures or property, whether public or private, will not be endangered or damaged and that cave-ins and slides are avoided.
6. Fill and compact all holes and voids left in the work by the removal of sheeting, shoring, or bracing as specified herein.
7. The Contractor may use a trench box, which is a prefabricated movable trench shield composed of steel plates welded to a heavy steel frame. The trench box shall be designed to provide protection equal to or greater than that of an appropriate shoring system.
8. A “Qualified Person”, as defined by OSHA regulations, shall be on-site at all times during activities requiring trench safety provisions.

B. Drainage and Dewatering

1. Provide for the collection and disposal of surface and subsurface water encountered during construction.

2. Drainage: So that construction operations progress successfully, completely drain construction site during periods of construction to keep soil materials sufficiently dry. Where applicable, the Contractor shall establish/construct storm drainage features (ponds/basins) at the earliest stages of site development and throughout construction grade the construction area to provide positive surface water runoff away from the construction activity and/or provide temporary ditches, swales, and other drainage features and equipment as required to maintain dry soils, prevent erosion and undermining of foundations]. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified herein. It is the responsibility of the Contractor to assess the soil and ground water conditions presented by the plans and specifications and to employ necessary measures to permit construction to proceed. Excavated slopes and backfill surfaces shall be protected to prevent erosion and sloughing. Excavation shall be performed so that the site, the area immediately surrounding the site, and the area affecting operations at the site shall be continually and effectively drained.
3. Dewatering:

    a. Groundwater flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. French drains, sumps, ditches or trenches will not be permitted within 3 feet of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Control measures shall be taken by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. While the excavation is open, the water level shall be maintained continuously, at least 2 feet below the working level.
    b. Operate dewatering system continuously until construction work below existing water levels is complete. Submit performance records weekly.

C. Underground Utilities

1. Location of the existing utilities indicated is approximate. The Contractor shall physically verify the location and elevation of all existing utilities prior to starting construction. The Contractor shall contact the Georgia 811, City of Tucker Public Works, Dekalb County Water and Sewer and any other affected utilities for assistance in locating existing utilities.

D. Machinery and Equipment: Movement of construction machinery and equipment over pipes during construction shall be at the Contractor's risk. Repair, or remove and provide new pipe for existing or newly installed pipe that has been displaced or damaged.

3.2 SURFACE PREPARATION

A. Clear and grub project area in accordance with Section 311000 – Site Clearing.

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

C. Protect plant life, lawns, and other features remaining as part of final landscaping.

D. Maintain and protect above and below grade utilities which are to remain.

3.3 EXCAVATION

A. Excavate to contours, elevation, and dimensions indicated. Reuse excavated materials that meet the specified requirements for the material type required at the intended location. Keep excavations free from water. Excavate soil disturbed or weakened by Contractor's operations, soils softened or made unsuitable for subsequent construction due to exposure to weather. Excavations below indicated depths will not be permitted except to remove unsatisfactory material.

1. Blasting: Where permitted and allowed by the Owner and Engineer as an acceptable trenching option, blasting shall be performed in accordance with appropriate criteria established by the National Fire Protection Association and all Local, County, State, and Federal codes and ordinances. The Contractor shall be responsible for obtaining all permits at no cost to the Owner. Blasting for utility excavation must be done in such a manner as to minimize the fracturing of rock beyond the required excavation. The Contractor shall consider the elevation of utilities in relation to the blasting charge and the relative alignment of existing and proposed trenches. Blasting within such areas shall be accomplished only by qualified Contractors who hold blasting licenses from a qualified agency. Any damage to existing utilities resulting from blasting shall be repaired at the Contractor’s expense. Sand shall not be used for bedding for backfill in trenches that have been blasted.

B. Wherever muck, quicksand, soft clay, swampy ground, or other material unsuitable for foundations, subgrade, or backfilling is encountered, remove it and continue excavation until suitable material is encountered. The material removed shall be disposed of in the manner described below. Then refill the areas excavated for this reason with 1 inch to 2 inch sized crushed stone up to the level of the lines, grades, and/or cross sections shown on the Drawings. The top 6 inches of this refill shall be No. 67 ASTM D2321 Class I crushed stone for bedding

C. Unless specified otherwise, refill excavations cut below indicated depth with backfill and fill material and compact to 95 percent of ASTM D698 maximum density. Satisfactory material removed below the depths indicated, without specific direction of the Engineer, shall be replaced with satisfactory materials to the indicated excavation grade. Determination of elevations and measurements of approved overdepth excavation of unsatisfactory material below grades indicated shall be done under the direction of the Engineer.

D. Pipe Trenches:

1. Unless the construction of lines by tunneling, jacking, or boring is called for by the Drawings or specifically authorized by the Engineer, make excavation for pipelines in open cut and true to the lines and grades shown on the Drawings or established

by the Engineer on the ground. Cut the banks of trenches between vertical parallel planes equidistant from the pipe centerline. The horizontal distance between the vertical planes (or, if sheeting is used, between the inside faces of that sheeting) shall vary with the size of the pipe to be installed, but shall not be more than the distance determined by the following formula: 4/3d + 15 inches, where "d" represents the internal diameter of the pipe in inches. When approved in writing by the Engineer, the banks of trenches from the ground surface down to a depth not closer than 1 foot above the top of the pipe may be excavated to nonvertical and nonparallel planes, provided the excavation below that depth is made with vertical and parallel sides equidistant from the pipe centerline in accordance with the formula given above. Any cut made in excess of the formula 4/3d + 15 inches shall be at the expense of the Contractor and may be cause for the Engineer to require that stronger pipe and/or a higher class of bedding be used at no cost to the Owner.

2. Grade bottom of trenches to provide uniform support for each section of pipe after pipe bedding placement. Tamp if necessary to provide a firm pipe bed. Recesses shall be excavated to accommodate bells and joints so that pipe will be uniformly supported for the entire length. Rock, where encountered, shall be excavated to a depth of at least 6 inches below the bottom of the pipe.
3. Excavate bell holes for bell and spigot pipe at proper intervals so that the barrel of the pipe will rest for its entire length upon the bottom of the trench. Bell holes shall be large enough to permit proper jointing of the pipe. Do not excavate bell holes more than 2 joints ahead of pipe laying.
4. Provide minimum depths of “Bedding Material” as defined in Tables 1, 2, and 3.
5. Do not excavate pipe trenches more than 200 feet ahead of the pipe laying, and perform all work so as to cause the least possible inconvenience to the public. Construct temporary bridges or crossings when and where the Engineer deems necessary to maintain vehicular or pedestrian traffic.
6. In all cases where materials are deposited along open trenches, place them so that in the event of rain no damage will result to the work and/or to adjacent property.

E. Hard Material and Rock

1. Any material that is encountered within the limits of the required excavation that cannot be removed except by drilling and/or blasting, including rock, boulders, masonry, hard pan, chert, shale, street and sidewalk pavements, and/or similar materials, shall be considered as unclassified excavation, and no separate payment will be made therefor.
2. Should rock be encountered in the excavation, remove it by blasting or other methods. Where blasts are made, cover the excavation with enough excavation material and/or timber or steel matting to prevent danger to life and property. The Contractor shall secure, at his own expense, all permits required by law for blasting operations and the additional hazard insurance required. Observe all applicable laws and ordinances pertaining to blasting operations.
3. Excavate rock over the horizontal limits of excavation and to a depth of not less than 6 inches below the bottom of pipe up to 30 inches in diameter and not less than 12 inches below the bottom of larger pipes if rock extends to such depth. Then backfill the space below grade with No. 67 ASTM D2321 Class I crushed

stone or other approved material, tamp to the proper grade, and make ready for construction.

F. Excavated Materials

1. Satisfactory excavated material required for fill or backfill shall be placed in the proper section of the permanent work required or shall be separately stockpiled if it cannot be readily placed. Satisfactory material in excess of that required for the permanent work and all unsatisfactory material shall be disposed of as specified in Paragraph "DISPOSITION OF SURPLUS MATERIAL."

3.4 FILLING AND BACKFILLING

A. Fill and backfill to contours, elevations, and dimensions indicated. Compact each lift before placing overlaying lift.

B. Backfill and Fill Material Placement For Utilities

1. Begin backfilling after the line construction is completed and then inspected and approved by the Engineer. Place this backfill simultaneously on either side of the pipe in even layers that before compaction are no more than 6 inches deep. Thoroughly and completely tamp each layer into place before placing additional layers.

C. At locations of improvements subject to damage by displacement, tamp and thoroughly compact the backfill in layers that, before compaction, are 6 inches deep. In other areas, the backfill for the upper portion of the trenches may be placed without tamping but shall be compacted to a density equivalent to that of adjacent earth material as determined by laboratory tests. Use special care to prevent the operation of backfilling equipment from causing any damage to the pipe.

D. If earth material for backfill is, in the opinion of the Engineer, too dry to allow thorough compaction, then add enough water so that the backfill can be properly compacted. Do not place earth material that the Engineer considers too wet or otherwise unsuitable.

E. Wherever excavation has been made within easements across private property, the top 1 foot of backfill material shall consist of topsoil, as defined in Section 329300 – Trees Plants and Ground Covers.

F. Wherever trenches have been cut across or along existing pavement and driveways, including gravel or dirt drives, temporarily pave the backfill of such trenches by placing ASTM D2321 Class I crushed stone as the top 12 inches of the backfill. Maintain this temporary pavement either until the permanent pavement is restored or until the project is accepted by the Owner.

G. Conduct backfilling around manholes, inlets, outfalls, and/or structures in the same manner as specified above for pipelines except that even greater care is necessary to prevent damage to the utility structure.

H. Do not use power operated tampers to tamp that portion of the backfill around the pipe within 1 foot above the pipe.

I. Perform backfilling so as not to disturb or injure any pipe and/or structure against which the backfill is being placed. If any pipe or structure is damaged and/or displaced during backfilling, open up the backfill and make whatever repairs are necessary, whenever directed to do so by the Engineer.

J. Backfilling and clean-up operations shall closely follow pipe laying; failure to comply with this provision will result in the Engineer's requiring that the Contractor's other activities be suspended until backfilling and clean-up operations catch up with pipe laying.

K. Compaction Requirements: Under buildings and 2 times the depth of pipe beyond, and under roads and 2 times the depth beyond the shoulder, compact to 98 percent maximum density in accordance with ASTM D698. In all other locations, compact to 95 percent maximum density.

3.5 BORROW

A. Whenever the backfill of excavated areas or the placement of embankments requires more material than is available from authorized excavations, or whenever the backfill material from such excavations is unsuitable, then obtain additional material from other sources. This may require the opening of borrow pits at points accessible to the work. In such cases, make suitable arrangements with the property owner and pay all incidental costs, including any royalties, for the use of the borrowed material. Before a borrow pit is opened, the quality and suitability of its material shall be approved by the Engineer.

B. Excavate borrow pits in such a way that the remaining surfaces and slopes are reasonably smooth and that adequate drainage is provided over the entire area. Construct drainage ditches wherever necessary to provide outlets for water to the nearest natural channel, thus preventing the formation of pools in the pit area. Leave the sides of borrow pit cuts at a maximum slope of 2:1 unless otherwise directed by the Engineer.

C. Properly clear and grub borrow pits, and remove all objectionable matter from the borrow pit material before placing it in the backfill.

D. The taking of materials from borrow pits for use in the construction of backfill, fills, or embankments shall be considered an incidental part of the work; no separate payment shall be made for this.

3.6 BURIED WARNING AND IDENTIFICATION TAPE

A. Provide buried utility lines with utility identification tape. Bury tape 12 inches below finished grade; under pavements and slabs, bury tape 6 inches below top of subgrade.

3.7 BURIED DETECTION WIRE

A. Tape detection wire directly to non-metallic piping. The wire shall extend continuously and unbroken, from manhole to manhole, or valve box to valve box. The ends of the wire shall terminate inside the manholes at each end of the pipe, with a minimum of 3 feet of wire, coiled, remaining accessible in each manhole or valve box. The wire shall remain insulated over its entire length. The wire shall enter manholes between the top of the corbel and the frame, and extend up through the chimney seal between the frame and the chimney seal. For water and force mains, the wire shall terminate in a valve pit at the end of the pipe.

3.8 FINISH OPERATIONS

A. Grading: Finish grades as indicated within one-tenth of one foot. Grade areas to drain water away from structures. Maintain areas free of trash and debris. For existing grades that will remain but which were disturbed by Contractor's operations, grade as directed.

B. Protection of Surfaces: Protect newly backfilled, graded, and topsoiled areas from traffic, erosion, and settlements that may occur. Repair or reestablish damaged grades, elevations, or slopes.

3.9 DISPOSITION OF SURPLUS MATERIAL

A. Whenever practicable, all materials removed by excavation that are suitable for backfilling pipe trenches or for other purposes shown on the Drawings or directed by the Engineer shall be used for these purposes. Any materials not so used shall be considered waste materials and disposed of by the Contractor as specified below.

B. Once any part of the work is completed, properly dispose of all surplus or unused materials (including waste materials) left within the construction limits of that work. The Contractor shall dispose of these surplus and waste materials off-site in an appropriate manner in conformity with pertinent codes and ordinances. Leave the surface of the work in a neat and workmanlike condition, as described below.

C. The disposal of waste materials shall be considered an integral part of the excavation work and one for which no separate payment shall be allowed.

3.10 FIELD QUALITY CONTROL

A. Sampling: Take the number and size of samples required to perform the following tests.

B. Testing: Perform one of each of the following tests for each material used. Provide additional tests for each source change.

1. Bedding Material and Fill and Backfill Material Testing: Test fill and backfill material in accordance with ASTM C136 for conformance to ASTM D2487 gradation limits; ASTM D1140 for material finer than the No. 200 sieve; ASTM

D4318 for liquid limit and for plastic limit; ASTM D698 or ASTM D1557 for moisture density relations, as applicable.

2. Density Tests: Test density in accordance with ASTM D1556, or ASTM D6938. When ASTM D6938 density tests are used, verify density test results by performing an ASTM D1556 density test at a location already ASTM D6938 tested as specified herein. Perform an ASTM D1556 density test at the start of the job, and for every 10 ASTM D6938 density tests thereafter. Test each lift at randomly selected locations with one test per 400 linear feet in each lift.

Table 1: Backfilling and Compaction of Trenches for Pressure Pipes in Unimproved Areas

	Depth			**Material****			
Layer*	≤15”Ø	18”-38”Ø	>38”Ø	DIP	PVC	HDPE	Conc
A	4” min	6” min	12” min	I B	II	II	I B
B1	½ OD			III	II	II	III
B2	½ OD			III	II	II	III
C	6”			III	II	II	III
D	6”			IV A	II	II	IV A
E	Varies			IV A	IV A	IV A	IV A
F	12”			As specified in Section 329200			

*See Figure 1.
**Bedding material to be used in wet conditions for all layers.

Table 2: Backfilling and Compaction of Trenches for Gravity Lines in Unimproved Areas

	Depth			**Material****			
Layer*	≤15”Ø	18”-38”Ø	>38”Ø	DIP	PVC	HDPE	Conc
A	4” min	6” min	12” min	I B	II	II	I B
B1	½ OD			I B	II	II	I B
B2	½ OD			III	II	II	III
C	6”			III	II	II	III
D	6”			IV A	II	II	IV A
E	Varies			IV A	IV A	IV A	IV A
F	12”			As specified in Section 329200			

*See Figure 1.
**Bedding material to be used in wet conditions for all layers.

Table 3: Backfilling and Compaction of Trenches in Paved Areas

	Depth			**Material**			
Layer*	≤15”Ø	18”-38”Ø	>38”Ø	DIP	PVC	HDPE	Conc
A	4” min	6” min	12” min	I B	II	II	I B
B1	½ OD			I B	II	II	I B
B2	½ OD			I B	II	II	I B
C	6”			I B	II	II	I B
D	6”			I B	II	II	I B

Layer*	Depth			Material			
	≤15”Ø	18”-38”Ø	>38”Ø	DIP	PVC	HDPE	Conc
E	Varies			I B	II	II	I B
F	12”			As required for pavement base			

*See Figure 1.

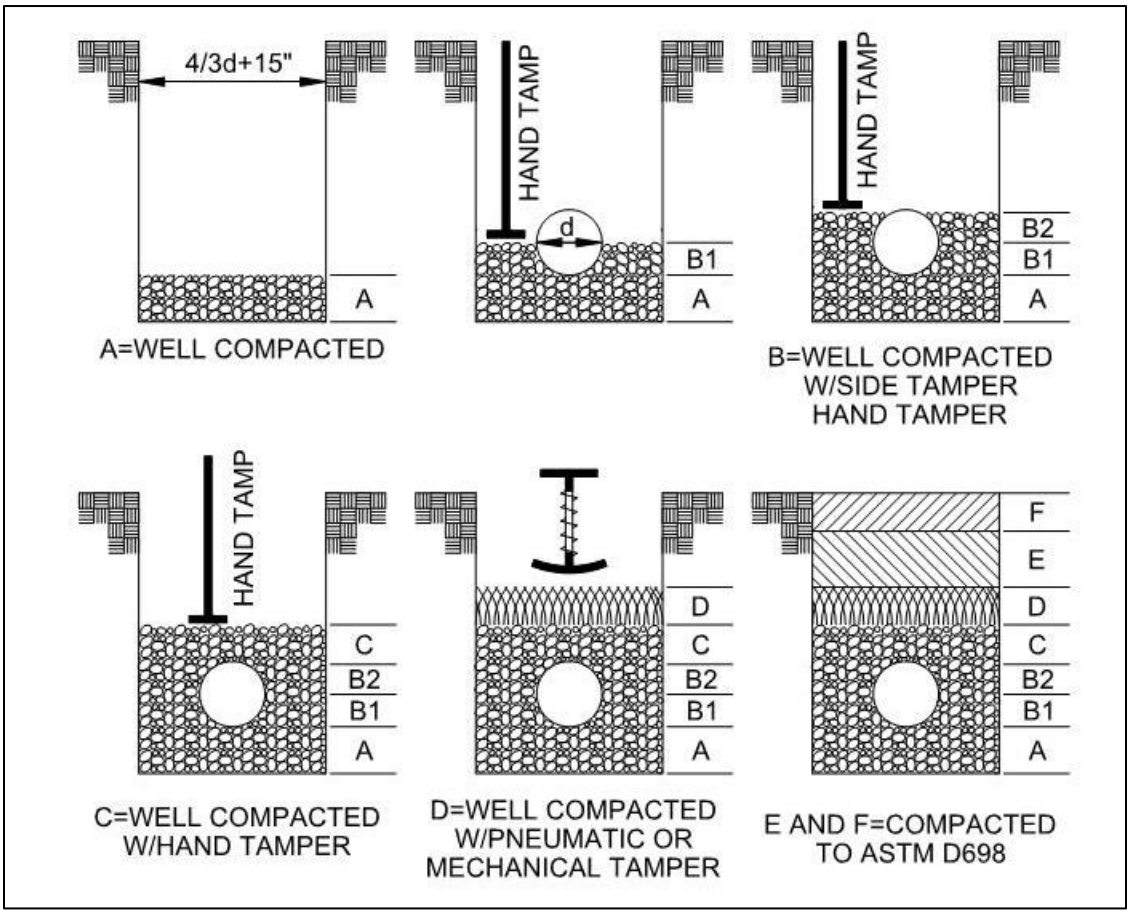

Figure 1: Backfilling and Compaction of Trenches

END OF SECTION 312333

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SECTION 321113 – SUBGRADE MODIFICATIONS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Preparation of the subgrade, including compacting to the required density and shaping to conform to the required lines, grades, and cross sections.

1.2 QUALITY ASSURANCE

A. Labor: Use adequate numbers of skilled laborers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with specified requirements and the methods needed for proper performance of the Work of this section.

B. Equipment: Use equipment adequate in size, capacity, and numbers to accomplish the work of this Section in a timely manner.

C. Codes and Standards: Perform construction of subgrade in compliance with applicable ordinance of governing authorities having jurisdiction.

1. In addition to complying with codes and standards having jurisdiction, comply with the geotechnical engineering report.
2. Conduct all operations in accordance with the applicable requirements of erosion control as shown on the Drawings and Specifications and as required by local authorities.

D. The Contractor shall provide necessary measures for storm water pollution control and water quality protection. The Contractor shall meet the standards of good housekeeping at all times.

E. Testing and Inspection Services: The Owner will engage a qualified soil testing and inspection service for quality control testing during earthwork operations. Testing shall be performed in accordance with the soil investigation reports and testing standards, the instructions of the Engineer and the applicable sections of General Conditions.

F. Survey: The Contractor shall employ the services of a licensed surveyor for the purposes of survey control, layout, grade and cross-sections required to control work.

1.3 SUBMITTALS

A. Conform to provisions of Section 013300.

B. Product Data:

1. Sources of imported materials.

1.4 DELIVERY, HANDLING, AND STORAGE

A. Delivery: All materials, tools, equipment, etc. to be delivered to the job-site, in such a manner coordinated with progress of work of this section.

B. Material Storage: Stockpile satisfactory excavated materials where directed, until required for backfill or dispose off-site. Place, grade and shape stockpiles for proper drainage.

1. Locate and retain soil materials away from edge of excavations. Do not store within drip line of trees indicated to remain.
2. Dispose of excess soil material and waste materials as herein specified.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 SUBGRADE PREPARATION

A. Proof Rolling: Finish proof rolling on an exposed subgrade free of surface water (wet conditions resulting from rainfall) which would promote degradation of an otherwise acceptable subgrade. After stripping, proof roll the existing subgrade of with six passes of a dump truck loaded with 4 cubic yards of soil. Operate the truck in a systematic manner to ensure the number of passes over all areas, and at speeds between 2-1/2 to 3-1/2 mph. When proof rolling, provide one-half of the passes made with the roller in a direction perpendicular to the other passes. Notify the Engineer a minimum of 3 days prior to proof rolling. Perform proof rolling in the presence of the Engineer. Undercut rutting or pumping of material as directed by the Engineer and replace with fill and backfill material.

B. Construction

1. Before starting the construction of the base course, pavement, or surface, prepare the subgrade to the full width of the widest course plus 1 foot of additional width beyond each edge, unless otherwise shown on the Drawings.
2. Shape subgrade to line, grade, and cross section, and compact as specified. Include plowing, disking, and any moistening or aerating required to obtain specified compaction for this operation. Remove soft or otherwise unsatisfactory material and replace with satisfactory excavated material or other approved material as directed. Excavate rock encountered in the cut section to a depth of 6 inches below finished grade for the subgrade. Bring up low areas resulting from removal of unsatisfactory material or excavation of rock to required grade with

satisfactory materials, and shape the entire subgrade to line, grade, and cross section and compact as specified. After rolling, the surface of the subgrade for roadways shall not show deviations greater than 1/2 inch when tested with a 12-foot straightedge applied both parallel and at right angles to the centerline of the area. Do not vary the elevation of the finish subgrade more than 0.05 foot from the established grade and cross section.

3. When using a sheepsfoot roller, finish the compaction with either a 3 wheel roller or a multiple wheel, pneumatic tired roller heavy enough to smooth out and compact the indentations made by the sheepsfoot roller.
4. When excess dust is present on the subgrade, either wet it or completely remove and replace with suitable material before placing any aggregate on the subgrade, and do so at no additional cost to the Owner.
5. Operate a grading machine over all subgrades as necessary to maintain a uniform cross section that is free from irregularities. Prepare all subgrades far enough ahead of the base course or pavement construction to permit the necessary testing and checking of the subgrade before any aggregate is placed. Furnish the templates and labor required for checking the subgrade.
6. Complete all ditches and drains in order to drain the subgrade effectively before any construction materials are placed thereon. Take every precaution to protect the subgrade and repair and restore to proper condition all damage that may be caused by the hauling of material or by other causes; place no material on any subgrade until it has been restored and is accepted by the Owner's Representative.
7. Equipment used for hauling materials over the completed subgrade shall be equipped with pneumatic tires. Operate no equipment over the subgrade that is of such weight as to cause rutting.

C. Compaction

1. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Except for paved areas, compact each layer of the embankment to at least 90 percent of laboratory maximum density.
2. Subgrade for Pavements: Compact subgrade for pavements to at least 98 percentage laboratory maximum density for the depth below the surface of the pavement shown. When more than one soil classification is present in the subgrade, thoroughly blend, reshape, and compact the top 12 inch of subgrade.
3. Subgrade for Shoulders: Compact subgrade for shoulders to at least 98 percentage laboratory maximum density for the full depth of the shoulder.

3.2 SHOULDER CONSTRUCTION

A. Construct shoulders of satisfactory excavated or borrow material or as otherwise shown or specified. Submit advanced notice on shoulder construction for rigid pavements. Construct shoulders immediately after adjacent paving is complete. In the case of rigid pavements, do not construct shoulders until permission of the Engineer has been obtained. Compact the entire shoulder area to at least the percentage of maximum density as specified in paragraph SUBGRADE PREPARATION above, for specific

ranges of depth below the surface of the shoulder. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Finish shoulder construction in proper sequence in such a manner that adjacent ditches will be drained effectively and that no damage of any kind is done to the adjacent completed pavement. Align the completed shoulders true to grade and shaped to drain in conformity with the cross section shown.

3.3 FINISHING

A. Finish the surface of subgrades to a smooth and compact surface in accordance with the lines, grades, and cross sections or elevations shown. Finish gutters and ditches in a manner that will result in effective drainage.

B. Subgrade: During construction, keep embankments and excavations shaped and drained. Maintain ditches and drains along subgrade to drain effectively at all times. Do not disturb the finished subgrade by traffic or other operation. Protect and maintain the finished subgrade in a satisfactory condition until ballast, subbase, base, or pavement is placed. Do not permit the storage or stockpiling of materials on the finished subgrade.

C. Do not lay subbase, base course, ballast, or pavement until the subgrade has been checked and approved, and in no case place subbase, base, surfacing, pavement, or ballast on a muddy, spongy, or frozen subgrade.

3.4 TESTING

A. Determine field in-place density in accordance with ASTM D6938. When ASTM D6938 is used, check the calibration curves and adjust using only the sand cone method as described in ASTM D1556. ASTM D6938 results in a wet unit weight of soil in determining the moisture content of the soil when using this method.

B. Check the calibration curves furnished with the moisture gauges along with density calibration checks as described in ASTM D6938; check the calibration of both the density and moisture gauges at the beginning of a job on each different type of material encountered and at intervals as directed by the Engineer. When test results indicate that compaction is not as specified, remove the material, replace and recompact to meet specification requirements.

C. Perform tests on recompacted areas to determine conformance with specification requirements. Appoint a registered professional civil engineer to certify inspections and test results. These certifications shall state that the tests and observations were performed by or under the direct supervision of the engineer and that the results are representative of the materials or conditions being certified by the tests. The following number of tests, if performed at the appropriate time, will be the minimum acceptable for each type operation.

1. Fill and Backfill Material Gradation: One test per 1000 cubic yards stockpiled or in-place source material. Determine gradation of fill and backfill material in accordance with ASTM C136.

2. In-Place Densities

    a. One test per 2500 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by other than hand-operated machines.
    b. One test per 2500 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by hand-operated machines.
    c. One test per 500 linear feet, or fraction thereof, of each lift of embankment or backfill for roads.

3. Check Tests on In-Place Densities: If ASTM D6938 is used, check in-place densities by ASTM D1556 as follows:

    a. One check test per lift for each 2500 square feet, or fraction thereof, of each lift of fill or backfill compacted by other than hand-operated machines.
    b. One check test per lift for each 2500 square feet, of fill or backfill areas compacted by hand-operated machines.
    c. One check test per lift for each 2500 linear feet, or fraction thereof, of embankment or backfill for roads.

4. Moisture Contents: In the stockpile, excavation, or borrow areas, perform a minimum of two tests per day per type of material or source of material being placed during stable weather conditions. During unstable weather, perform tests as dictated by local conditions and approved by the Engineer.
5. Optimum Moisture and Laboratory Maximum Density: Perform tests for each type material or source of material including borrow material to determine the optimum moisture and laboratory maximum density values. One representative test per 100 cubic yards of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density.
6. Tolerance Tests for Subgrades: Perform continuous checks on the degree of finish specified in paragraph SUBGRADE PREPARATION during construction of the subgrades.

END OF SECTION 321113

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SECTION 321116.16 – AGGREGATE SUBBASE COURSE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Furnish and install select-material base course for rigid pavement and select-material subbase course for flexible pavement and pervious pavement systems.

1.2 SUBMITTALS

A. Submit the following in accordance with Section 013300:

B. Product Data:

1. Materials
2. Geotextile

C. Design Data: Gradation curve.

D. Test Reports

1. Bearing ratio
2. Liquid limit
3. Plasticity index
4. Dry weight of slag
5. Percentage of wear
6. Gradation tests
7. Density tests

E. Certificates: Source location and name.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Inspect materials delivered to the site and store aggregates in a manner that will prevent segregation and contamination.

1.4 CONSTRUCTION EQUIPMENT

A. Subject to approval of the Engineer, special equipment as dictated by local conditions may be used.

B. Calibrated equipment, such as scales, batching equipment, spreaders, and other similar equipment, shall have been calibrated by within 12 months of commencing work.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Do not construct course when atmospheric temperature is below 35 degrees F or when weather conditions could detrimentally affect quality of finished course. When temperature falls below 35 degrees F, protect areas of completed course against freezing.

PART 2 - PRODUCTS

2.1 MATERIALS

A. ASTM D2940/D2940M, except as modified herein.

B. Material shall consist of natural, processed or blends of waste concrete, masonry, cement, tile, or other waste material from on-site work as specified; rock, crushed concrete, concrete block, or crushed slag from off-site grading or demolition work; recycled porcelain, concrete, stone, or other recycled material complying with ASTM D6155; Class II Fill tire complying with ASTM D6270; steel slag complying with ASTM D5106; gravel; stone; slag; chert; caliche; limerock; coral; shell; quarry and mine waste; sand; or screenings; and soil or other similar binding or filler material.

C. Obtain materials from sources approved by the Engineer. Preliminary approval of pits shall not mean that material found in the deposit will be acceptable. Maximum dimensions of material particles shall not be greater than two-thirds the compacted thickness of the layer in which it is to be placed.

1. Coarse aggregate shall have a percentage of wear of not more than 40 as determined by ASTM C131/C131M. Material shall have a bearing ratio of at least 30 as determined by laboratory test on a four day soaked specimen in accordance with ASTM D1883; compact the specimen in accordance with ASTM D1557, Method B, C, or D. Material passing the No. 40 sieve shall have a liquid limit of not more than 25 and a plasticity index of not more than 5 in accordance with ASTM D4318.
2. Slag shall be an air-cooled blast furnace product having a dry weight not less than 65 pounds per cubic foot when tested in accordance with ASTM C29/C29M and consisting of angular fragments uniform in density and quality and reasonably free from thin and elongated pieces, dirt, or other objectionable material.
3. Gradation of the final composite mixture shall conform to the following size and shall be the basis of the gradation curve:

Sieve Size (Square Openings)	Design Range (Percent Passing)	Job Mix Tolerance (Percent)
2 inch	100	-3
1 1/2 inch	90-100	+5
No. 4	30-60	+10
No. 200	0-15	+5

2.2 SOURCE QUALITY CONTROL

A. Prior to production and delivery of aggregates, take at least one initial sample in accordance with ASTM D75/D75M. Collect each sample by taking three incremental samples at random from source material to make a composite sample of not less than 50 pounds. Repeat sampling procedure when source of material is changed or when deficiencies or variations from specified grading of materials are found in testing.

PART 3 - EXECUTION

3.1 GRADE CONTROL

A. Provide line and grade stakes for control.

B. Place grade stakes in lanes parallel to centerline of areas to be paved and space for string lining or other control methods.

3.2 PLACING AND MIXING

A. Clean underlying surface of foreign substances and ensure proper compaction and smoothness before placement of course.

B. Verify subsoils have a permeability between 0.5 and 3.0 inches per hour.

C. Recondition, reshape, and recompact areas damaged by freezing, rainfall, or other weather conditions. Place geotextiles in accordance with specifications and drawings.

D. Mix and place materials to obtain a uniform course for the water content and gradation specified. Construct course in one or more layers. Make each layer between 3 and 8 inches in compacted thickness. If used, recycled tires shall be installed in accordance with ASTM D6270.

3.3 COMPACTING AND FINISHING

A. Compact each layer to at least 100 percent of the maximum laboratory density determined in accordance with ASTM D1557 for areas subject to heavy vehicular traffic. Compact each layer to at least 95 percent Standard Proctor Density per ASTM D698 for pedestrian areas.

B. Compact material inaccessible to rolling equipment by mechanical tamping.

C. Finish surface of the layer by blading and rolling. Blade, roll, and tamp until surface is smooth and free from waves and irregularities.

D. Aerate material excessively moistened by rain during construction. Aerate using blade graders, harrows, or other equipment until the moisture content is that needed to obtain specified density.

E. Place and compact earth at edges of course for at least one foot of the shoulder.

3.4 FIELD QUALITY CONTROL

A. Sampling During Construction: Take one random sample of each 1000 tons of material placed, but not less than one random sample per day's run. Take samples in accordance with ASTM D75/D75M.

B. Testing:

1. Material: Make gradation tests from each sample in accordance with ASTM C136/C136M. Determine material passing the No. 200 sieve in accordance with ASTM C117.
2. Smoothness Test: Test with a 10 foot straightedge applied parallel with and at right angles to centerline of the rolled area. Correct surface deviations in excess of 3/8 inch by loosening, adding or removing material, reshaping, watering, and compacting. When course is constructed in more than one layer, smoothness requirements apply only to the top layer.
3. Field Density Tests: ASTM D1556/D1556M or ASTM D6938. Take one field density test for each 500 square yards of each layer of course. When using ASTM D6938 to test field compaction densities, verify the results of the tests by performing one test per day using ASTM D1556/D1556M at locations previously tested by ASTM D6938 and one additional test using ASTM D1556/D1556M for every ten tests performed at locations previously tested by ASTM D6938.
4. Laboratory Density Tests: ASTM D1557, Method B, C, or D, for all material.
5. Thickness Test: Determine thickness of course from test holes not less than 3 inches in diameter. Obtain a thickness test for each 500 square yards of course. Where course deficiency is more than 1/2 inch, correct by scarifying, adding mixture of proper gradation, reblading, and recompacting. Where the measured thickness exceeds the indicated thickness by more than 1/2 inch, consider the measured thickness as the indicated or specified thickness plus 1/2 inch for determining the average. The average thickness shall be the average of the depth measurements and shall not underrun the thickness shown by more than 1/4 inch.

3.5 MAINTENANCE

A. After construction is completed, protect and maintain all areas of course against detrimental effects. Maintenance includes drainage, rolling, shaping, watering, or other

action required to maintain course in proper condition. Maintain sufficient moisture by light sprinkling with water at the surface to prevent a dusty condition.

END OF SECTION 321116.16

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SECTION 321123 – AGGREGATE BASE COURSE

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Aggregate base courses for roadway construction, including materials, placement, and quality control

1.2 REFERENCES

A. Georgia Department of Transportation (GDOT) Standard Specifications for Construction of Transportation Systems.

1.3 DEFINITIONS

A. Completed Course: Compacted, unyielding, free from irregularities, with smooth, tight, even surface, true to grade, line, and cross-section.

B. Completed Lift: Compacted with uniform cross-section thickness.

1.4 SUBMITTALS

A. Informational Submittals:

1. Certified Test Results on Source Materials: Submit copies from commercial testing laboratory 14 days prior to delivery of materials to Project showing materials meeting the physical qualities specified.
2. Certified results of in-place density tests from independent testing agency.

PART 2 - PRODUCTS

2.1 BASE COURSE

A. Group 1 Graded Aggregate as specified in Section 310 of the Georgia Department of Transportation Standard Specifications for Construction of Transportation Systems.

2.2 SOURCE QUALITY CONTROL

A. Perform tests necessary to locate acceptable source of materials meeting specified requirements.

B. Final approval of aggregate material will be based on test results of installed materials.

C. Should separation of coarse from fine materials occur during processing or stockpiling, immediately change methods of handling materials to correct uniformity in grading.

PART 3 - EXECUTION

3.1 SUBGRADE PREPARATION

A. As Specified in Section 312000 – Earth Moving.

B. Obtain Engineer's acceptance of subgrade before placing base course or surfacing material.

C. Do not place base course or surfacing materials on soft, muddy, or frozen subgrade.

3.2 EQUIPMENT

A. Compaction Equipment: Adequate in design and number to provide compaction and to obtain specified density for each layer.

3.3 HAULING AND SPREADING

A. Hauling Materials:

1. Do not haul over surfacing in process of construction.
2. Loads: Of uniform capacity.
3. Maintain consistent gradation of material delivered; loads of widely varying gradations will be cause for rejection.

B. Spreading Materials:

1. Distribute material to provide required density, depth, grade, and dimensions with allowance for subsequent lifts.
2. Produce even distribution of material upon roadway or prepared surface without segregation.
3. Should segregation of coarse from fine materials occur during placing, immediately change methods of handling materials to correct uniformity in grading.

3.4 CONSTRUCTION OF COURSES

A. Untreated Aggregate Base Course:

1. Maximum Completed Lift Thickness: 6 inches.
2. Completed Course Total Thickness: As shown in the design Drawings.
3. Spread lift on preceding course to required cross-section.
4. Lightly blade and roll surface until thoroughly compacted.
5. Add keystone to achieve compaction and as required when aggregate does not compact readily due to lack of fines or natural cementing properties, as follows:

    a. Spread evenly on top of base course, using spreader boxes or chip spreaders.
    b. Roll surface until keystone is worked into interstices of base course without excessive displacement.
    c. Continue operation until course has become thoroughly keyed, compacted, and will not creep or move under roller.

6. Blade or broom surface to maintain true line, grade, and cross-section.

3.5 ROLLING AND COMPACTION

A. Commence compaction of each layer of base after spreading operations and continue until density of 98 percent of maximum density has been achieved.

B. Roll each layer of material until material does not creep under roller before succeeding layer is applied.

C. Commence rolling at outer edges and continue toward center; do not roll center of road first.

D. Apply water as needed to obtain specified densities.

E. Place and compact each lift to required density before succeeding lift is placed.

F. Remove floating or loose stone from surface of preceding course before placing leveling course.

G. Surface Defects: Remedy by loosening and rerolling. Reroll entire area, including surrounding surface, until thoroughly compacted.

H. Finished surface shall be true to grade and crown before proceeding with surfacing.

3.6 SURFACE TOLERANCES

A. Blade or otherwise work surfacing as necessary to maintain grade and cross-section at all times, and to keep surface smooth and thoroughly compacted.

B. Finished Surface of Untreated Aggregate Base Course: Within plus or minus 0.04 foot of grade shown at any individual point.

C. Overall Average: Within plus or minus 0.02 foot from crown and grade specified.

3.7 FIELD QUALITY CONTROL

A. In-Place Density Tests:

1. Provide Engineer and testing laboratory at least 24 hours advance notification prior to testing.
2. Show proof that areas meet specified requirements before requesting that Engineer identify density test locations.
3. Refer to Table 1 for minimum sampling and testing requirements for aggregate base course and surfacing.

Table 1
Minimum Sampling and Testing Requirements

Property	Test Method	Frequency	Sampling Point
Gradation		One Sample every 500 tons but at least every 4 hours of production	Roadbed after processing
Moisture Density (Maximum Density)		One test for every aggregate grading produced	Production output or stockpile
In-place Density and Moisture Content		One for each 500 ton but at least every 10,000 sq ft of area	In-place completed, compacted area

3.8 CLEANING

A. Remove excess material from the Work area. Clean stockpile and staging areas of all excess aggregate.

END OF SECTION 321123

SECTION 321313 - CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Driveways.
2. Roadways.
3. Parking lots.
4. Curbs and gutters.
5. Walks.

1.2 REFERENCE

A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirement shall govern.

1. American Concrete Institute (ACI): 325.9R: Guide for Construction of Concrete Pavements and Concrete Bases.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.4 SUBMITTALS

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

B. Shop Drawings:

1. Joint plan, showing type and location, no smaller than the scale of the construction documents.
2. Joint details, including dowels where appropriate.

C. Samples for Initial Selection: For each type of product, ingredient, or admixture requiring color selection.

D. Samples for Verification: For each type of product or exposed finish, prepared as Samples of size indicated below:

1. Exposed Aggregate: 10-lb Sample of each mix.

E. 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.

F. Qualification Data: For qualified ready-mix concrete manufacturer if requested.

G. Material Certificates: For the following, from manufacturer, if requested:

1. Cementitious materials.
2. Steel reinforcement and reinforcement accessories.
3. Fiber reinforcement.
4. Admixtures.
5. Curing compounds.
6. Applied finish materials.
7. Bonding agent or epoxy adhesive.
8. Joint fillers.

H. Material Test Reports: For each of the following:

1. Aggregates, if requested.

I. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94 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.

E. ACI Publications: Comply with ACI 301 unless otherwise indicated.

F. 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 Owner and not less than 96 inches by 96 inches.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless the Owner specifically approves such deviations in writing.
4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

G. Pre-installation Conference: Conduct conference at Project site if requested.

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. Ready-mix concrete manufacturer.
d. Concrete paving subcontractor.
e. Manufacturer's representative of stamped concrete paving system used for detectable warnings.

1.6 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. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.

1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less.

B. 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. Recycled Content: Provide steel reinforcement with an average recycled content of steel so postconsumer recycled content plus one-half of pre-consumer recycled content is not less than 25 percent.

B. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from steel wire into flat sheets.

C. Deformed-Steel Welded Wire Reinforcement: ASTM A 497, flat sheet.

D. Epoxy-Coated Welded Wire Reinforcement: ASTM A 884, Class A, plain steel.

E. Reinforcing Bars: ASTM A 615, Grade 60 (Grade 420); deformed.

F. Galvanized Reinforcing Bars: ASTM A 767, Class II zinc coated, hot-dip galvanized after fabrication and bending; with ASTM A 615, Grade 60 (Grade 420) deformed bars.

G. Epoxy-Coated Reinforcing Bars: ASTM A 775 or ASTM A 934; with ASTM A 615, Grade 60 (Grade 420) deformed bars.

H. Steel Bar Mats: ASTM A 184; with ASTM A 615, Grade 60 (Grade 420), deformed bars; assembled with clips.

I. Plain-Steel Wire: ASTM A 82.

J. Deformed-Steel Wire: ASTM A 496.

K. Epoxy-Coated-Steel Wire: ASTM A 884, Class A coated.

L. Joint Dowel Bars: ASTM A 615, Grade 60 (Grade 420) plain-steel bars. Cut bars true to length with ends square and free of burrs.

M. Epoxy-Coated, Joint Dowel Bars: ASTM A 775; with ASTM A 615, Grade 60 (Grade 420), plain-steel bars.

N. Tie Bars: ASTM A 615, Grade 60 (Grade 420), deformed.

O. Hook Bolts: ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6), internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

P. 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.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

Q. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.

R. 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, gray Portland cement Type I or Type III. Supplement with the following as appropriate:

   a. Fly Ash: ASTM C 618, Class C or Class F.
   b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

2. Blended Hydraulic Cement: ASTM C 595 cement.

B. Normal-Weight Aggregates: ASTM C 33, uniformly graded. Provide aggregates from a single source with documented service-record data of satisfactory service in similar paving applications and service conditions using similar aggregates and cementitious materials.

1. Maximum Coarse-Aggregate Size: Per State Department of Transportation requirements.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Exposed Aggregate: Selected, hard, and durable; washed; free of materials with deleterious reactivity to cement or that cause staining; from a single source, with gap-graded coarse aggregate as follows:

1. Aggregate Sizes: Per State Department of Transportation requirements.

D. Water: Potable and complying with ASTM C 94.

E. Air-Entraining Admixture: ASTM C 260.

F. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

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

G. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.

1. Manufacturers: See Drawings for Materials Schedule (L7.00) & list of approved colors and integral color manufacturers.
2. Color: As selected by Owner from manufacturer's full range.

2.4 FIBER REINFORCEMENT

A. Synthetic Fiber: Monofilament or fibrillated polypropylene fibers engineered and designed for use in concrete paving, complying with ASTM C 1116, Type III, 1/2 to 1-1/2 inches long.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Monofilament Fibers:

1) Axim Italcementi Group, Inc.; FIBRASOL II P.
2) Euclid Chemical Company (The), an RPM company; Fiberstrand 100, Fiberstrand 150.
3) FORTA Corporation.
4) Grace, W. R. & Co. - Conn.; Grace MicroFiber.
5) Metalcrete Industries; Polystrand 1000.
6) QC Construction Products; QC FIBERS.

b. Fibrillated Fibers:

1) Axim Italcementi Group, Inc.; FIBRASOL F.
2) Euclid Chemical Company (The), an RPM company; Fiberstrand F.
3) FORTA Corporation.
4) Grace, W. R. & Co. - Conn.; Grace Fibers.
5) Propex Concrete Systems Corp.; Fibermesh 300.

2.5 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, burlap cloth made from jute or kenaf, dry or cotton mats.

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.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Axim Italcementi Group, Inc.; Caltexol CIMFILM.
b. BASF Construction Chemicals, LLC; Confilm.
c. ChemMasters; Spray-Film.
d. Conspec by Dayton Superior; Aquafilm.
e. Dayton Superior Corporation; Sure Film (J-74).
f. Edoco by Dayton Superior; BurkeFilm.
g. Euclid Chemical Company (The), an RPM company; Eucobar.
h. Kaufman Products, Inc.; VaporAid.
i. Lambert Corporation; LAMBCO Skin.
j. L&M Construction Chemicals, Inc.; E-CON.
k. Meadows, W. R., Inc.; EVAPRE.
l. Metalcrete Industries; Waterhold.
m. Nox-Crete Products Group; MONOFILM.
n. Sika Corporation, Inc.; SikaFilm.
o. SpecChem, LLC; Spec Film.
p. Symons by Dayton Superior; Finishing Aid.
q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
r. Unitex; PRO-FILM.
s. Vexcon Chemicals Inc.; Certi-Vex EnvioAssist.

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

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Anti-Hydro International, Inc.; A-H Curing Compound #2 DR WB.
b. ChemMasters; Safe-Cure Clear.
c. Conspec by Dayton Superior.
d. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
e. Edoco by Dayton Superior.
f. Euclid Chemical Company (The), an RPM company; Kurez W VOX.
g. Kaufman Products, Inc.; Thinfilm 420.

h. Lambert Corporation; AQUA KURE - CLEAR.
i. L&M Construction Chemicals, Inc.; L&M CURE R.
j. Meadows, W. R., Inc.; 1100-CLEAR SERIES.
k. Nox-Crete Products Group; Resin Cure E.
l. SpecChem, LLC; PaveCure Rez.
m. Symons by Dayton Superior; Resi-Chem Clear.
n. Tamms Industries, Inc., Euclid Chemical Company (The); TAMMSCURE WB 30C.
o. TK Products, Division of Sierra Corporation.
p. Vexcon Chemicals Inc.; Certi-Vex Enviocure 100.

F. White, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B, dissipating.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Anti-Hydro International, Inc.; A-H Curing Compound #2 WP WB.
b. ChemMasters; Safe-Cure 2000.
c. Conspec by Dayton Superior.
d. Dayton Superior Corporation; Day-Chem White Pigmented Cure (J-10-W).
e. Edoco by Dayton Superior; Resin Emulsion Cure V.O.C. (Type II).
f. Euclid Chemical Company (The), an RPM company; Kurez VOX White Pigmented.
g. Kaufman Products, Inc.; Thinfilm 450.
h. Lambert Corporation; AQUA KURE - WHITE.
i. L&M Construction Chemicals, Inc.; L&M CURE R-2.
j. Meadows, W. R., Inc.; 1100-WHITE SERIES.
k. SpecChem, LLC; PaveCure Rez White.
l. Symons by Dayton Superior; Resi-Chem White.
m. Vexcon Chemicals Inc.; Certi-Vex Enviocure White 100.

2.6 RELATED MATERIALS

A. Joint Fillers: ASTM D 1751 Type II, asphalt-saturated cellulosic fiber in preformed strips.

1. Premolded filler shall be one piece for the full depth and width of the joint leaving a sealant recess as indicated on the Drawings.
2. Use of multiple pieces of lesser dimensions to make up the required depth and width of the joint will not be permitted.
3. Except as otherwise noted on the Drawings, joint filler shall be ½ inch thick

B. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.

C. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin capable of humid curing and bonding to damp surfaces; of class suitable for application temperature, of grade complying with requirements, and of the following types:

1. Types I and II, non-load bearing or Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

E. Chemical Surface Retarder: Water-soluble, liquid, set retarder with color dye, for horizontal concrete surface application, capable of temporarily delaying final hardening of concrete to a depth of 1/8 to 1/4 inch.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. ChemMasters; Exposee.
b. Conspec by Dayton Superior; Delay S.
c. Dayton Superior Corporation; Sure Etch (J-73).
d. Edoco by Dayton Superior; True Etch Surface Retarder.
e. Euclid Chemical Company (The), an RPM company; Surface Retarder Formula S.
f. Kaufman Products, Inc.; Expose.
g. Meadows, W. R., Inc.; TOP-STOP.
h. Metalcrete Industries; Surftard.
i. Nox-Crete Products Group; CRETE-NOX TA.
j. Scofield, L. M. Company; LITHOTEX Top Surface Retarder.
k. Sika Corporation, Inc.; Rugasol-S.
l. SpecChem, LLC; Spec Etch.
m. TK Products, Division of Sierra Corporation; TK-6000 Concrete Surface Retarder.
n. Unitex; TOP-ETCH Surface Retarder.
o. Vexcon Chemicals Inc.; Certi-Vex Envioset.

F. Pigmented Mineral Dry-Shake Hardener: Factory-packaged, dry combination of portland cement, graded quartz aggregate, color pigments, and plasticizing admixture. Use color pigments that are finely ground, nonfading mineral oxides interground with cement.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Anti-Hydro International, Inc.; A-H S-Q Hardener.
b. BASF Construction Chemicals, LLC; Mastercron.
c. ChemMasters; ConColor.
d. Conspec by Dayton Superior; Conshake 600 Colortone.
e. Dayton Superior Corporation; Quartz Tuff.
f. Euclid Chemical Company (The), an RPM company; Surflex.

g. Lambert Corporation; COLORHARD.
h. L&M Construction Chemicals, Inc.; QUARTZPLATE FF.
i. Metalcrete Industries; Floor Quartz.
j. Scofield, L. M. Company; LITHOCHROME Color Hardener.
k. Southern Color N.A., Inc.; Mosaics Color Hardener.
l. Stampcrete International, Ltd.; Color Hardener.
m. Symons by Dayton Superior; Hard Top.

2. Color: As selected by Owner from manufacturer's full range.

G. Rock Salt: Sodium chloride crystals, kiln dried, coarse gradation with 100 percent passing 3/8-inch sieve and 85 percent retained on a No. 8 sieve.

2.7 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: 0.50.
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: 4.0 to 5.5 percent.

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 admixtures 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.

F. Cementitious Materials: Limit percentage by weight of cementitious materials other than portland cement according to ACI 301 requirements as follows:

1. Fly Ash or Pozzolan: 25 percent.

2. Ground Granulated Blast-Furnace Slag: 50 percent.
3. Combined Fly Ash or Pozzolan, and Ground Granulated Blast-Furnace Slag: 50 percent, with fly ash or pozzolan not exceeding 25 percent.

G. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate for application and performance required.

H. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.8 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94 and ASTM C 1116. Furnish batch certificates for each batch discharged and used in the Work.

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

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94. 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.

2.9 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

3.2 AGGREGATE BASE COURSE

A. Aggregate base course for paving and the spreading, grading and compaction methods employed shall conform to standard requirements for usual base course of this type for first class road work and the following:

1. GDOT Specification Section 310, Graded Aggregate Construction.

B. Compaction of aggregate base course shall be to 95% of maximum density as determined by ASTM D 1557, Method D. Stone greater than 2-1/2 inches shall be excluded from course.

C. Width of base course shall be greater than or equal to the width of pavement surface, if continuous lateral support is provided during rolling, and shall extend at least 2 x base thickness beyond the edge of the course above, if not so supported.

D. Aggregate material shall be applied in lifts less than or equal to 6 inches thick, compacted measure. Each lift shall be separately compacted to specified density, using a 6-ton steel wheel roller or vibratory roller equivalent to a 6 ton static roller, or an approved equivalent. Completely proof-roll subbase and base course in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 MPH.

E. Material shall be placed adjacent to wall, manhole, catch basin and other structures only after they have been set to required grade and level.

F. Rolling shall begin at sides and progress to center of crowned areas and shall begin on low side and progress toward high side of sloped areas. Rolling shall continue until material does not creep or wave ahead of roller wheels.

G. Surface irregularities (pumping or rutting) which exceed ½ inch measured by means of a 10 foot long straightedge shall be corrected according to the requirements in Division 31 Section “Earth Moving.”

H. Proceed with installation only after unsatisfactory conditions have been corrected.

I. Subgrade and base course shall be kept clean and uncontaminated. Less select materials shall not be permitted to become mixed with gravel. Materials spilled outside pavement lines shall be removed and area repaired.

J. Portions of subgrade or of construction above which become contaminated, softened or dislodged by passing of traffic, or otherwise damaged, shall be cleaned, replaced and otherwise repaired to conform to the requirements of the specification before proceeding with the next operation.

3.3 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.4 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.

3.5 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.

F. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963.

G. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

3.6 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. Butt Joints: Use bonding agent or epoxy bonding adhesive at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
4. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
5. 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. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, buildings, and other fixed objects, and where indicated.

1. Locate expansion joints at intervals shown on the drawings.
2. Extend joint fillers full width and depth of joint.
3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.

5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
6. 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. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas at maximum spacing of 15 ft. on center each way. Complete contraction jointing within twelve hours of concrete placement

E. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:

1. Grooved Joints: As soon as concrete can be worked without raveling, form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 3/8-inch maximum radius. Repeat grooving of contraction joints after applying surface finishes.

    a. Tolerance: Ensure that grooved joints are within 2 inches either way from centers of dowels.

2. Sawed Joints: As soon as concrete can be worked without raveling, form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

    a. Tolerance: Ensure that sawed joints are within 2 inches either way from centers of dowels.

3. Doweled Contraction 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.

F. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 3/8-inch maximum radius. Repeat tooling of edges after applying surface finishes.

3.7 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. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.

K. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.

1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

L. 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.

M. 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.

3.8 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. 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.

1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
2. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.
3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.

3.9 SPECIAL FINISHES

A. Monolithic Exposed-Aggregate Finish: Expose coarse aggregate in paving surface as follows:

1. Immediately after float finishing, spray-apply chemical surface retarder to paving according to manufacturer's written instructions.
2. Cover paving surface with plastic sheeting, sealing laps with tape, and remove when ready to continue finishing operations.
3. Without dislodging aggregate, remove mortar concealing the aggregate by lightly brushing surface with a stiff, nylon-bristle broom. Do not expose more than one-third of the average diameter of the aggregate and not more than one-half of the diameter of the smallest aggregate.
4. Fine-spray surface with water and brush. Repeat cycle of water flushing and brushing until cement film is removed from aggregate surfaces to depth required.

B. Seeded Exposed-Aggregate Finish: Immediately after initial floating, spread a single layer of aggregate uniformly on paving surface. Tamp aggregate into plastic concrete and float finish to entirely embed aggregate with mortar cover of 1/16 inch.

1. Spray-apply chemical surface retarder to paving according to manufacturer's written instructions.
2. Cover paving surface with plastic sheeting, sealing laps with tape, and remove sheeting when ready to continue finishing operations.
3. Without dislodging aggregate, remove mortar concealing the aggregate by lightly brushing surface with a stiff, nylon-bristle broom. Do not expose more than one-third of the average diameter of the aggregate and not more than one-half of the diameter of the smallest aggregate.
4. Fine-spray surface with water and brush. Repeat cycle of water flushing and brushing until cement film is removed from aggregate surfaces to depth required.

C. Slip-Resistive Aggregate Finish: Before final floating, spread slip-resistive aggregate finish on paving surface according to manufacturer's written instructions and as follows:

1. Uniformly spread slip-resistive aggregate over paving surface at the recommended rate in two applications. Tamp aggregate flush with surface using a steel trowel, but do not force below surface.
2. Uniformly distribute approximately two-thirds of slip-resistive aggregate over paving surface with mechanical spreader, allow to absorb moisture, and embed by power floating. Follow power floating with a second slip-resistive aggregate application, uniformly distributing remainder of material at right angles to first application to ensure uniform coverage, and embed by power floating.
3. Cure concrete with curing compound recommended by slip-resistive aggregate manufacturer. Apply curing compound immediately after final finishing.
4. After curing, lightly work surface with a steel wire brush or abrasive stone and water to expose nonslip aggregate.

D. Rock-Salt Finish: After initial floating, uniformly spread rock salt over paving surface at the rate of 5 lb/100 sq. ft.

1. Embed rock salt into plastic concrete with roller or float.
2. Cover paving surface with 1-mil- thick polyethylene sheet and remove sheet when concrete has hardened and seven-day curing period has elapsed.
3. After seven-day curing period, saturate concrete with water and broom-sweep surface to dissolve remaining rock salt, thereby leaving pits and holes.

E. Pigmented Mineral Dry-Shake Hardener Finish: After initial floating, apply dry-shake materials to paving surface according to manufacturer's written instructions and as follows:

1. Uniformly spread dry-shake hardener at a rate recommended by manufacturer to match paving color required.
2. Uniformly distribute approximately two-thirds of dry-shake hardener over the concrete surface with mechanical spreader; allow hardener to absorb moisture and embed it by power floating. Follow power floating with a second application of pigmented mineral dry-shake hardener, uniformly distributing remainder of material at right angles to first application to ensure uniform color, and embed hardener by final power floating.
3. After final power floating, apply a hand-trowel finish followed by a broom finish.

4. Cure concrete with curing compound recommended by dry-shake hardener manufacturer. Apply curing compound immediately after final finishing.

3.10 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, 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 occurring during installation or curing period using cover material and waterproof tape.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas that have been subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

3.11 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:

1. Elevation: 3/4 inch.
2. Thickness: Plus 3/8 inch, minus 1/4 inch.
3. Surface: Gap below 10-foot long, unleveled straightedge not to exceed 1/2 inch.

4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches of tie bar.
5. Lateral Alignment and Spacing of Dowels: 1 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. Contraction Joint Depth: Plus 1/4 inch, no minus.
10. Joint Width: Plus 1/8 inch, no minus.

3.12 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least one month. Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

C. Install semi-rigid joint filler. Overfill joint and trim joint filler flush with top of joint after hardening.

3.13 FIELD QUALITY CONTROL

A. Testing Agency: Owner will 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 5000 sq. ft. 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; 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; 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; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39; 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 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 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 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.

3.14 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 Architect.

B. Drill test cores, where directed by 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 321313

SECTION 321314 - EXPOSED AGGREGATE CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all equipment and materials and do all work necessary to construct the “Top Cast” exposed aggregate concrete paving work, complete, as indicated on the Drawings and as specified.

1.2 REFERENCES

A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirement shall govern.

1. American Concrete Institute (ACI):
   - 305R Hot Weather Concreting
   - 306R Cold Weather Concreting
   - 325.9R Guide for Construction of Concrete Pavements and Concrete Bases.

2. American Society for Testing and Materials (ASTM):
   - A 185 Welded Steel Wire Fabric for Concrete Reinforcement
   - C 33 Concrete Aggregates
   - C 94 Ready-Mixed Concrete
   - C 143 Slump of Portland Cement Concrete
   - C 150 Portland Cement
   - C 171 Sheet Materials for Curing Concrete
   - C 231 Air Content of Freshly Mixed Concrete by the Pressure Method
   - C 260 Air Entraining Admixtures for Concrete
   - C 309 Liquid Membrane-Forming Compounds for Curing Concrete
   - C 494 Chemical Admixtures for Concrete
   - C 920 Elastomeric Joint Sealants
   - C 962 Guide for Use of Elastomeric Joint Sealants
   - D 226 Asphalt-Saturated Organic Roofing Felt for Use in Membrane Waterproofing and Built-Up Roofing
   - D 1557 Moisture - Density Relations of Soils and Soil Aggregate Mixtures Using 10 lb. Rammer and 18-in. Drop
   - D 1752 Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

3. Americans with Disabilities Act (ADA):
   - Appendix to Part 1191 Accessibility Guidelines for Buildings and Facilities

4. State of Georgia Department of Transportation (GDOT):
   Specifications Standard Specifications Highways and Bridges

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products who complies with ASTM C 94/C 94M requirements for production facilities and equipment and has a minimum 10 years' experience in the production of specified products.

   1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

B. Installer Qualifications: Installer shall have a minimum 10 years' experience installing cast-in-place concrete for projects and elements of similar scope and complexity.

   1. Installer shall submit project names and addresses, including architect name if applicable, for five (5) projects completed within last 5 years of similar scope and complexity.

C. ACI Publications: Unless otherwise specified, work and materials for construction of the Portland cement concrete paving shall conform to ACI 325.9R.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1.

   1. Before submitting design mixtures, review concrete pavement mixture design and examine procedures for ensuring quality of concrete materials and concrete pavement construction practices. Require representatives, including the following, of each entity directly concerned with concrete pavement, to attend conference:

      a. Contractor's superintendent.
      b. Independent testing agency responsible for concrete design mixtures.
      c. Ready-mix concrete producer.

E. Paving work, base course etc., shall be done only after excavation and construction work which might injure them have been completed. Damage caused during construction shall be repaired before acceptance.

F. Existing paving areas shall, if damaged or removed during course of this project, be repaired or replaced under this section of the specification. Workmanship and materials for such repair and replacement, except as otherwise noted, shall match as closely as possible those employed in existing work.

G. Pavement, base, or subbase shall not be placed on a muddy or frozen subgrade.

1.4 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

1.5 PRECONSTRUCTION MOCK-UP PANELS

A. General

1. Schedule mock-up casting for acceptance 30 days prior to casting of concrete surfaces represented by the mockups.
2. Locate mock-up panels in non-public areas accepted by the Architect.
3. Continue to cast mock-ups until acceptable mock-ups area produced. Accepted mock-ups shall be the standard for color, texture, aggregate mix, surface retarding, curing, sealing and workmanship for the work.
4. Mock-up sequence of forming, placing, form removal, curing, and finishing shall be reviewed and accepted by the Architect.
5. Mock-up formwork shall be inspected and accepted by the Architect before placing of concrete.
6. Use the same concrete mixes and placement procedures, accepted in mock-ups, in the final work, unless otherwise directed by the Architect.
7. Protect accepted mock-ups from damage until completion and acceptance of the work represented by the mock-up.
8. Remove mock-up panels from site at completion of project, as directed by the Architect.

B. Construct mock-up panels or areas as indicated to demonstrate the ability to cast concrete for exposed aggregate concrete paving to achieve shape, color, jointing and exposed aggregate textured finish required. Tamping or vibrating shall be minimized to allow coarse aggregate to remain near the surface. Mock-ups shall include or meet the following requirements:

1. Typical walks: Provide mock-up panel 5 ft. x 10 ft. size, full depth.
2. Plaza Paving: Provide mock-up panel 10 ft. wide x 20 ft. long size, full depth.
3. Provide mock-ups simulating actual design and execution conditions for concrete mix materials, reinforcement, formwork, placing sequence, form removal, curing, finishing, and methods and materials of stain removal and correction of defective work.
4. On mock-ups where directed by the Architect, provide minimum of three variation of mix color to be used in the repair of defective work, in order to determine acceptable color and texture match.
5. Demonstrate in the construction of the mock-up formwork the sealer material, form release agent, and curing materials and methods to be used.
6. Include control joints and expansion joints with joint sealer.

C. Source of Materials. Utilize the same source, stock, or brand of concrete materials for each class or mix of concrete which is to be exposed. Do not interchange materials or mixes until an additional mock-up shows that uniformity in finish texture and color, as

compared to original mock-up will be maintained. If necessary, obtain and stockpile materials in sufficient quantity to ensure continuity and uniformity.

1.6 SUBMITTALS

A. Description of Methods and Sequence of Placement. For each type of specially-finished concrete provide description of methods and sequence of placement.

B. Manufacturers' product data shall be submitted for the following items:

1. Admixtures
2. Aggregate, including sieve analysis
3. Concrete sealer
4. Curing material
5. Preformed joint filler
6. Form release agent
7. Surface retarder
8. Sealants
9. Fiber reinforcement

C. Shop drawings of exposed aggregate paving shall be submitted. Drawings shall indicate expansion joint and control joint locations.

D. Submit samples of the following:

1. Preformed joint filler, two pieces, full depth and width, 4 in. length.
2. Color chart for selection of sealant color.
3. A 10 lb. minimum sample of aggregate proposed for use in the exposed aggregate paving mix shall be submitted for approval. Accompanying the sample shall be information from the aggregate supplier indicating source, type, color, and gradation of aggregate.

E. Material Certificates: Signed by manufacturers certifying that each of the following materials complies with requirements:

1. Cementitious materials.
2. Steel reinforcement and reinforcement accessories.
3. Admixtures.
4. Curing compounds.
5. Applied finish materials.
6. Bonding agent or epoxy adhesive.
7. Joint fillers.

F. Field quality-control test reports.

G. Minutes of preinstallation conference.

1.7 TESTING

A. Inspection and testing of the concrete mix will be performed by an independent testing laboratory selected by, engaged by, and responsible to the Architect. Testing equipment shall be supplied by the laboratory, and the preparation of samples and all testing shall be performed by the laboratory personnel.

1. Concrete materials and operations will be tested and inspected as work progresses. Failure to detect any defective work or material shall not in any way prevent later rejection when such defect is discovered, nor shall it obligate the Architect to final acceptance.
2. Cost for retesting required shall be conducted by the Architect and paid for by the Contractor.

B. The following testing services will be provided by the Architect:

1. General:

a. Review and test of the Contractor's proposed materials for compliance with the specifications.
b. Review of the Contractor's proposed mix design.
c. Sampling and testing of materials at plants or stockpiles during the course of the work for compliance with the specifications.
d. Strength tests of concrete specimens.
e. Inspection of concrete batching, mixing, and delivery.
f. Air content and temperature.

2. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 will be performed according to the following requirements:

a. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.

1) 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.

b. 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.
c. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173/C 173M, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

d. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.

C. 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 Architect.

D. Remove and replace concrete pavement where test results indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

1.8 DESIGN OF CONCRETE MIX

A. The Contractor shall be responsible for the design of the concrete mixture. Mix design shall match mix design used in approved mock-up panel and be certified by an independent testing laboratory. The statement of materials constituting the design mix shall be submitted to the Architect for approval within one week following award of Contract. The concrete mix design shall include the following information:

1. Proportions of cement, fine and coarse aggregates, and water.
2. Water-cement ratio, design strength, slump, and air content.
3. Type of cement.
4. Type of aggregates including sieve analysis.
5. Type and dosage of all admixtures.
6. Special requirements for pumping.
7. Range of ambient temperature and humidity for which the design is valid.
8. Any special characteristics of the mix which require precautions in the mixing, placing, finishing, or curing methods to achieve the finished product specified.

B. No concrete shall be delivered to the job site until the Architect has reviewed and approved the design mix.

PART 2 - PRODUCTS

2.1 AGGREGATE BASE COURSE

A. Aggregate for base course shall be a graded, granular, non-frost susceptible, free-draining material, consisting of either durable stone and coarse sand or of blast furnace slag, practically free from loam and clay, and which can be readily compacted to form a stable foundation.

1. Material shall conform to GDOT Specifications Section 815, Graded Aggregate.

2.2 REINFORCEMENT

A. Recycled Content: Minimum 25 percent post-consumer recycled content, plus one-half pre- consumer recycled content.

B. Welded wire fabric reinforcement shall conform to the applicable requirements of ASTM A 185. Fabric reinforcement shall be furnished in flat sheets. Fabric reinforcement in rolls will not be permitted.

C. Fiber reinforcement shall be polypropylene fibre processed into fibrillated bundles designed to open when placed in concrete to produce a homogeneously distributed monofilament polypropylene fiber reinforcement.

1. Fiber size (length) required shall be based on top size of coarse aggregate in the concrete mix, in accordance with manufacturer's recommendations and printed instructions, complying with ASTM C1116, Type III, 1/2 in. to 1-1/2 in.

2.3 CONCRETE

A. Concrete shall be air-entrained type, conforming to ASTM C 94. Concrete to receive an exposed- aggregate surface shall contain a minimum of 560 lb. of ASTM C 150, Type II Portland cement per cubic yard of concrete, and a water-cement ratio no greater than 0.53 by weight. Minimum compressive strength shall be 3,000 psi at 28 days.

B. Maximum slump shall not exceed 4 in. and air entrainment shall be 6 percent + 1 percent.

C. Maximum size of coarse aggregate of the base mix shall be 3/4 in.

D. Ready mixed concrete, if used, shall meet ASTM C 94.

E. An oversanded base mix may be used, and if so, the water-cement ratio specified above shall govern the mix design, and the cement content shall be raised accordingly. Aggregate source and cement type and brand shall not be altered once construction begins.

2.4 CHEMICAL ADMIXTURES

A. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Air-Entraining Admixture: ASTM C 260.

2.5 MONOLITHIC AGGREGATE

A. Special aggregate to be exposed shall be hard, sound, durable, and free of all deleterious materials and staining qualities.

B. The select aggregate shall be stored off the ground and protected from contamination and moisture.

C. The color and size of the aggregate shall be approved by the Architect and shall match that in the sample and approved mockup.

D. Aggregate shall be of one sieve size or no more than two.

E. Shape of aggregate shall resemble spheres and cubes. Flat, slivery stones which may become dislodged easily shall not be used.

F. Aggregate shall be supplied by a quarrying member of the Elberton Granite Association, Inc., One Granite Plaza, P.O. Box 640, Elberton, GA 30635; Tel. 706-283-2551; Web: www.egaonline.com.

2.6 CONCRETE FINISH RETARDER

A. Spray applied, film forming, water based top surface retarder, calibrated for specific sized aggregate and finish requirements.

1. Acceptable Materials: “Top Cast” by Grace Construction Products. Customer Service Center - 888-336-9303, www.graceconstructionproducts.com or contact Matt Prior, Argos Ready Mix, LLC; Tel. 678-283-6142.

B. Spray applied film forming protective coating for surfaces adjacent to retarded finish surfaces.

1. Acceptable Materials: “Face Off” by Grace Construction Products, www.graceconstructionproducts.com, Grace Customer Service Center 888-336-9303 or contact Matt Prior, Argos Ready Mix, LLC; Tel. 678-283-6142.

2.7 CURING MATERIALS

A. Curing shall be by use of curing paper.

B. Moisture-Retaining Cover: Curing paper shall be non-staining, fiber reinforced laminated kraft bituminous product conforming to ASTM C 171. Four mil polyethylene sheeting may be substituted for curing paper.

C. Water: Potable.

2.8 RELATED MATERIALS

A. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

B. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to requirements.

2.9 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94 and ASTM C 1116. Furnish batch certificates for each batch discharged and used in the Work.

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

B. Project-Site Mixing: 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.

2.10 EXPANSION JOINTS

A. Unless otherwise indicated on the Drawings, expansion joints shall be located 30 ft. o.c., maximum.

B. Expansion joint filler shall be preformed, nonbituminous type joint filler conforming to ASTM D 1752, Type II.

1. Premolded filler shall be one piece for the full depth and width of the joint leaving a sealant recess as indicated.
2. Use of multiple pieces of lesser dimensions to make up required depth and width of joint will not be permitted.
3. Except as otherwise noted on the Drawings, joint filler shall be 1/2 in. thick.

C. Dowels shall be furnished under this Section, and shall be Type 304 stainless steel.

2.11 CONTROL JOINTS

A. Control joints indicated on the Drawings to be sawn, shall be made by saw cutting concrete slab after concrete is finished and when the surface is stiff enough to support the weight of workmen without damage to the slab. Saw blade shall cut into slab at least 1 in., but in no case less than 25% of slab depth.

B. Unless otherwise indicated on the Drawings, control joints shall be the width of the walk and located 10 ft. o.c. maximum.

2.12 CONSTRUCTION JOINTS

A. Transverse construction joints shall be placed whenever placing of concrete is suspended for more than 30 minutes.

1. Butt joint with dowels or thickened edge joint shall be used if construction joints occurs at location of control joint.
2. Keyed joints with tiebars shall be used if the joint occurs at any other location.

2.13 GROUT

A. Grout shall be mixed in the proportions of one part Portland cement to two parts sand, by volume. Only sufficient water shall be used to enable grout to barely hold its shape when squeezed into a ball in the hand. Sand for grout shall be "Fine Aggregate", conforming to ASTM C 33.

B. Nonshrink grout shall be pre-mixed non-shrinking, high strength grout. Compressive strength in 28 days shall be 5,000 psi minimum, but in no case less than the specified strength of the adjacent concrete. Manufacturer shall provide evidence that the material meets the requirements of the COE CRD-C 621 (558). Grout permanently exposed to view shall be nonoxidizing; metallic grout may be used in other locations.

1. Nonshrink grout shall be one of the following, or approved equal:

Manufacturer	Product
Gifford-Hill Co.	Supreme
Master Builders Co.	Embeco
U.S. Grout Corporation	Five Star Grout

2.14 SEALANT

A. Sealant for sealing of expansion joints in concrete walks shall be a two component polyurethane based sealant conforming to Section 079200, JOINT SEALANTS.

1. Color of sealant shall be selected by the Architect from the manufacturer's full color range.

2.15 BOND BREAKER

A. Bond breaker shall be asphalt felt conforming to ASTM D 226, Type I or 6 mil polyethylene sheeting.

PART 3 - EXECUTION

3.1 GRADING

A. Areas to be paved will be compacted and brought approximately to subgrade elevation under Section 312000, EARTH MOVING before work of this section is performed. Final fine grading, filling, and compaction of subgrade to receive paving, as required to form a firm, uniform, accurate, and unyielding subgrade at required elevations and to required lines, shall be done under this Section.

B. Existing subgrade material which will not readily compact as required shall be removed and replaced with satisfactory materials. Additional materials needed to bring subgrade to required line and grade and to replace unsuitable material removed shall be material conforming to Section 312000, EARTH MOVING.

C. Subgrade of areas to be paved shall be recompacted as required to bring top 8 in. of material immediately below gravel base course to a compaction of at least 90% of maximum density, as determined by ASTM D 1557, Method D. Subgrade compaction shall extend for a distance of at least 1 ft. beyond pavement edge.

D. Excavation required in pavement subgrade shall be completed before fine grading and final compaction of subgrade are performed. Where excavation must be performed in completed subgrade or subbase subsequent backfill and compaction shall be performed as directed by the Architect as specified in Section 312000, EARTH MOVING. Completed subgrade after filling such areas shall be uniformly and properly graded.

E. Areas being graded or compacted shall be kept shaped and drained during construction. Ruts greater than or equal to 2 in. deep in subgrade, shall be graded out, reshaped as required, and recompacted before placing pavement.

F. Materials shall not be stored or stockpiled on subgrade.

G. Disposal of debris and other material excavated and/or stripped under this section, and material unsuitable for or in excess of requirements for completing work of this Section shall conform to the following:

1. Material shall be legally disposed of off-site.

H. Prepared subgrade will be inspected by the Architect. Subgrade shall be approved by the Architect before installation of paving base course. Disturbance to subgrade caused by inspection procedures shall be repaired under this Section of the specification.

3.2 AGGREGATE BASE COURSE

A. Aggregate base course for paving and the spreading, grading, and compaction methods employed shall conform to standard requirements for usual base course of this type for first class road work, and the following:

1. GDOT Specifications Section 310, Graded Aggregate Construction.

B. Compaction of aggregate base course shall be to 95% of maximum density as determined by ASTM D 1557, Method D. Stone greater than 2-1/2 in. shall be excluded from course.

C. Width of base course shall be greater than or equal to the width of pavement surface, if continuous lateral support is provided during rolling, and shall extend at least 2 x base thickness beyond edge of the course above, if not so supported.

D. Aggregate material shall be applied in lifts less than or equal to 6 in. thick, compacted measure. Each lift shall be separately compacted to specified density, using a 6 ton steel wheel roller or vibratory roller equivalent to a 6 ton static roller, or an approved equivalent. Limit vehicle speed to 3 mph.

1. Material shall be placed adjacent to wall, manhole, catch basin, and other structures only after they have been set to required grade and level.
2. Rolling shall begin at sides and progress to center of crowned areas, and shall begin on low side and progress toward high side of sloped areas. Rolling shall continue until material does not creep or wave ahead of roller wheels.
3. Surface irregularities (pumping or rutting) which exceed 1/2 in. measured by means of a 10 ft. long straightedge shall be replaced and properly compacted in accordance with Section 312000, EARTH MOVING.
4. Proceed with installation only after unsatisfactory conditions have been corrected.

E. Subgrade and base course shall be kept clean and uncontaminated. Less select materials shall not be permitted to become mixed with gravel. Materials spilled outside pavement lines shall be removed and area repaired.

F. Portions of subgrade or of construction above which become contaminated, softened, or dislodged by passing of traffic, or otherwise damaged, shall be cleaned, replaced, and otherwise repaired to conform to the requirements of this specification before proceeding with next operation.

3.3 REINFORCEMENT

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

B. Before being placed in position, reinforcing for reinforced concrete shall be thoroughly cleaned of loose mill and rust scale, dirt, ice, and other foreign material which may reduce the bond between the concrete and reinforcing. Where there is delay in placing

concrete after reinforcement is in place, bars shall be reinspected and cleaned when necessary.

C. Any bar showing cracks after bending shall be discarded.

D. Unless otherwise indicated on the Drawings, reinforcing shall extend within 2 in. of formwork and expansion joints. Reinforcing shall continue through control joints. Adjacent sheets of fabric reinforcing shall lap 6 in.

E. After forms have been coated with form release agent, but before concrete is placed, reinforcing steel anchors shall be securely wired in the exact position called for, and shall be maintained in that position until concrete is placed and compacted. Chair bars and supports shall be provided in a number and arrangement satisfactory to the Architect.

F. 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.

G. Fiber reinforcement shall be introduced directly into the concrete either at the batch plant or job site at the rate of 1.6 pounds (minimum) per cubic yard (unless otherwise recommended by fiber reinforcement manufacturer). If introduced at the batch plant with the aggregate, no extra mixing time is required. If added at the job site, approximately 3 to 5 minutes mixing at agitating speed is required.

3.4 CONCRETE PLACEMENT

A. Paving mix, equipment, methods of mixing and placing, and precautions to be observed as to weather, condition of base etc., shall meet the requirements of ACI 325.9R. Pavement shall be constructed in accordance with the Drawings.

B. The Architect shall be notified of concrete placement sufficiently in advance of start of operation to allow his representative to complete preliminary inspection of the work, including subgrade, forms, and reinforcing steel, if used.

C. Normal concrete placement procedures shall be followed. Concrete shall arrive at the jobsite so that no additional water will be required to produce the desired slump. When conditions develop that require addition of water to produce the desired slump, permission of the Architect must be obtained. The concrete shall be transported from the mixer to its place of deposit by a method that will prevent segregation or loss of material. Concrete shall be placed in accordance with ACI 304.

D. Concrete shall be consolidated by suitable means to eliminate voids and pockets.

E. The strike-off and darby or bullfloat operations should be such that a level surface is obtained sufficiently below the final finish grade to allow for volume growth due to the addition of the seeding aggregate.

F. Expansion joints shall be formed in the concrete to required width with preformed joint filler in place. Depth of filler shall be as required to form a 5/8 in. deep sealant and backer rod recess below finished surface of walkway.

3.5 MONOLITHIC EXPOSED-AGGREGATE FINISH (with surface retarder)

A. Monolithic Exposed-Aggregate Finish: Expose coarse aggregate in pavement surfaces as follows:

1. Preparation and Application: Immediately after float finishing, spray-apply chemical surface retarder to pavement according to manufacturer's written instructions. (A surface retarder may be used, only after approval by the Architect and shall be of the same brand used to prepare the approved sample panel.)

    a. Protect all curbs, borders, adjacent stones, pavers, etc. that are not to receive retarded finish prior to concrete pour and application of retarder. Use Protector Face Off by Grace Construction Products.
    b. Do Not Delay The Application of The Surface Retarder Beyond the Loss of the Initial Bleed Water Especially in Warmer Temperatures for Best Results.
    c. Apply Top Cast Retarders with a low-pressure sprayer at a rate per manufacturers' requirements. Material is colored to allow for verification of even and complete coverage.
    d. Once dry (1-2 hours), Top Cast provides protection against intermittent rain or hot, windy conditions and requires no additional covering.

2. Retarder Selection Guidelines

Number Code	Etch/Aggregate Size to Expose*	Coverage	Color
5	Lt. Sandblast Finish	"	Lt. Blue

* Values listed are for standard 6-sack mix. Always test to verify the appropriate grade for specific mix designs

3. Finishing

    a. Wash with water rinse/light broom or pressure wash with power equipment within 6 – 24 hours after the retarder is applied. Retarder removal intervals depend on strength of mix, exposed aggregate size and desired washing techniques. Earlier washing for light etch finishes may be necessary. Verify in test panels.
    b. Do not over-finish and/or delay application beyond the initial bleeding on the light finishes.

3.6 CURING AND SEALING

A. As soon as the washing operation ceases, the curing operation shall begin. The concrete shall be kept in continuously moist condition by covering with new, unwrinkled, non-staining, high-quality curing paper for 5 days in warm weather (70 deg. F. or higher) or 7 days in cooler weather (50-70 deg. F.). The temperature of the concrete shall not be allowed to fall below 50 deg. F. during the curing period.

1. During periods of excessively hot weather (95 deg. F., or above) ingredients in the concrete shall be cooled insofar as possible and cold mixing water shall be used to maintain the temperature of the concrete at permissible levels all in accordance with the provisions of ACI 305. Any concrete with a temperature above 95 deg. F. when ready for placement will not be acceptable, and will be rejected.

B. After curing is completed, concrete surface shall be protected by applying concrete sealer in accordance with manufacturer's printed instructions.

3.7 CONSTRUCTION JOINTS

A. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour unless pavement terminates at isolation joints.

1. Continue steel reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated.
2. Provide tie bars at sides of pavement strips where indicated.
3. Butt Joints: Use epoxy bonding adhesive at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

3.8 EXPANSION JOINTS

A. Expansion joints (isolation joints) shall be 1/2 in. wide and unless otherwise indicated on the Drawings, shall be located 30 ft. o.c., at building edge and at places where pavement meets other structures. Expansion joint shall be formed in the concrete to required width with preformed joint filler in place. Joint filler shall extend the full width and depth of the slab. Joint filler shall extend the full length of the expansion joint.

1. Depth of joint filler shall be as required to form a 1-1/4 in. deep sealant and backer rod recess below finished concrete surface.
2. Doweled Joints: Install sleeves and dowel bars at expansion joints as indicated. Lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.9 CONTROL JOINTS

A. Control joints indicated shall be sawn by using a diamond blade concrete power saw. Joint shall be made after concrete is finished and when the surface is stiff enough to support the weight of workmen without damage to the slab. Saw shall cut into slab at least 1 in., but in no case less than 25% of slab depth.

3.10 DECORATIVE SAW CUT JOINTS

A. Unless otherwise indicated, decorative saw cut joints shall be sawn into the concrete slab at intervals and patterns indicated on the Drawings. Joint shall be made after concrete is finished and when the surface is stiff enough to support the weight of workmen without damage to the slab, but before slab has achieved its final set. Saw cut joints shall be straight and accurate to line.

1. Saw cut joints shall be sawn flush to vertical surfaces.

B. Decorative saw cut joints shall be located each way to create scoring patterns indicated on the Drawings.

C. Depth of decorative saw cut joint shall be 3/4 in.

3.11 SEALING OF JOINTS

A. Where indicated on the Drawings, expansion joints and control joints shall be sealed with joint sealant in accordance with Section 079200, JOINT SEALANTS.

3.12 PROTECTION OF CONCRETE SURFACES

A. Concrete surfaces shall be protected from traffic or damage until surfaces have hardened sufficiently. If necessary 1/2 in. thick plywood sheets shall be used to protect the exposed surface.

B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with portland cement concrete bonded to pavement with epoxy adhesive.

3.13 CONSTRUCTION WASTE MANAGEMENT

A. Comply with all City, State and Federal requirements for removal and disposal of construction debris and waste.

1. Do not allow excavated materials to accumulate on-site.

END OF SECTION 321314

SECTION 321373 - CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cold-applied joint sealants.
2. Hot-applied joint sealants.
3. Joint-Sealant Backer Materials.
4. Primers.

1.2 PRECONSTRUCTION TESTING

A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, Samples of materials that will contact or affect joint sealants.

1. Use ASTM C 1087 or manufacturer's standard test method to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
2. Submit no fewer than three (3) pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
5. Testing will not be required if joint-sealant manufacturers submit joint-preparation data that are based on previous testing, not older than 24 months, of sealant products for compatibility with and adhesion to joint substrates and other materials matching those submitted.

1.3 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in ½ inch wide joints formed between two 6-inch long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

C. Pavement-Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

D. Qualification Data: For qualified Installer, if requested.

E. Product Certificates: For each type of joint sealant and accessory, from manufacturer.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for joint sealants.

G. Preconstruction Compatibility and Adhesion Test Reports: From joint-sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility with and adhesion to joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain each type of joint sealant from single source from single manufacturer.

C. Product Testing: Test joint sealants using a qualified testing agency.

1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

1.5 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Owner from manufacturer's full range.

2.2 COLD-APPLIED JOINT SEALANTS

A. Single-Component, Nonsag, Silicone Joint Sealant for Concrete: ASTM D 5893, Type NS.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Crafco Inc., an ERGON company; RoadSaver Silicone.
b. Dow Corning Corporation; 888.
c. Pecora Corporation; 301 NS.

B. Single-Component, Self-Leveling, Silicone Joint Sealant for Concrete: ASTM D 5893, Type SL.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Crafco Inc., an ERGON company; RoadSaver Silicone SL.
b. Dow Corning Corporation; 890-SL.
c. Pecora Corporation; 300 SL.

C. Multicomponent, Pourable, Traffic-Grade, Urethane Joint Sealant for Concrete: ASTM C 920, Type M, Grade P, Class 25, for Use T.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Pecora Corporation; Urexpan NR-200.

2.3 HOT-APPLIED JOINT SEALANTS

A. Hot-Applied, Single-Component Joint Sealant for Concrete: ASTM D 3406.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Crafco Inc., an ERGON company; Superseal 444/777.

B. Hot-Applied, Single-Component Joint Sealant for Concrete and Asphalt: ASTM D 6690, Types I, II, and III.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Meadows, W. R., Inc.; Sealtight Hi-Spec or Sealtight 3405.
    b. Right Pointe; D-3405 Hot Applied Sealant.

2.4 JOINT-SEALANT BACKER MATERIALS

A. General: Provide joint-sealant backer materials that are non-staining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint-sealant manufacturer based on field experience and laboratory testing.

B. Round Backer Rods for Cold- and Hot-Applied Joint Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

C. Round Backer Rods for Cold-Applied Joint Sealants: ASTM D 5249, Type 3, of diameter and density required to control joint-sealant depth and prevent bottom-side adhesion of sealant.

D. Backer Strips for Cold- and Hot-Applied Joint Sealants: ASTM D 5249; Type 2; of thickness and width required to control joint-sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

2.5 PRIMERS

A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.

B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.

B. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install joint-sealant backings of kind indicated to support joint sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of joint-sealant backings.
2. Do not stretch, twist, puncture, or tear joint-sealant backings.
3. Remove absorbent joint-sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install joint sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place joint sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants according to the following requirements to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint:

1. Remove excess joint sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.

F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

3.4 CLEANING

A. Clean off excess joint sealant or sealant smears adjacent to joints as the Work progresses, by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect joint sealants, during and after curing period, from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations in repaired areas are indistinguishable from the original work.

3.6 PAVEMENT-JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Joints within cement concrete pavement.

1. Joint Location:

    a. Expansion and isolation joints in cast-in-place concrete pavement.
    b. Contraction joints in cast-in-place concrete slabs.
    c. Other joints as indicated.

2. Silicone Joint Sealant for Concrete: Single component, nonsag.
3. Urethane Joint Sealant for Concrete: Multicomponent, pourable, traffic-grade.
4. Hot-Applied Joint Sealant for Concrete: Single component.
5. Joint-Sealant Color: As selected by Owner from manufacturer's full range.

B. Joint-Sealant Application: Joints between cement concrete and asphalt pavement.

1. Joint Location:

    a. Joints between concrete and asphalt pavement.
    b. Joints between concrete curbs and asphalt pavement.
    c. Other joints as indicated.

2. Hot-Applied Joint Sealant for Concrete and Asphalt: Single component.
3. Joint-Sealant Color: As selected by Owner from manufacturer's full range.

END OF SECTION 321373

SECTION 321416 - BRICK UNIT PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all equipment and materials and do all work necessary to furnish and install the brick paving and brick edge band, as indicated on the Drawings and as specified.

1.2 RELATED WORK

A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that directly relate to work of this Section include, but are not limited to:

1. Section 033001, Cast-In-Place Concrete - Sitework.
2. Section 321313, Concrete Paving.

1.3 REFERENCES

A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirement shall govern.

1. American Association of State Highway and Transportation Officials (AASHTO): Specifications Standard Specifications for Highway Bridges.
2. American Society for Testing and Materials (ASTM):

a. C 67 Sampling and Testing Brick and Structural Clay Tile
b. C 136 Sieve Analysis of Fine and Coarse Aggregates
c. C 144 Aggregate for Masonry Mortar
d. C 150 Portland Cement
e. C 170 Compressive Strength of Dimension Stone
f. C 207 Hydrated Lime for Masonry Purposes
g. C 216 Facing Brick (Solid Masonry Units Made from Clay or Shale)
h. C 270 Mortar for Unit Masonry
i. C 902 Pedestrian and Light Traffic Paving Brick
j. C 1272 Heavy Vehicular Paving Brick

1.4 SUBMITTALS

A. Samples: Furnish ten individual brick pavers as samples, showing extreme variations in color and texture.

B. Manufacturer's Product Data: Manufacturer's product data shall be submitted for the following items:

1. Brick paver.
2. Polymeric sand.
3. Mortar materials, including additives.

C. Test Report: Submit reports from tests conforming to ASTM C 67 methods indicating:

1. Compressive strength, psi.
2. Absorption, 5 hr. submersion in cold water.
3. Absorption, 24 hr. submersion in cold water.
4. Maximum saturation coefficient.
5. Initial rate of absorption (suction).
6. Abrasion index.
7. Freeze-thaw.
8. Efflorescence.

1.5 SAMPLE PANEL

A. Construct a sample panel of brick paving band on the specified base and setting bed before start of any brick paving.

1. Sample panel shall exhibit proposed color range, texture, bond, jointing, pattern, and workmanship and relationship to abutting pavement.
2. Size of panel shall be 6 ft. x 6 ft., minimum.

B. Mockups: Before installing unit pavers, build mockups for each form and pattern of unit pavers required to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mockups to comply with the following requirements, using materials indicated for the completed Work, including same base construction, special features for expansion joints, and contiguous work as indicated:

1. Build mockups in the location and of the size indicated.
2. Notify Design Professional seven days in advance of dates and times when mockups will be constructed.
3. Demonstrate the proposed range of aesthetic effects and workmanship.
4. Obtain Design Professional's approval of mockups before starting unit paver installation.
5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
6. Demolish and remove mockups when directed.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Brick pavers shall be carefully packed by the supplier for shipment.

B. Brick shall be stored off the ground and protected against staining and other damage.

C. Pavers damaged in any manner will be rejected and replaced with new materials at no additional cost to the Owner.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed unit paver installations similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Source Limitations: Obtain each type of unit paver, joint material, and setting material from one source with resources to provide materials and products of consistent quality in appearance and physical properties.

1.8 PROJECT CONDITIONS

A. Cold Weather Protection:

1. Remove any ice or snow formed on brick or concrete bed by carefully applying heat until top surface is dry to touch.
2. Remove brick work determined to be damaged by freezing conditions.
3. Perform the following construction procedures while work is progressing:

Air Temperature	Procedures
40° - 32°F	Heat sand to produce mortar temperatures between 40° and 120°F.
32° - 25°F	Heat sand to produce mortar temperatures between 40° and 120°F. Maintain temperature of mortar on boards above freezing.
25° - 20°F	Heat sand to produce mortar temperatures between 40° and 120°F. Maintain temperature of mortar on boards above freezing. Use wind breaks when wind is in excess of 15 mph.
20°F - below	Heat sand to produce mortar temperatures between 40° and 120°F. Provide enclosures and auxiliary heat to maintain air temperature above.
32°F	Do not lay units which have a surface temperature below 20°F.

4. Latex admixture shall be kept at 40°F minimum.

a. Cold Weather Protection for Completed Brick Work:

5. Mean Daily

Air Temperatures	Procedures
40° - 32°F	Protect brick work from rain or snow for at least 24 hours by covering with weather-resistive membrane.
32° - 25°F	Completely cover brick work with weather-resistive membrane for at least 24 hours.
25° - 20°F	Completely cover brick work with insulating blankets or similar protection for at least 24 hours.
20°F - below	Maintain brick work at temperature above 32°F for 24 hours using enclosures and supplementary heat.

6. Do not use frozen materials or materials mixed or coated with ice or frost. Do not lower the freezing point of mortar by use of admixtures or antifreeze agents, and do not use calcium chloride in mortar or grout.
7. Do not build on frozen work; remove and replace brick work damaged by frost or freezing.
8. During all seasons, protect partially completed brick work against weather when work is not in progress.

1.9 PROTECTION OF FINISHED SURFACES

A. Finished surfaces adjacent to the brick paving work shall be adequately protected from soiling, staining, and other damage during construction.

PART 2 - PRODUCTS

2.1 BRICK PAVERS

A. Brick pavers shall meet or exceed the requirements of ASTM C 902, Class SX, Abrasion Type I for pedestrian and light vehicular traffic, Application PX for sand filled joints. Brick pavers shall meet or exceed the requirements of ASTM C 1272, Type F for heavy traffic application.

B. Brick pavers shall be as listed in the Materials Schedule in the drawings. See Sheet L7.00

1. Brick pavers sizes and color mixes shall be as indicated on the Drawings.

C. Color and texture shall match the sample at the office of the Design Professional, and samples submitted by the Contractor prior to delivery.

D. Brick shall be uniform in color, size, appearance, and dimensions, and shall have smooth regular edges where they are closely butted.

2.2 POLYMERIC SAND JOINT FILLER

A. Joint filler between paver joints shall be RG+ polymeric sand manufactured by Techniseal 300, Liberte Ave., Candiac Quebec, Canada, J5R 6X1, Phone 800-465-7325 or approved equivalent.

1. Polymeric sand color shall be submitted by the Contractor and approved by Owner's Representative.

2.3 SETTING BED SAND

A. Sand shall be a clean, sharp, natural sand conforming to ASTM C 33, except that the fineness modulus shall be 2.25 + 0.10.

1. Gradation for setting bed sand shall be as follows:

Sieve Size	% Passing by Weight
3/8 in.	100
No. 4	95 - 100
No. 8	80 - 100
No. 16	50 - 85
No. 50	10 - 30
No. 100	5 - 15
No. 200	0 - 10

2.4 SETTING BED MORTAR

A. Setting bed mortar shall be a pre-mixed and packaged polymer fortified blend of carefully selected polymers, Portland cement and graded aggregates which does not require the use of a latex admixture, but only the need to add water to produce a thick bed mortar with exceptional strength, conforming to ASTM C 270.

2.5 MORTAR GROUT FOR JOINTS

A. Mortar grout for pointing of joints shall consist of one (1) part white Portland cement, two (2) parts sand, mortar coloring additive, gauged with latex polymer additive.

1. White Portland cement; ASTM C 150, complying with the staining requirements of ASTM C 91 for not more than 0.03% water soluble alkali. Furnish Type I, except Type III may be used for setting pavers in cold weather.
2. Color pigment shall not exceed 10% of the Portland cement in the mortar.
3. Color will be selected by Design Professional.

2.6 WATER

A. Water shall be potable and shall be free of injurious contaminants.

2.7 CLEANING MATERIALS

A. Water: Potable.

B. Hot Water (if required): Water heated to a temperature of 140 to 160 deg F.

C. Job-Mixed Detergent Solution: Solution prepared by mixing 2 cups of tetrasodium polyphosphate, 1/2 cup of laundry detergent, and 20 quarts of hot water for every 5 gal. of solution required.

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. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ACCEPTABILITY OF CONCRETE BASE

A. Contractor shall examine the concrete base slab to determine its adequacy to receive brick paving and setting bed. Concrete shall have fully cured. Evidence of inadequate base shall be brought to the immediate attention of the Design Professional.

B. Start of work of this Section shall constitute acceptance of concrete base slab.

3.3 PREPARATION

A. Vacuum clean concrete substrates to remove dirt, dust, debris, and loose particles.

3.4 INSTALLATION, GENERAL

A. Do not use unit pavers with chips, cracks, voids, discolorations, and 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: As indicated.

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.

3.5 SETTING BRICK PAVERS – SAND BED

A. Setting bed shall be protected from damage prior to setting pavers.

B. Setting shall be done by competent workmen under adequate supervision, and in accordance with manufacturer's recommendations. Pavers shall be placed on the setting bed, to true line and plane and in required position.

C. Pavers with chips, cracks, or other structural or aesthetic defects shall not be used.

D. Place leveling course and screed to a maximum thickness of 1 in., taking care that moisture content remains constant, and density is loose and constant until pavers are set and compacted.

E. Treat leveling base with soil sterilizer to inhibit growth of grass and weeds.

F. Set pavers with a minimum joint width of 1/16 inch and a maximum of 1/8 inch, being careful not to disturb leveling base. If pavers have spacer bars, place pavers hand tight against spacer bars. Use string lines to keep straight lines. Fill gaps between units that exceed 3/8 inch with pieces cut to fit from full-size unit pavers.

1. When installation is performed with mechanical equipment, use only unit pavers with spacer bars on sides of each unit.

G. Vibrate pavers into leveling course with a low-amplitude plate vibrator capable of a 3500- to 5000-lbf compaction force at 80 to 90 Hz. Perform at least three passes across paving with vibrator. Vibrate under the following conditions:

1. After edge pavers are installed and there is a completed surface or before surface is exposed to rain.
2. Before ending each day's work, fully compact installed concrete pavers to within 36 inches of the laying face. Cover open layers with non-staining plastic sheets overlapped 48 inches on each side of the laying face to protect it from rain.

H. 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.

3.6 POLYMERIC SAND JOINT TREATMENT

A. Spread dry polymeric sand and fill joints immediately after setting pavers.

1. Make sure that the pavers’ side and top surfaces are dry before applying the polymeric sand. Spread the polymeric sand over the pavers then use a hard-bristle brush to sweep the sand into the joints, filling them completely. Run a vibrating plate over the pavers in several directions to compact the sand inside the joints

(this action is not appropriate for slabs). Repeat this step (spreading the sand, then compacting) at least two more times. If a vibrating plate compactor cannot be used, tamp the stones with a rubber mallet and make sure the polymeric sand is densely packed in the joints.

2. Using a fine-bristle broom, remove any excess from paver surfaces. Make sure the finished sand level is at least 1/8 in. lower than the surface of the pavers. Using a leaf blower, remove any sand residue from paved surfaces. Depending on the physical layout, it may be more appropriate to remove residue by using a vacuum unit.
3. At a height of 4 feet, use a water gun connected to a hose to direct a fine mist (water gun setting: “mist” or equivalent) of water on a specific paved area for 10 to 15 seconds. Wait 3 to 4 minutes (not longer).
4. From a height of 2 feet, aim the water mist directly at the paved surface. Mist and rinse simultaneously so as to eliminate any polymeric sand residue left on the pavers. Any polymeric sand residue should go directly into the paver joints. Wait 3 to 4 minutes (not longer).
5. From a height of 2 feet, aim the water mist again directly at the paved surface. Again, mist and rinse simultaneously so as to eliminate any polymeric sand residue left on the pavers. The polymeric sand residue should go directly into the paver joints. However, stop misting (ALERT) when you see a minimal amount of water retention on the paver joints. NOTE: Repeat the directions of steps 3 to 5 for all other areas that have not been misted with water.
6. Use a leaf blower to remove any excess water lying on paver pores and crevices. This blowing action is necessary to help remove any remaining polymeric sand residue that was left on the paver surface from the previous steps.

3.7 SETTING BRICK PAVERS - MORTAR BED

A. All setting shall be done by competent granite setters under adequate supervision.

B. Brick units with chips, cracks, stains, or other defects which might be visible in the finished work shall not be used.

C. Before setting, brick shall be clean and free of dirt, and foreign matter on all sides. Brick shall be dry before setting.

D. Brick shall be set true to the required lines and grades. All joints shall be uniform 1/2 in. in thickness. Control joints shall be sealed as specified in Section 079200, JOINT SEALANTS.

E. Brick paver edge band shall be set on a mortar setting bed over a prepared concrete base slab. All setting shall be done by competent masons under adequate supervision.

F. Mortar bed shall be spread evenly to 1-1/4 in. thickness.

G. Before setting, the back of each paver shall be dampened and shall receive a slurry of mortar to ensure maximum contact with mortar bed. Each piece shall be carefully bedded in a full bed of mortar and tapped home to a full and solid bearing. Particular

care shall be exercised to equalize bed and joint openings and eliminate the need for redressing of exposed surfaces.

H. Brick pavers shall be set true to the required lines and grades in the pattern detailed on the Drawings. Brick pavers shall be neatly cut and fitted at all perimeters and closures to fit neatly and closely, with joints uniform in thickness. Pavers shall be cut with a water-cooled, cut-off wheel masonry saw using a diamond blade.

I. Exposed surfaces shall be kept free from mortar at all times. Excess mortar shall be immediately removed before latex modified mortar can set.

3.8 GROUTED JOINT TREATMENT

A. Spaced Joint Widths: Provide 1/2 inch nominal joint width with variations not exceeding plus or minus 1/16 inch.

B. Grout joints as soon as possible after initial set of setting bed. Force grout into joints, taking care not to smear grout on adjoining pavers and other surfaces. After initial set of grout, finish joints by tooling to produce a slightly concave polished joint, free from drying cracks.

C. Cure grout by maintaining in a damp condition for seven days, unless otherwise recommended by latex-additive manufacturer.

D. Exposed surfaces shall be kept free from mortar at all times. Excess mortar shall be immediately removed before latex modified mortar can set.

E. After filling joints, brick work shall be carefully cleaned, removing all dirt, excess mortar and stains. Expansion joints shall be cleaned of all mortar and left ready for sealing of joints under Section 079200, JOINT SEALANTS.

F. Upon completion of brick paving, surfaces shall be left in a clean, unsoiled condition, acceptable to the Design Professional.

3.9 CLEANING AND PROTECTION OF BRICK SURFACES

A. After completion of brick paving, surfaces shall be carefully cleaned, removing all dirt, excess filler, and stains.

3.10 CONSTRUCTION WASTE MANAGEMENT

A. Comply with the requirements for removal and disposal of construction debris and waste.

END OF SECTION 321416

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SECTION 321640 - GRANITE CURB

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install equipment and materials to construct granite curb, as indicated on the Drawings and as specified, including, but not limited to:

1. Granite curbing.

1.2 REFERENCES

A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

1. American Society for Testing and Materials (ASTM):

C 131	Resistance to Degradation of Small-size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
C 615	Structural Granite

2. Georgia Department of Transportation (GDOT):

Specifications	Standard Specifications for Construction of Roads and Bridges

1.3 SAMPLE SECTION

A. A sample curb section, full dimension, 6 ft. long minimum, shall be fabricated prior to start of granite curbing. The work will be inspected by the Design Professional. If the original sample is not acceptable, the Contractor shall construct additional sample sections until an accepted sample is obtained. The accepted sections shall become the standard for the entire job and shall remain undisturbed until completion of all granite curbing.

1.4 SUBMITTALS

A. Submit complete shop drawings of each curb type and size for Design Professional's approval. Reproduction of Drawings is not acceptable as Shop drawings. Indicate size, location and radii as applicable for each piece of curb.

B. Samples: The following samples shall be submitted:

Material	Sample Size or Quantity
Granite Curb	36 in. length, straight section
Granite Curb	36 in. length, radial section

C. Field Measurements: Take all necessary field measurements before preparation of shop drawings and fabrication. Do not delay progress of the job.

1.5 FIELD LAYOUT

A. The Contractor shall field stake the granite curb layout for Design Professional's approval prior to start of excavation.

1.6 QUALITY ASSURANCE

A. Unless otherwise indicated, granite curb materials and construction shall conform to the applicable portions of the following:

1. GDOT Specifications Section 437, Granite Curb.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Granite curb units shall be delivered to the job adequately protected from damage during transit.

B. Curb shall be protected against staining, chipping, and other damage. Cracked, badly chipped, or stained units will be rejected and shall not be employed in the work.

PART 2 - PRODUCTS

2.1 AGGREGATE BASE COURSE

A. Aggregate for base course shall be a graded, granular, non-frost susceptible, free-draining material, consisting of either durable stone and coarse sand or of blast furnace slag, practically free from loam and clay, and which can be readily compacted to form a stable foundation.

1. Material shall conform to GDOT Specifications Section 815, “Graded Aggregate”.

2.2 GRANITE CURB

A. Granite shall be a structural granite conforming to ASTM C 615, Class I Engineering Grade, suitable for curbstone use. Curb shall be free from seams which impair

structural integrity, and with percentage of wear less than 32%, as determined by ASTM C 131.

1. Granite curb shall conform to GDOT Specifications Section 805, Type 1

B. Suppliers and Colors:

1. Granite shall be supplied by a quarrying member of the Elberton Granite Association, Inc., One Granite Plaza, P.O. Box 640, Elberton, GA 30635; Tel. 706-283-2551; Web: www.egaonline.com

a. Granite color shall be “Elberton Gray”; finish shall be as indicated on the Drawings.
b. Granite shall be of the sizes and dimensions indicated on the Drawings.
c. All faces shall be at right angles to the plane of the top.
d. Granite shall be cut accurately to required shapes and dimensions.

2.3 CEMENT MORTAR

A. Mortar for pointing joints between curbstones shall be a cement mortar composed of one part Portland cement and two parts sand, by volume with sufficient water to form a workable, stiff mixture.

2.4 CONCRETE

A. Concrete for foundation shall conform to Section 033000, “Cast-in-Place Concrete-Sitework”.

PART 3 - EXECUTION

3.1 GRADING

A. Areas to receive granite curbing will be compacted and brought to subgrade elevation under Section 312000, EARTH MOVING before work of this section is performed. Final fine grading, furnishing and installing aggregate base course, and compaction of this material at required elevations and to required lines, shall be done under this Section.

B. Existing subgrade material which will not readily compact as required shall be removed and replaced with satisfactory materials. Additional materials needed to bring subgrade to required line and grade and to replace unsuitable material removed shall be material conforming to this Section.

C. Subgrade of areas to receive granite curbing shall be re-compacted as required to bring top 4 in. of material immediately below aggregate base to a compaction of at least 90% of maximum density, as determined by ASTM D 1557. Subgrade

compaction shall extend for a distance of at least 1 ft. beyond proposed edge of granite curb.

D. Excavation required in subgrade shall be completed before fine grading and final compaction of subgrade are performed. Where excavation must be performed in completed subgrade or aggregate base, subsequent backfill and compaction shall be performed as directed by the Design Professional as specified in Section 312000, EARTH MOVING. Completed subgrade after filling such areas shall be uniformly and properly graded.

E. Areas being graded or compacted shall be kept shaped and drained during construction. Ruts greater than or equal to 1 in. deep in subgrade, shall be graded out, reshaped as required, and re-compacted before placing granite curbing.

F. Materials shall not be stored or stockpiled on subgrade.

G. Disposal of debris and other material excavated and/or stripped under this section, and material unsuitable for or in excess of requirements for completing work of this section shall be disposed of off-site.

3.2 BASE COURSE

A. Unless otherwise specified, base course for granite curb and the spreading, grading, and compaction methods employed shall conform to the following:

1. GDOT Specifications Section 310, "Graded Aggregate Construction".

B. Compaction of aggregate base shall be to 95% of maximum density as determined by ASTM D 1557. Stone greater than 2 in. shall be excluded from course.

C. Width of base course shall extend at least 2 x base thickness beyond edge of the granite curb.

D. Material shall be applied in lifts less than or equal to 3 in. thick, compacted measure. Each lift shall be separately compacted to specified density.

E. Subgrade and base course shall be kept clean and uncontaminated. Less select materials shall not be permitted to become mixed with base course.

F. Portions of subgrade or of construction above which become contaminated, softened, or dislodged by passing of traffic, or otherwise injured, shall be cleaned, replaced, re-compacted, or otherwise repaired to conform to the requirements of this specification before proceeding with next operation.

3.3 SETTING CURB

A. Curb shall be set in concrete foundation, with trench bottom at minimum 6 in. below bottom of curb.

B. Vertical face of vertical curb shall be plumb, with curb top parallel to adjacent surface.

C. Granite edging shall be installed in accordance with GDOT Specifications Section 437, “Granite Curb”.

D. Curb shall be set accurately to line and grade. Curb units shall be fitted together as closely as possible. Curb shall not be field cut.

E. Joints, between curb units shall be carefully filled with a cement mortar, and neatly pointed on the top and front exposed portions. After pointing excess mortar shall be cleaned from curb surface.

F. Backfill material on each side of curb shall be as specified for adjacent surface and shall be thoroughly compacted by means of power tampers. Extreme care shall be taken not to destroy alignment. Curb sections disturbed during backfilling or otherwise shall be reset to line and grade, and properly backfilled.

3.4 PROTECTING GRANITE CURB

A. Curb shall be protected against staining, chipping, and other damage. Cracked, badly chipped, or stained curbing will be rejected and shall be replaced.

END OF SECTION 321640

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SECTION 328400 – IRRIGATION SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes piping, valves, sprinklers, controls, and wiring for automatic control irrigation systems.

B. Extent of the underground irrigation system is shown in the plans, schedules, and notes.

C. Provide all labor. Materials and equipment required or inferred from the Drawing and Specifications to complete the Work of this Section.

D. Provide a complete and operable system for the irrigation of all landscapes areas on the project site, unless indicated otherwise. The Drawings and specifications are intended to include all items obviously necessary and requisite for the proper irrigation of the project.

E. The contractor shall be responsible for adjusting head locations, nozzle type and size, and any other system components so that the irrigation system layout is coordinated with actual field conditions. Such adjustments shall be made at no cost to the Owner except, when authorized in writing, such adjustments which will be compensated for at an agreed upon cost.

1.2 DEFINITIONS

A. Lateral Piping: Downstream from control valves to sprinklers, specialties, and drain valves. Piping is under pressure during flow.

B. Drain Piping: Downstream from circuit-piping drain valves. Piping is not under pressure.

C. Mainline Piping: Downstream from point of connection to water distribution piping to, and including, control valves. Piping is under water-distribution-system pressure.

D. The following are industry abbreviations for plastic materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. FRP: Fiberglass-reinforced plastic.
3. PA: Polyamide (nylon) plastic.
4. PE: Polyethylene plastic.
5. PP: Polypropylene plastic.
6. PTFE: Polytetrafluoroethylene plastic.

7. PVC: Polyvinyl chloride plastic.
8. TFE: Tetrafluoroethylene plastic.
9. HDPE High Density Polyethylene plastic.

1.3 PERFORMANCE REQUIREMENTS

A. Head-to-head coverage irrigation system for lawns and exterior plants as shown or indicated on associated plans.

B. Drawings are diagrammatic and generally indicate the Work to be installed. The Drawing do not indicate all off-set fittings that may be necessary. The Contractor shall furnish such items as may be required to complete the work.

C. Location of Sprinklers and Specialties: Design location is approximate. Make minor adjustments necessary to avoid plantings and obstructions such as signs and light standards. Maintain a minimum of head-to-head coverage and dripline row spacing for turf and planting areas unless otherwise indicated.

D. Minimum Working Pressures: The following are minimum pressure requirements for piping, valves, and specialties, unless otherwise indicated:

1. Irrigation Main Piping: 200 psi.
2. Lateral Piping: 200 psi.
3. All exposed piping, SCH 40.

1.4 SUBMITTALS

A. Approval: Obtain approval from Landscape Architect for all submittals prior to the beginning of Work, unless otherwise approved.

B. Product Data: Individual copies for product data shall be submitted Include pressure ratings, rated capacities, and settings of selected models for the following:

1. Contractor Qualifications as per Article 1.5.A.
2. Sprinklers and nozzles.
3. Electrical Control Valves.
4. Drip Control Valves.
5. Quick Coupler Valves.
6. Isolation Valves.
7. Valve boxes.
8. Drip Tubing and fittings.
9. Drip Indicator.
10. Controllers and associated communication equipment.
11. Control cables. Include splice kits.
12. Decoders.
13. Grounding equipment.
14. Rain Sensor
15. PVC fittings.

16. PVC Primer and Cement.
17. Mainline, Lateral and Sleeve piping.
18. Mainline, Lateral pipe fittings.
19. As-Built Drawings: Any changes in the layout and or arrangements of the proposed irrigation system, or any other differences between the proposed system and actual installed conditions are to be recorded by the Irrigation Contractor in the form of an “As-Built” Drawing. As-Built Drawing to be produced in an electronic format using AutoCAD. Provide the Owner and the Landscape Architect and AutoCAD & PDF file along with five (5) hard copies of the As-Built Drawings before Work under this Contract will be considered for Acceptance. All automatic and manual valves, hose bibs or quick couplers, wire splice, and pressurized mainline locations shall be show with actual field dimensions in feet and inches from tow permanent reference points so they may be located easily in the field. Submittals of approved As-Built Drawing will precede any Application for Final Payment by the Contractor.

C. Operation and Maintenance Data: For irrigation systems, to include in emergency, operation, and maintenance manuals, including data for the following:

1. Automatic-control valves.
2. Isolation valves.
3. Sprinklers.
4. Control systems.
5. Test Reports: Field test results of the irrigation supply well to include flow rates, and recovery rates.
6. Shop Drawings: Submit certified shop drawings showing complete information for fabrication and installation of pump station. Shop drawings shall include a complete electrical wiring diagram.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Installing contractor must be licensed in the state that the work is being conducted. In the absence of a license requirement the contractor must be an Irrigation Association Certified Contractor, in good standing. Engage a firm or firms specializing in irrigation system installation. Installer shall have successfully completed five projects similar in material, size, scope and complexity to that indicated for this Project that have resulted in construction with a record of successful in-service performance. Provide listing of the 5 similar project showing number of zones, water source, mainline sizes, control system and project contact phone number and e-mail address. Contractor to be an Irrigation Association CID. Contractor must have manufacturers 2-wire installation and programming training certificates.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Codes and Standards: Perform the work in compliance with applicable requirements of governing authorities having jurisdiction. County regulations supersede these specifications. Notify Landscape Architect in writing of all discrepancies immediately.

D. Approval and Selection of Materials and Work: The selection of all materials and the execution of all operations required under the Drawings and Specifications is subject to the approval of the Owner and Landscape Architect. The have the right to reject any and all materials and any and all work which, in their opinion, does not meet the requirements of the Contract Documents at any state of the operations. Remove rejected Work and or materials from the project site and replace promptly.

E. Do Not Make Substitutions: If the Contractor desires to make substitutions of materials, sufficient descriptive literature and material samples must be furnished to establish the material as an equal substitute. In addition, the Contractor must state his reasons for desiring substitute materials and any potential cost savings. Submit this request and information to the Landscape Architect.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.7 PROJECT CONDITIONS

A. The site irrigation system is comprised of 2 major components, sprinkler system and the control system.

B. The irrigation system is designed to operate under the following conditions. A minimum of 70 psi water pressure, and at least a 38 gpm available water supply at the pump station discharge outlet.

C. Insurance on irrigation materials or equipment stored or installed is the responsibility of the Contractor. Such insurance shall cover fire, theft and vandalism. Should the Contractor elect not to provide for such insurance, he will in no way hold the Owner responsible for any losses incurred by the aforementioned acts. The Contractor is responsible for all costs incurred in replacing damaged or stolen materials or equipment prior to Substantial Completion of the Work.

D. Obtain all required permits and pay all required fees, at no additional cost to the Owner. Any penalties imposed due to the failure to obtain permits or pay fees are the responsibility of the Contractor.

E. Provide and maintain all passageways, guard fences, warning lights and other protective devices required by the local authorities.

F. Existing grades: Existing grades will be within .2 feet of grades shown on the Civil Engineering Drawings at the time of work. Determine conditions of existing grades prior to beginning the Work. When irregular or incomplete grading conditions are encountered, notify the Owner in writing before beginning the Work. Determine location of existing drainage patterns and maintain patterns in completed Work. Perform Work in a manner which will avoid damage to finished grading and drainage patterns. All damage to finished grading and drainage resulting from Work covered in these Contract Documents shall be repaired at the Contractor's expense.

G. Existing Utilities: Determine location of underground utilities. Perform Work in a manner which will avoid possible damage. Excavate as required. Maintain grade stakes set by other unless removal is mutually agreed upon by parties concerned. All damage to utilities resulting from Work covered in these Contract Documents shall be repaired at the Contractor's expense.

H. Existing Conditions: Perform irrigation Work in Tree Protection zones and in existing or previously completed landscape areas to avoid damage and disturbance to these areas. Limit work in these areas to only that necessary to perform work specified herein and shown on the Drawings. Return and repair any areas damaged or disturbed while performing the Work to the existing conditions encountered prior to the Work.

I. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:

1. Notify Owner's Representative no fewer than two (2) days in advance of proposed interruption of water service.
2. Do not proceed with interruption of water service without Owner's Representative written permission.

J. Removal of Hardscape: Do not remove hardscape surface unless permitted under the following conditions:

1. Coordinate with Owner's Representative no fewer than two (2) days in advance of proposed hardscape removal.
2. Hardscape removal must not interrupt normal traffic flow on hardscape area.
3. Area of removal must be useable prior to close of workday and completely repaired within 2 days of removal.

1.8 COORDINATION

A. Coordinate installation of irrigation system with Owner's Representative and/or all other trades on site to ensure irrigation system or other work on site will not be damaged. Should contractor fail to coordinate, and damages occur it will be the contractor's responsibility to repair damages at his own costs.

1.9 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sprinkler Units: Equal to two (2) percent of amount installed for each type and size indicated, but no fewer than 10 units of each type.
2. Spray Sprinkler Units: Equal to two (2) percent of amount installed for each type and size indicated, but no fewer than 10 units.
3. Electric Control Valve Units: Equal to five (5) percent of amount installed for each type indicated, but no fewer than five (5) units of each size and type.
4. Isolation Valves: Equal to five (5) percent of amount installed for each type indicated, but no fewer than two (2) units of each type.
5. Decoders: A minimum of 2 units of each type.

1.10 PRE-INSTALLATION MEETING

A. Conduct a virtual conference/meeting. Review methods and procedures related to the site landscape irrigation system including, but not limited to the following.

B. The General Contractor is to contact the Irrigation Consultant/Landscape Architect and Owner Representative a minimum of 60 days prior to the schedule date of commencement of the irrigation installation.

C. Meet with Owner Representative and Irrigation Consultant/Landscape Architect to review Contract documents.

D. Verify current drawing release date with contractor’s documents.

E. Review submittal procedure including codes, substitutions, product data, qualifications, and As-Built procedures and formats.

F. Review project conditions including tap & meter Size, permits, utility locations and water conditions.

G. Review methods and procedures related to irrigation installation.

H. Review and finalize construction schedule and verify availability of materials, contractor’s personnel, equipment, and facilities needed to make progress and avoid delays.

I. Review warranty guidelines.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide and warrantee products by one of the manufacturers specified.

2.2 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, Schedule 40, Type S or E, Grade A or B, galvanized with threaded ends.

1. Steel Pipe Nipples: ASTM A 733 made of ASTMA 53A 53M or ASTM A 106, Schedule 40, galvanized, seamless steel pipe with threaded ends.
2. Malleable-Iron Unions: ASME B16.39, Class 150, hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface and female threaded ends.
3. Gray-Iron Threaded Fittings: ASME B16.4, Class 125, galvanized, standard pattern.
4. Cast-Iron Flanges: ASME B16.1, Class 125.
5. Cast-Iron Flanged Fittings: ASME B16.1, Class 125, galvanized.

B. Soft Copper Tube: ASTM B 88, Type L, water tube, annealed temper.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end.
3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.

C. Hard Copper Tube: ASTM B 88, Type L, water tube, drawn temper.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought- copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end.
3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.

D. PVC Pipe: ASTM D 1785, PVC 1120 compound, Class 200.

1. Pipe 3” and larger to have gasket joint connections. Pipe 2-1/2” and smaller to be bell end.
2. PVC Socket Fittings, Schedule 40: ASTM D 2466, 2-1/2” and smaller
3. Ductile Iron Gasket Joint Fittings ASTM A536 for pipe sizes 3” and larger, all ductile iron fittings to have joint restraints as per manufacturer’s recommendations.

E. PVC Pipe: ASTM D 1785, PVC 1120 compound, Schedule 80.

1. PVC Socket Fittings, Schedule 80: ASTM D 2467.
2. PVC Threaded Fittings: ASTM D 2464.

2.3 GENERAL-DUTY VALVES

A. AWWA, Cast-Iron Gate Valves: AWWA C509, resilient-wedge nonrising-stem, gray- or ductile-iron body and bonnet gate valve, epoxy coated; with steel stem and 2” operating nut.

1. Minimum: Working Pressure: 200 psig.
2. End Connections: Mechanical join flanged or ring-tite.
3. Interior Coating: Complying with AWWA C550.
4. Manufacturers:

    a. Matco
    b. Leemco
    c. Approved Equal

B. Isolation Valve Boxes: Ten-inch circular valve box with 6” SDR 21 PVC pipe riser from top of valve to center line of valve box. Pipe to be centered on operating nut to allow easy access.

1. Operating Wrenches: Furnish total of two (2) steel, tee-handle operating wrenches with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

C. Bronze Gate Valves: MSS SP-80, Class 125, Type 1, non-rising-stem, bronze body with solid wedge, threaded ends, and malleable-iron hand wheel.

1. Manufacturers:

    a. NIBCO INC.
    b. Approved Equal.

2.4 SPECIALTY VALVES

A. Quick-Couplers: Factory-fabricated, bronze or brass, two-piece assembly. Include coupler water-seal valve; removable upper body with spring-loaded or weighted,

rubber-covered cap; hose swivel with ASME B1.20.7, 3/4-11.5NH threads for garden hose on outlet; and operating key.

1. Locking-Top Option: Vandal-resistant, locking feature. Include four matching keys with hose swivel for each key.
2. Manufacturers:

    a. Hunter Industries.
    b. Approved Equal.

2.5 CONTROL-VALVE BOXES

A. Plastic Control-Valve Boxes: Box and cover, with open bottom and openings for piping; designed for installing flush with grade. Size for all valves to be standard 14" rectangular.

1. Shape: Rectangular.
2. Sidewall Material: ABS or HDPE.
3. Cover Material: ABS or HDPE.

    a. Lettering: IRRIGATION.
    b. Green in Color.
    c. Lockable with hex key mechanism or similar.

4. Manufacturers:

    a. Rain Bird.
    b. Approved Equal.

2.6 SPRINKLERS

A. Description: Plastic housing and corrosion-resistant interior parts designed for uniform coverage over entire spray area indicated, at available water pressure.

1. Manufacturers:

    a. Hunter Industries.
    b. Approved Equal

2. Pop-up Spray Sprinklers: Fixed or adjustable pattern with screw-type flow adjustment, stainless-steel retraction spring, drain check valve, pressure regulation, co-molded riser seal that seals cap to body and pop-up heights of 4", 6", 12".
3. Pop-up, Rotary Sprinklers: Gear drive, full-circle and adjustable part-circle types with screw-type flow adjustment, stainless-steel retraction spring, stainless steel riser, drain check valve, flow stop valve, minimum of 8 nozzles available, integral rubber cover, adjustable from the top of the sprinkler and pop-up heights of 4", 6", 12".

2.7 DRIP COMPONENTS

A. Description: Inline Drip Tubing with pressure compensating and check valve emitters. Use manufacturers fittings specifically for specified tubing.

1. Manufacturers:

a. Rain Bird.
b. Or Approved Equal
c. Description: Drip Control Zone Kit with pressure regulation, disc filtration, filter cleaning indicator, 220 psi control valve and a pre-assembled package.

2. Manufacturers:

a. Rain Bird.
b. Or Approved Equal
c. Description: Drip Indicator. 6” pop-up sprinkler body with yellow indicator on sprinkler pop-up stem.

3. Manufacturers:

a. Hunter Industries.
b. Or Approved Equal
c. Description: Flush Valve. ½” plastic ball valve with barbed inlet and outlet.

4. Manufacturers:

a. Hunter Industries.
b. Or Approved Equal

2.8 ELECTRIC CONTROL VALVES

A. Description: Electrically controlled hydraulically actuated control valves.

1. Manufacturers:

a. Rain Bird.
b. Or Approved Equal

B. Features:

1. 24vac solenoid with 410mA inrush current and 280mA holding current.
2. Pressure rating of 220 psi.
3. Fabric reinforced diaphragm.
4. Internal and external bleed.
5. Flow control handle.
6. Contamination Resistant.

2.9 AUTOMATIC-CONTROL SYSTEM

A. Manufacturers:

1. Rain Bird.
2. Or Approved Equal

B. Exterior Control Enclosures: NEMA 250, Type 4, weatherproof, with locking cover and two matching keys; include provision for grounding.

1. Material: Enameled-steel or stainless steel.
2. Mounting: Surface type for wall mounting, concrete mounting base for pedestal.

C. Control Transformer/Decoder Output: 24VAC 4A secondary, with overload protection and or primary fuse.

1. Decoder Line Output: 32 VAC RMS over 2-wire path
2. Solenoid Capacity: 2 standard 24VAC solenoids per output, maximum output of 14 simultaneously.

D. Controller Stations for Automatic Control Valves: Each station is variable from approximately 1 minute to 23.9 hours. Include switch for manual or automatic operation of each station.

E. Timing Device: Adjustable, 24-hour, 365-day clock, with automatic operations to skip operation any day in timer period, to operate every other day, odd-even days, interval days, to operate 8 or more times daily.

1. Manual or Semi-automatic Operation: Allows this mode without disturbing preset automatic operation.
2. Minimum 30-day internal power storage: Automatically powers timing device during power outages.
3. Eight (8) start times.
4. Simultaneous program operation.
5. Test program.
6. One button manual start.
7. Seasonal adjust 25% to 200%.
8. Twenty (20) independent programs.
9. Surge Protection: Metal-oxide-varistor type on each station and primary power.
10. Rain Sensor compatible with over-ride capabilities.
11. Remote control capabilities.
12. Five (5) Master Valve and Flow Meter input.
13. Flow monitoring by station.
14. ET based irrigation scheduling.

F. Wiring:

1. Manufacturers:

a. Paige Electric.

b. Or Approved Equal

2. Feeder-Circuit Cables: No. 14 AWG minimum, between building and controllers.
3. Decoder Output Cable: No. 14 Paige #P7072D “Maxi Cable”.
4. Splicing Materials: 3M DBY-6 as required by manufacturer.

PART 3 - EXECUTION

3.1 GENERAL

A. Observation of Work in Progress: During the installation, the Landscape Architect\Irrigation Consultant will make regular site visits and reject any work and materials which do not meet the requirements called for in the Contract Documents.

B. Inspect project site prior to start of Work to determine that all site conditions are acceptable for Work to begin. Inform Landscape Architect\Irrigation Consultant of unsuitable conditions. Do not proceed with installation of the irrigation system until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

C. Locate all existing underground utilities prior to trenching and\or boring operations and protect them against damage during the Work. Obtain utility location from Owner and\or General Contractor and utilize utility locating services when necessary.

3.2 EXAMINATION

A. Investigate and determine available water supply, water pressure and flow characteristics.

B. When unanticipated utilities that conflict with the intended function or design are encountered, investigate, and measure the nature and extent of the conflict. Promptly submit a written report to the Owner for action.

3.3 EARTHWORK

A. Install warning tape directly above pressure piping, 12 inches below finished grades, except 6 inches below subgrade under pavement and slabs.

B. Install piping and wiring in sleeves under sidewalks, roadways, parking lots, and railroads.

1. Install piping sleeves prior to hardscape sub-base being installed if possible.
2. Sleeving installed in open trench to be completely backfilled crushed limestone, approved by owner’s representative and compacted to insure no future settling.
3. Pipe sleeves are to be a minimum of two times the diameter of the pipe in the sleeve.

C. Provide minimum cover over top of underground piping according to the following:

1. Irrigation Main Piping: Minimum depth of 18 inches from top of pipe to finished grade.
2. Circuit Piping: 12” within general landscape areas, piping to be a minimum of 3 inches laterally\vertically from any other pipe or conduit at all times.
3. Drain Piping: 12 inches.
4. Sleeves: 18 inches from top of pipe for mainlines and 12 inches from top of pipe for laterals.

3.4 EXCAVATION PREPARATION

A. Set stakes to identify locations of proposed irrigation system. Obtain Owner’s Representative’s approval before excavation.

B. Excavate area for pipe installation 4” wider than diameter of pipe.

1. Level trench base to insure consistent contact of pipe to trench bottom.
2. Remove all rocks and other sharp objects.
3. Place pipe in trench snaking from side to side if possible.
4. Backfill to the top of pipe compacting the sides.
5. Backfill in 8” lifts compacting to 90% between lifts until complete.
6. All trenches greater than 4” in width to be restored to grade, +- ¼”, with sod as approved by owner’s representative.
7. All trenches 4” or small in width to be restored to grade, +- ¼” with a minimum of 3” of topsoil as approved by owner’s representative.
8. Whenever possible trenching should be outside of a tree dripline. If trenching is done within the dripline it should be at least 10’ from existing tree, if 10’ is not possible the trenching must be done by hand and all tree roots greater than 1” to be left in place. All tree roots 1” or less may be removed by saw cutting root on either side of the excavation and root removal.

3.5 PIPING APPLICATIONS

A. Install components having pressure rating as shown on the plan.

B. Piping in above ground may be joined with flanges instead of joints indicated.

C. Aboveground Irrigation Main Piping: Use the following piping materials for each size range:

1. NPS 3 and Larger: Steel pipe; malleable-, gray-, or cast-iron fittings; and threaded joints.
2. NPS 25 and Smaller: hard copper tube, wrought- or cast-copper fittings, and soldered joints.

D. Underground Irrigation Main Piping: Use the following piping materials for each size range:

1. NPS 25 and Smaller: Class 200, PVC, pressure-rated pipe; Schedule 40, PVC socket fittings; and solvent-cemented joints.
2. NPS 3 and larger: Class 200 PVC, pressure rated pipe with gasket joint ends, Ductile Iron gasket joint fittings with manufacturer's recommended joint restraint.

E. Circuit Piping: Use the following piping materials for each size range:

1. NPS 4 and Smaller: Class 200, PVC, pressure-rated pipe; Schedule 40, PVC socket fittings; and solvent-cemented joints.

F. Underground Branches and Offsets at Sprinklers and Devices: Schedule 80, PVC pipe; acme threaded o-ring sealed PVC fittings.

1. Option: Plastic piping manufactured for this application may be used on sprinkler inlets of 1/2" or smaller instead of pipe and fittings specified, "swing pipe and spiral barbed elbows). If this is to be used the offset must be more than 12" and less than 18" as per detail.

G. Risers to Aboveground Sprinklers and Specialties: Type L hard copper tube, wrought-copper fittings, and soldered joints.

H. Sleeves: SCH 40 PVC pipe and socket fittings; and solvent-cemented joints.

I. Transition Fittings: Use transition fittings for plastic-to-metal pipe connections according to the following:

1. Couplings:

a. Underground Piping NPS 2-1/2 and Smaller: Manufactured fitting or coupling.
b. Underground Piping NPS 3 and Larger: PVC Flange with stainless steel bolts and rubber gasket.

2. Fittings:

a. Aboveground Piping: Plastic-to-metal transition fittings.
b. Underground Piping: Union with plastic end of same material as plastic piping.

J. Dielectric Fittings: Use dielectric fittings for dissimilar-metal pipe connections according to the following:

1. Underground Piping:

a. NPS 2 and Smaller: Dielectric couplings or dielectric nipples.
b. NPS 2-1/2 and Larger: Prohibited except in valve box.

2. Aboveground Piping:

a. NPS 2 and Smaller: Dielectric unions.

b. NPS 2-1/2 to NPS 4: Dielectric flanges.

3. Piping in Valve Boxes or Vaults:

a. NPS 2 and Smaller: Dielectric unions.
b. NPS 2-1/2 to NPS 4: Dielectric flanges.

3.6 VALVE APPLICATIONS

A. Aboveground, Shutoff-Duty Valves:

1. NPS 2 and Smaller: Bronze gate valve.
2. NPS 2-1/2 and Larger: Cast-iron, nonrising-stem gate valve.

B. Isolation Valves:

1. NPS 2 and Smaller: Bronze nonrising-stem gate valve.
2. NPS 2-1/2 and Larger: Cast-iron, nonrising-stem gate valve with 2” operating nut.

3.7 PIPING INSTALLATION

A. Location and Arrangement: Drawings indicate suggested location and arrangement of piping systems. Install piping as indicated unless deviations are approved by Owner’s Representative.

B. Install piping free of sags and bends.

C. Install groups of pipes parallel to each other with a space between minimum of 4”, spaced to permit single valve removal and or servicing.

D. Install fittings for changes in direction and branch connections.

E. Install dielectric fittings to connect piping of dissimilar metals.

F. Install underground thermoplastic piping according to ASTM D 2774 and ASTM F 690.

G. Lay piping on solid subbase, uniformly sloped without humps or depressions.

H. Install PVC piping in dry weather when temperature is above 32 deg F 5 deg C. Allow joints to cure at least 24 hours at temperatures above 32 deg F 5 deg C before testing unless otherwise recommended by manufacturer.

I. Install water regulators with shutoff valve and strainer on inlet and pressure gage on outlet. Flush the line prior to installation to remove debris. Install the valve so that the flow arrow marked on the valve body tag corresponds to the flow through the line. Install shutoff valve on outlet.

3.8 VALVE INSTALLATION

A. Electrical Control Valves: Install in valve box with top flush with and perpendicular to grade.

1. All electrical control valve boxes to be 14” rectangular valve box.
2. From bottom of valve to a depth of 6” install washed stone or gravel sized between ¾” and 1” in diameter to create sump and stabilize valve box.
3. Install valve box extensions as necessary to bring lid level with finished landscape grade.
4. Control Valves to be installed with center line of valve 12” below finished grade.

B. Underground, Manual Control Valves: Install with 6” SDR 21 PVC riser from top of pipe to center line of valve box finishing with 10” round valve box level with finished landscape grade.

1. Install valves and PVC pipe with restrained, gasketed joints as necessary at the same depth as the mainline pipe.

3.9 SPRINKLER INSTALLATION

A. Flush circuit piping with full head of water prior to installing sprinklers.

B. Install sprinklers at manufacturer's recommended heights perpendicular to grade.

C. Locate part-circle sprinklers to maintain a minimum distance of 4 inches from walls and 2 inches from other boundaries, unless otherwise indicated.

D. Adjust all sprinklers to irrigated plant material indicated for the station.

3.10 DRIP COMPONENT INSTALLATION

A. All dripline to be installed on FG. Flush all dripline tubing prior to covering with mulch. Install dripline in grid fashion as per plan details and manufacturers recommendations.

B. Install drip control zone kit as per valve installation specification 3.09.A and plan detail.

C. Install Drip Indicator as per specification 3.10.B and plan detail.

D. Install Drip Flush Valves in a 10” valve box as per plan detail.

3.11 AUTOMATIC-CONTROL SYSTEM INSTALLATION

A. Obtain approval of controller location from owner’s representative prior to installation. Install wall mount controller level and at eye level. Securely fasten controller to wall with metallic fasteners appropriate for wall type or install pedestal controller on concrete pad with all necessary conduit installed through the pad to accommodate all

wire to controller. All irrigation control wire between controller and finished grade to be in PVC electrical conduit.

B. Install control wire conduit in same trench as mainline piping and at least 4 inches to the side of the piping. Provide conductors of size not smaller than recommended by controller manufacturer. Install wire in separate sleeve under paved areas if irrigation piping is installed in sleeve. All wire splices to be in minimum 10” round valve box.

3.12 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Ground equipment according to ASIC Grounding Guidelines www.aisc.org. Resistance readings to ground to be as recommended by the manufacturer. If there are no manufactures requirements, then the controller should have a resistance of 10 ohms or less.

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.13 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, operate controllers and automatic control valves to confirm proper system operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
4. Remove and replace units and retest and re-inspect as specified above.

3.14 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service of control system.

B. Verify that controllers are installed and connected according to the Contract Documents.

C. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements in Division 26 Sections.

D. Complete startup checks according to manufacturer's written instructions.

3.15 ADJUSTING

A. Program controller(s) to ensure adequate moisture is available for the root zone of the plant. Insure there is no run-off, over watering or deep percolation. Ensure controller operates within irrigation window as defined by Owner's Representative or local governing authorities. See additional controller programming notes on plans provided.

B. Adjust automatic control valves to provide flow rate at rated operating pressure required for each sprinkler circuit. Use pressure regulation for each control valve if pressure is higher than recommended for the sprinklers in the circuit.

C. Adjust sprinklers so they will be 1/8 inch above finish grade in sodded lawns and 1/2 inch above grade in seeded lawns. In shrub beds adjust sprinklers to insure top of sprinkler is at finished mulch levels.

D. Adjust sprinklers arc and radius to ensure no water is sprayed outside of the irrigated area.

3.16 CLEANING

A. Flush dirt and debris from piping before installing sprinklers and other devices.

3.17 DEMONSTRATION

A. It is contractors' responsibility to train Owner's maintenance personnel to adjust, operate, and maintain sprinklers, isolation valves, controllers, and automatic control valves.

3.18 OBSERVATION AND ACCEPTANCE

A. Periodic site visits will be made by the Landscape Architect\Irrigation Consultant to review the quality and progress of the work. Work found to be unacceptable must be corrected within five (5) calendar days. Remove rejected materials promptly from the project.

B. Upon completion of the Work, the Contractor shall notify the Landscape Architect and Owner at least ten (10) days prior to requested date of the site visit for Substantial Completion of all portions of the Work. Landscape Architect\Irrigation Consultant will issue a punch list for all work to be corrected. All work on the punch list must be complete within five (5) working days from the date of the site visit. Where Irrigation Work does not comply with the requirements, replace rejected Work. If such replacements are not completed within the time specified, the Irrigation Contractor may be considered to be in default of the Contract, and the Owner may use the Contract Retainage to hire other Contractors to finish the work.

C. It will be the responsibility of the Irrigation Contractor to provide reliable communication system (remote control or two-way radios) for Substantial Completion and all periodic site visits.

D. If a site visit to verify Substantial Completion has been scheduled and the Landscape Architect\Irrigation Consultant arrives at the site and determines that the irrigation system is not substantially complete (all system components in place, operational and checked) the Contractor will be responsible for all expenses included but are not limited to the following: mileage, airfare, consultant's time, parking fees, meals, car rental, etc. All incurred expenses will be deducted from the final contract amount.

END OF SECTION 328400

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SECTION 329113.19 – PLANTING SOILS

PART 1 - GENERAL

1.1 SUMMARY

A. This scope of work includes, but is not limited to, all labor, materials, equipment, transportation and services necessary for, and incidental to performing all operations with salvaging, amending, and placing Planting Soils as shown on the drawings and as specified herein.

B. The scope of work in this section includes, but is not limited to, the following:

1. Locate, purchase, deliver and install soil amendments and furnished soil, as needed.
2. Salvage and stockpile existing site soils suitable for Planting Soils.
3. Modify existing site soil.
    a. Modify existing site soil in place for use as Planting Soils.
    b. Modify existing site soil within critical root zone.
4. Amend salvaged existing soil for use as Planting Soils and place.
5. Importing Furnished Soil for use as Planting Soils within tree pits.
6. Install Mulch and/or Compost over soil surface.
7. Fine grade Planting Soils.
8. Clean up and disposal of all excess and surplus material.

C. Related Specifications and References:

1. Section 329200 Lawns and Grasses
2. Section 329300 Trees, Plants, and Ground Covers

D. Related References:

1. ASTM: American Society of Testing Material cited section numbers.
2. U.S. Department of Agriculture, Natural Resources Conservation Service, 2003. National Soil Survey Handbook, title 430-VI. Available Online.
3. U.S. Composting Council https://www.compostingcouncil.org

1.2 DEFINITIONS

A. Amendment: Material added to soil to produce soil mix such as mulches or compost.

B. Biological Amendment: Amends used to enhance the biological characteristics of the soil such as Mycorrhizal additives.

C. Compacted soil: Soil where the bulk density is greater than the threshold for root limiting, and as further defined in this specification.

D. Compost: Well decomposed stable organic material as defined by the US Composting Council, and as further defined in this specification.

E. Existing soil: In-situ mineral soil present on site, and as further defined in this specification.

F. Fine grading: Final grading of the soil to achieve proposed contours, and as further defined in this specification.

G. Finished grade: Surface of elevation of Soils after final grading and 12 months of settlement, and as further defined in this specification.

H. Scarify: Loosening and roughening the surface of subsoil prior to placing additional soil on top, and as further defined in this specification.

I. Subsoil: Subsurface horizon or layer immediately below the topsoil, and as further defined in this specification.

J. Subsoiling: Loosening the subsoil by using a backhoe or by dragging a ripping shank or chisel thru the soil to depths of 18-24 inches or as specified, and as further defined in this specification.

K. Tilling: Loosening the topsoil with a rotary tine tilling machine, roto tiller, or spade tiller to depths of 6 inches or as specified, and as further defined in this specification.

L. Topsoil: Soil surface horizon or layer, and as further defined in this specification.

M. Undisturbed soil: Areas of soil with a topsoil that have not been graded or compacted.

1.3 SUBMITTALS

A. Product data and certifications: For each Planting Soil product, submit data and/or certificates that product meets the specification requirements, signed by the product manufacturer/supplier. Product data and certifications are required from each manufacturer/supplier, particularly when sources are changed.

B. Testing of furnished products is required at the following intervals:

1. Test every 400 cubic yards (CY) prior to placement or at a change in manufacturer/supplier.

C. Testing of salvaged and onsite source material is required at the following intervals:

1. Test Existing Soil in increments of 2 samples per small block and 3 samples for each of the larger blocks (B, D & H), or more frequently if conditions warrant

(e.g., change in physical appearance, etc.) prior to modification. The soil sample of the Existing Soil shall be collected as a composite sample.

D. Submit information identifying manufacturer/sources of all Planting Soil products.

1. The Owner's Representative shall have the right to reject any manufacturer/supplier.
2. Submit manufacturer/supplier name, address, telephone and fax numbers and contact name.
3. Submit certification that accepted manufacturer/supplier is able to provide sufficient quantities of Planting Soil product(s) for the entire or a defined portion of the project.

E. Representative Samples: Submit for each of the following to the Owner's representative for approval, prior to ordering or using the Planting Soil products:

1. Mix 1: Planting Soil Mix, two-gallon sample from each source. The sample shall be a mixture of random samples taken from the source stockpile or field.

1.4 SOIL INSTALLATION MOCKUPPrior to installation and modification of Planting Soil, construct onsite, a mockup of each soil type using the means and methods and equipment proposed by the Contractor to complete the work. The purpose of the mockup is to test the means and methods of the installation. In addition, it can be used to serve as a benchmark for completed soil compaction and to calibrate soil penetrometers reading to known proctor density of the mockup.

1.5 QUALITY ASSURANCE

A. Soil testing laboratory qualifications include an independent laboratory with experience and capability to conduct testing indicated herein and that specialize in USDA agricultural soil testing.

B. Compost testing laboratory qualifications include an independent, US Composting Council STA Program certified lab for compost testing. Verifying current participation in the STA program can also be achieved by logging onto the USCC website at https://www.compostingcouncil.org/page/CertifiedLabs.

C. All modified, furnished and installed Planting Soil products shall conform to the approved submittal's test analysis. Any Planting Soil products that fail to meet the criteria shall be modified or removed from the site and new soil installed if requested by the Owner's Representative.

D. Following installation of planting mixes and/or modification of existing soil, test soil compaction with a penetrometer.

1. Maintain at the site at all times a soil cone penetrometer with pressure dial and a soil moisture meter to check soil compaction and soil moisture.

a. Penetrometer shall be AgraTronix Soil Compaction Meter distributed by Ben Meadows, www.benmeadows.com or an approved equal.
b. Moisture meter shall be “general digital soil moisture meter” distributed by Ben Meadows, www.benmeadows.com or an approved equal.

2. Prior to testing the soil with the penetrometer check the soil moisture and penetrometer readings in the soil. Penetrometer readings are impacted by soil moisture and excessively wet or dry soils will read significantly lower or higher than soils at optimum moisture.
3. The penetrometer readings shall be within 20% plus or minus of the reading in the approved mockup when at similar moisture levels.

1.6 SOIL COMPACTION

A. Bulk density method, standard proctor method ASTM D 698 and penetrometer resistance method are all common ways to measure, quantify and assess levels of compaction. This specific requires the penetrometer resistance method and equate it to the standard proctor method.

B. The following parameters shall define the general description of threshold points of soil compaction in existing, modified and installed soil and subsoil.

1. Penetrometer Resistance Method uses a penetrometer to measure compaction in PSI (pressure per square inch). Soil moisture shall be measured at the same time to ensure moisture is within the allowable range for compaction testing.

C. The following are penetrometer resistance thresholds for levels of compaction:

1. Acceptable Compaction: Good rooting anticipated, but increasing settlement expected as compaction is reduced and/or organic matter is increased. Approximately 75-250 PSI.
2. Root limiting Compaction: Root grow is limited with fewer, shorter and slower growing roots. Approximately 300 PSI.
3. Excessive Compaction: Roots not likely to grow but can penetrate soil when soil moisture is above field capacity. Approximately greater than 400 PSI.

1.7 DELIVERY, STORAGE AND HANDLING

A. In addition, the following provision is established: Material shall not be handled or hauled, placed or compacted when it is wet as after a heavy rainfall or is frozen. Soil shall be handled only when the moisture content is less than at field capacity. The Owner’s Representative shall be consulted to determine if the soil is too wet to handle.

B. Store and handle packaged materials in strict compliance with manufacturer’s instructions and recommendations. Protect all materials from weather, damage, injury and theft.

C. Prohibit vehicular and pedestrian traffic on or around stockpiled planting soil.

D. Soil that is to be stockpiled longer than two weeks, whether on or off site, shall not be placed in mounds greater than ten feet high. If soil stockpiles greater than ten feet high are present longer than two weeks then the contractor shall break down and disperse soil so that mounds do not exceed the ten foot height restriction for longer than two weeks.

E. Vehicular access to the site is restricted. Before construction, the Contractor shall submit for approval a plan showing proposed routing for deliveries and site access.

PART 2 - PRODUCTS

2.1 MIX 1: PLANTING SOIL MIX

A. Planting Soil Mix shall be mixes of Existing Soil and amendments (Topsoil, Compost, and Pine Bark Nuggets) to make new soil that meets the project goals for the indicated planting area. They may be mixed off site or onsite. If Existing Soil does not meet the physical and chemical criteria, furnished soil will be used.

B. Existing Soil prior to modification shall meet the following physical and chemical criteria:

1. Soil texture: USDA loam, sandy loam
2. pH value: 5.5-8.0
3. Percent organic matter (OM): 1-5% by dry weight
4. Soluble salt level: less than 2.0 mmhos/cm

C. Planting Mix Topsoil shall be composed of Existing Soil and Topsoil to be placed in planting areas requiring fill.

1. The mix of Existing Soil and Compost shall be a mix ratio of 50% Topsoil and 50% Existing Soil by volume.
2. Final tested organic matter between 4-10% by dry weight.

D. General requirements for all modifications:

1. Take soil samples of existing soil, test for chemical and physical properties, test compaction, and make appropriate adjustments.
2. All soil grading, subsoiling and tilling must be completed at times when soil moisture is below field capacity.

E. Description of condition to be modified: Deep soil compaction from previous grading, filling or compaction forces. The soil organic matter content is not suitable for proposed planting.

1. Soil Ripping, depending on available space:

a. After grading and removing all plants and debris from the surface.

b. Spread Planting Soil Mix #1 over the soil surface. Using a tracked dozer or similar large grading equipment, loosen the soil by dragging a ripping shank or chisel thru the soil to depths of 18-inches with ripping shanks spaced 18 inches or less apart in two directions. The number of shanks per pull is dependent on the degree of soil compaction and the size of the dozer. The mulch will be mixed into the soil with the ripping shanks or chisel.

2.2 MIX 2: FURNISHED SOIL FOR TREE PITS

A. Planting Soil for Tree Pits shall be imported topsoil for use in tree pits of large tree stock. Locations to be determined based on proposed planting plan. They may be mixed off site or onsite.

B. Furnished topsoil for tree pits shall meet the following physical and chemical criteria:

1. Soil texture: USDA loam, sandy loam
2. pH value: 5.5-7.0
3. Percent organic matter (OM): 4-10% by dry weight
4. Soluble salt level: less than 2.0 mmhos/cm

2.3 COMPOST

A. Compost: Compost shall be a well decomposed, stable, weed free organic matter source. It shall be derived from leaves or yard waste. The compost shall be composted for a minimum of 9 months and at temperatures sufficient to break down all woody fiber, seeds, and leaf structures. The compost shall be free of debris such as plastics, metal, concrete or other debris. The compost shall be free of stones larger than 1/2", larger branches and roots. The compost shall be a dark brown to black color and be capable of supporting plant growth with appropriate management practices and other amendments as applicable, with no visible free water or dust, with no unpleasant odor.

B. Compost shall be commercially prepared and meet the US Composting Council (USCC) Seal of Testing Assurance (STA) program. Leaf compost can also be sourced directly from the Georgia Tech Facilities.

C. Compost shall meet the following parameters:

Parameters[1]	**Reports as (units of measure)**	**General Range**
pH	pH units	6.0-8.5
Soluble Salt Concentration (electrical conductivity)	dS/m (mmhos/cm)	Maximum 10
Moisture Content	%, wet weight basis	30-60
Organic Matter Content	%, dry weight basis	30-65[2]
Particle Size	% passing a selected mesh size, dry weight basis	Minimum of 98% pass through ¾” screen or smaller

Parameters[1]	**Reports as (units of measure)**	**General Range**
Bulk Density	pounds/cubic yard	Unit only needed for estimating application rate of organic amendment.
Chemical Contaminants[3]	Mg/kg (ppm)	Meet or exceed US EPA Class A standard, 40 CFR 503.13, Tables 1 and 3 levels
Biological Contaminants[4] Select Pathogens Fecal Coliforms Bacteria, or Salmonella	MPN per gram per day dry weight; MPN per 4 grams per dry weight	Meet or exceed US EPA Class A standard, 40 CFR 503.32(a) levels
[1]Recommended test methodologies are provided in Test Methods for the Examination of Composting and Compost (TMECC, The US Composting Council) [2]This is the typical range of organic matter content found in compost. An organic matter content greater than 65% would also be acceptable. [3]US EPA Class A Standard, 40 CFR 503.13, Table 1 and 3 levels = Arsenic 41 ppm, Cadmium 39ppm, Copper 1,5Z0ppm, Lead 300ppm, Mercury 17ppm, Molybdenum 75ppm, Nickel 420ppm, Selenium 100ppm, Zinc 2,800ppm. [4]US EPA Class A standard, 40 CFR 503.32(a) levels = Salmonella <3 MPN/4 grams of total solids or Fecal Coliform <1000 MPN/gram of total solids.		

2.4 MULCH

A. Mulch: Refer Section 329200 Lawns and Grasses, Section 329300 Trees, Plants, and Ground Covers, and Planting Details.

PART 3 - EXECUTION

3.1 COORDINATION WITH PROJECT WORK

A. The Contractor shall coordinate with all other work that may impact the completion of the Planting Soil work. Prior to start of work, the Contractor shall prepare a detailed schedule of the work for coordination with other trades/work (i.e. utilities, buildings, paths, etc.).

3.2 EXISTING SOIL MODIFICATION

A. Follow the requirements for modifying existing soil as indicated in Part 2.

3.3 PLANTING SOIL INSTALLATION FOR PLANTING SOIL MIX AND FURNISHED SOIL FOR TREE PITS

A. In areas of soil installation above existing subsoil, scarify the subgrade prior to installing Planting Soil Mix or Furnished Soil for Tree Pits.

B. Install Planting Soil Mix in 12 inch lifts to the required depths.

C. Limit paths of construction vehicle traffic to reduce the impact of compacting in Planting Soils.

D. Depths and grades shown on the drawing are final grades after settlement and shrinkage of compost material. The Contractor shall install the Planting Soils at a higher level to anticipate this settlement. A minimum settlement of approximately 10-15% of soil depth is expected. All grade increases are assumed to be measured prior to addition of surface Compost or Mulch.

3.4 COMPACTION REQUIREMENTS FOR MODIFIED EXISTING SOIL AND INSTALLED PLANTING SOIL MIXES AND FURNISHED SOIL FOR TREE PITS

A. Compact installed Planting Soil to the compaction rates indicated and using the methods approved for the soil mockup. Compact each soil lift as the soil is installed.

B. Existing soil that is modified by subsoiling or tilling shall have a density to the depth of the modification, after completion of the loosening, such that the penetrometer reads approximately 75 to 250 psi at soil moisture approximately the mid-point between wilting point and field capacity. This will be approximately between 75 and 82% of maximum dry density standard proctor.

C. Installed Planting Soil Mix and re-spread salvaged existing soil shall have a soil density through the required depth of the installed layers of soil, such that the penetrometer reads approximately 75 to 250 psi at soil moisture approximately the mid-point between wilt point and field capacity. This will be approximately between 75 and 82% of maximum dry density standard proctor.

D. Planting Soil compaction shall be tested at each lift using a penetrometer calibrated to the mockup soil and its moisture level. The same penetrometer and moisture meter used for the testing of the mockup shall be used to test installed soil throughout the work.

E. Maintain moisture conditions within the Planting Soil during installation or modification to allow for satisfactory compaction. Suspend operations if the Planting Soil becomes wet.

F. Provide adequate equipment to achieve consistent and uniform compaction of the Planting Soils. Use the smallest equipment and/or equipment with low ground pressure tires that can reasonably perform the task of spreading and compaction.

3.5 FINE GRADING

A. The Owner’s Representative shall approve all rough grading prior to the fine grading, planting and mulch or compost over finished grade.

B. Grade the finished surface to meet the finished grades shown on the drawings, allowing the finished grade to remain higher (10-15% of depth of soil modification) than the grade on the grading plan to anticipate settlement over the first year.

C. Utilize hand equipment, small garden tractors with rakes or teethed buckets, or equipment with low ground pressure tires to keep surface rough without further compaction. Do no use equipment that will smooth, compress and/or compact the finished grade.

D. Provide smooth, rounded transitions between slopes of different gradients and direction unless otherwise shown on drawings or directed by the Owner's Representative.

3.6 CLEANUP

A. Repair and re-establish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or compaction due to subsequent construction operations or weather conditions. Scarify or remove and replace material to a depth as directed by the Lead Landscape Architect; reshape at optimum moisture content to the required density.

B. Remove and dispose of all excess Planting Soil products and other material bough onsite by the Contractor.

3.7 SUBSTANTIAL COMPLETION ACCEPTANCE

A. The Owner's Representative shall review the Planting Soil work and make a determination if the work is substantially complete upon written notice from the Contractor.

3.8 FINAL ACCEPTANCE/SOIL SETTLEMENT

A. At the end of the plant warrantee and maintenance period, the soil installation work and establish all provisions of the contract are complete and work is satisfactory.

B. The Contractor shall restore any soil settlement and/or erosion areas to grades show on the drawings. When restoring grades, remove plants and mulch/compost and add appropriate Planting Soil before restoring the planting and mulch/compost over the finished grade. Do not place additional soil over the root balls of plants, on top of plants or on top of mulch/compost.

END OF SECTION 329113.19

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SECTION 329119 - LANDSCAPE GRADING

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all equipment and materials, and do all work necessary to complete the site grading, as indicated on the Drawings and as specified.

1.2 REFERENCES

A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

1. American Society for Testing and Materials (ASTM):

D 1556	Density of Soil in Place by the Sand-Cone Method
D 2167	Density and Unit Weight of Soil In Place by the Rubber-Balloon Method

1.3 EXISTING CONDITIONS

A. By submitting a bid, the Contractor affirms that he has carefully examined the site and all conditions affecting work under this Section. No claim for additional costs will be allowed because of lack of full knowledge of existing conditions.

1.4 QUALITY CONTROL

A. The Design Professional reserves the right to perform on-site observation during the grading operations. The observations may include, but not be limited to the following:

1. Observation of subgrade preparation for slab-on-grade and paved areas.
2. Observation of rough and finish grading operations.

B. All grade breaks shall be staked with grade stakes at each end, any change of direction, and at 20’ centers along the length for Design Professional’s review during grading operations.

C. The Design Professional's presence does not include supervision or direction of the actual work by the Contractor, his employees, or agents. Neither the presence of the Design Professional, nor any observations and testing performed by him shall excuse the Contractor from defects discovered in his work.

1.5 PROTECTION OF EXISTING STRUCTURES AND UTILITIES

A. The work shall be executed in such manner as to prevent any damage to adjacent property and any other property and existing improvements such as, but not limited to: streets, curbs, paving, utility lines and structures, monuments, bench marks and other public and private property.

B. In case of any damage or injury caused in the performance of the grading work, the Contractor shall, at his own expense, make good such damage or injury to the satisfaction of, and without cost to the Owner. Existing roads, sidewalks, and curbs damaged during the grading work shall be repaired or replaced to their original condition at the completion of operations. The Contractor shall replace, at his own cost, existing benchmarks, monuments, and other reference points which are disturbed or destroyed.

1.6 COORDINATION

A. Prior to start of grading operations, the Contractor shall arrange an on-site meeting with the Design Professional for the purpose of establishing Contractor's schedule of operations and scheduling inspection procedures and requirements.

B. As construction proceeds, the Contractor shall be responsible for notifying the Design Professional prior to start of grading operations requiring inspection and/or testing.

C. The Contractor shall be responsible for obtaining test samples of soil materials proposed to be used and transporting them to the site sufficiently in advance of time planned for use of these materials for testing of materials to be completed. Use of these proposed materials by the Contractor prior to testing and approval or rejection, shall be at the Contractor's risk.

PART 2 - PRODUCTS

2.1 SOURCE OF MATERIALS

A. Material shall be obtained from off-site sources.

PART 3 - EXECUTION

3.1 GRADING - GENERAL

A. Uniformly grade areas within the limits of site grading under this section, including adjacent transition areas. Smooth finished surfaces within specified tolerances, and between points where elevations are shown, or between such points and existing grades.

B. The degree of finish required will be that ordinarily obtainable from either blade-grader or scraper operations.

1. Grade Breaks located on the plans indicate crisp transitions, not blended or rounded edges. These should be clean, sharp, and uniform in line and curve as indicated on the plans.

3.2 ROUGH GRADING

A. General: Rough grading shall include the shaping, trimming, rolling and refinishing of all surfaces of the subbase, shoulders, earth embankments and the preparation of grades as shown on the Drawings. The grade of shoulders and sloped areas may be done by machine methods.

B. Complete all cutting, filling and grading to lines and grades indicated on the Drawings. Grade evenly to within the dimensions required for grades shown on the Drawings and specified herein. No stones larger than 4 in. shall be placed in upper 6 in. of fill. Fill shall be left in compacted state at the end of work-day and sloped to drain.

1. Design Professional may make such adjustments in grades and alignments as are found necessary to avoid special conditions encountered.
2. Provide a smooth transition between adjacent existing grades and new grades.
3. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

C. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Lawn or Unpaved Areas: Plus or minus 1 inch.
2. Pavements: Plus or minus 1/4 inch.
3. Up to 2 in. in 10 ft. – 0 in. tolerance shall be permitted on slopes provided the slopes are uniform in appearance and without any abrupt changes.
4. Traffic of men and equipment across soil subgrade areas shall be prohibited following excavation to the required lines and grades.

3.3 FINE GRADING

A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

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. Finish Grading:

1. Lawn or Unpaved Areas: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future.
2. Pavements: Shape the surface of the areas under pavement to line, grade and cross- section, with the finish surface not more than 1/4 in. above or below the required subgrade elevation, compacted as specified, and graded to prevent ponding of water after rains. Include such operations as plowing, disking, and any moisture or aerating required to provide the optimum moisture content for compaction. Fill low areas resulting from removal of unsatisfactory soil materials, obstructions, and other deleterious materials, using satisfactory soil material. Shape to line, grade, and cross- section as shown on the Drawings.

3.4 MAINTENANCE

A. Protect newly graded areas from traffic and erosion. Keep free of trash and debris.

B. Repair and re-establish grades in settled, eroded, and rutted areas to the specified tolerances.

C. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify the surface, re-shape, and compact to the required density prior to further construction.

3.5 CONSTRUCTION WASTE MANAGEMENT

A. Comply with the requirements of Division 01 for removal and disposal of construction debris and waste.

END OF SECTION 329119

SECTION 329200 - LAWNS AND GRASSES

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all materials and equipment, and do all work required to complete the seeding and sodding of lawn areas, including removal of existing vegetation, grading, furnishing and placing planting soil, as indicated on the Drawings and as specified.

1. Extent of sod and seed areas will be reviewed and approved by Design Professional and Owner prior to commencement of Work of this Section.
2. The placement of the sod shall be sequenced in such a manner as to allow proper root growth and establishment prior to the completion of the project and acceptance by the Owner.

1.2 REFERENCES

A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

1. American Society for Testing and Materials (ASTM):

a. C 136 Sieve Analysis of Fine and Coarse Aggregates
b. D 422 Particle-Size Analysis of Soils
c. E 11 Wire-Cloth Sieves for Testing Purposes

2. American Sod Producers Association –Guideline Specifications for:

a. Sodding: FSO-F-241 Fertilizers, Mixed, Commercial

1.3 SUBMITTALS

A. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture stating the botanical and common name and percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

1. Certification of each seed mixture for turfgrass sod, identifying source, including name and telephone number of supplier.

B. Onsite Topsoil Sample: Submit 1quart of topsoil proposed for use.

C. Soil Mix Sample: Submit 1 quart of each proposed soil mix, including the components of the soil mix.

D. Soil Report: Submit results of laboratory soil tests of on-site soil and proposed topsoil for soil mix.

E. Fertilizer Analysis (to be used in soil mix and on lawn areas): Submit label or technical data for fertilizer bearing the trade name, manufacturer's name, weight and analysis.

F. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of lawns during a calendar year. Submit before expiration of required initial maintenance periods.

1.4 OWNER'S INSPECTION AND TESTING

A. Work will be subject to inspection at all times by the Design Professional. The Owner reserves the right to engage an independent testing laboratory to analyze and test materials used in the construction of the work. Where directed by the Design Professional, the testing laboratory will make material analyses and will report to the Design Professional whether materials conform to the requirements of this specification.

1. Cost of tests and material analyses made by the testing laboratory will be borne by the Owner when they indicate compliance with the specification, and by the Contractor when they indicate non-compliance.
2. Testing equipment will be provided by and tests performed by the testing laboratory.
3. Upon request by the Design Professional, shall provide such auxiliary personnel and services needed to accomplish the testing work.
4. Gradation of granular materials shall be determined in accordance with ASTM C 136.
5. Sieves for determining material gradation shall be as described in ASTM E 11.

1.5 CONTRACTOR'S INSPECTION AND TESTING

A. The Contractor shall engage an independent testing agency, experienced in the testing of agricultural soils and acceptable to the Design Professional, to perform the topsoil/planting soil tests and analyses specified herein. All costs associated with testing shall be the Contractor's responsibility.

1. Particle size analysis shall include the following gradient of mineral content:

USDA Designation	Size in mm
Gravel	+ 2 mm
Very coarse sand	1-2 mm
Coarse sand	0.5-1 mm
Medium sand	0.25-0.5 mm
Fine sand	0.1-0.25 mm

Very fine sand	0.05-0.1 mm
Silt	0.002-0.05 mm
Clay	< 0.002 mm

2. Chemical analysis shall include the following:

   a. pH and buffer pH.
   b. percentage of organic content by oven-dried weight.
   c. Nutrient levels by parts per million, including phosphorus, potassium, magnesium, manganese, iron, zinc, and calcium. Nutrient test shall include testing laboratory recommendations for supplemental additions to the soil, if necessary, based on the requirements for ornamental horticultural plants. Recommendations shall include rates at which additives are to be applied.
   d. Soluble salt by electrical conductivity of a 1:2 soil/water sample.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Digging Sod:

1. Sod shall not be dug at the nursery or approved source until ready to transport sod to the site of the work or acceptable storage location.
2. Before stripping, sod shall be mowed at a uniform height of 2 in.
3. Cut sod to specified thickness and to standard width and length desired.

B. Transportation of Sod:

1. Sod transported to the Project in open vehicles shall be covered with tarpaulins or other suitable covers securely fastened to the body of the vehicle to prevent injury. Closed vehicles shall be adequately ventilated to prevent overheating of the sod.
2. Evidence of inadequate protection following the digging, carelessness while in transit, or improper handling shall be cause for rejection.
3. Sod shall be kept moist, fresh, and protected at all times. Such protection shall encompass the entire period during which the sod is in transit, being handled, or are in temporary storage.
4. Upon arrival at the temporary storage location or the site of the work, sod material shall be inspected for proper shipping procedures. Should the sod be dried out, the Design Professional will reject the sod. When sod has been rejected, the Contractor shall at once remove it from the area of the work and replace it with acceptable material.
5. Unless otherwise authorized by the Design Professional, the Contractor shall notify the Design Professional at least two working days in advance of the anticipated delivery date of sod material. Certificate of Inspection when required shall accompany each shipment.

C. Handling and Storage of Sod:

1. Sod material shall be handled with extreme care to avoid breaking or tearing strips.

2. Sod shall not be stored for longer than 30 hours prior to installation. Sod shall be stored in a compact group and shall be kept moist. Sod shall be prevented from freezing.
3. Sod that has been damaged by poor handling or improper storage will be rejected by the Design Professional.

D. Deliver seed in original sealed containers, labeled with analysis of seed mixture, percentage of pure seed, year of production, net weight, date of packaging, location of packaging, and name of seed grower. Damaged packages will not be accepted.

E. Seed shall be stored under cool and dry conditions so that the endophytic seed in the mixture is capable of maintaining a high level of endophytes.

F. Deliver fertilizer in sealed waterproof bags, printed with manufacturer's name, weight, and guaranteed analysis.

1.7 PLANTING SEASON

A. Planting season shall be as follows:

Material:	Planting Season:	
	Spring	Fall
Seeding: Cool Season	3/1 to 5/15	9/1 to 11/15
Seeding: Warm Season	3/31 to 8/31	
Sodding: Cool Season	3/1 to 5/15	9/1 to 11/15
Sodding: Warm Season	4/15/ to 8/15	

1. Dormant Bermuda Grass sod may be installed, however, Contractor shall assume full responsibility for all sod through establishment and acceptance. Owner will not pay for dormant sod until fully established during season.

B. Planting shall only be performed when weather and soil conditions are suitable for planting the material specified in accordance with locally accepted practice.

C. Planting season may be extended with the written permission of the Design Professional.

1.8 WARRANTY

A. Warranty for a period of one year, following the Date of Substantial Completion of the Project, all grass / seed against any defects (including: death and unsatisfactory growth) as determined by the Owner’s Representative. Defects resulting from neglect by the Owner, abuse or damage by others, or unusual phenomenon or incidents beyond the Contractor's control are expected. Should questions arise concerning the responsibility of replacement, the Owner’s Representative will be available for arbitration provided the Owner and Contractor mutually desire.

B. Remove and replace all lawn found to be dead or in unhealthy condition during warranty period as determined by Owner's Representative or Owner. Make replacements as soon as weather conditions permit.

C. Replacements: Match adjacent specimens of same species. Replacements are subject to all requirements stated in the Contract Documents and are subject to inspection by the Owner's Representative prior to removal.

D. Repair grades, lawn areas, paving and any other damage resulting from replacement planting operations, at no additional cost to the Owner.

E. Inspect Project Site monthly during warranty period to determine what changes, if any, should be made in the maintenance program. Submit all recommended changes in writing to the Owner.

F. Replacements made during the Warranty Period or following inspection for Final Acceptance will carry on additional one year warranty beginning at the time of replacement.

PART 2 - PRODUCTS

2.1 SEED

A. Seed mixture: Standard grade seed of the most recent season's crop. Seed shall be dry and free of mold. Seed shall be inoculated with endophytes. Unless otherwise directed by the Owner, seed mixture shall be as follows:

1. Bermuda Seed Mix:

a. Princess 77 Bermuda seed at a rate of 90 pounds per acre.

2.2 SOD

A. Certified Turfgrass Sod: Superior sod grown from certified, high-quality seed of known origin or from plantings of certified grass seedlings or stolons. It shall be inspected by the certification agency of the state in which it is grown to assure satisfactory genetic identity and purity, overall high-quality and freedom from noxious weeds as well as excessive quantities of other crop and weedy plants at time of harvest. All seed or original plant material in mixture must be certified. Turfgrass sod shall meet the published state standards for certification.

1. Sod shall be 'Tifway 419' Bermudagrass as shown on the plans.

B. Sod shall be nursery grown on cultivated mineral agricultural soils. Sod shall have been mowed regularly and carefully, and otherwise maintained from planting to harvest.

C. Type and Size of Sod:

1. Furnish either big roll or block sod. Ensure that big roll sod is a minimum of 21 in. wide x 52 ft. long. Minimum dimensions for block sod shall be 12 in. wide x 22 in. long. Ensure that all sod consists of uniform soil thickness of not less than 1 in.

D. Strength of Sod Strips: Standard size sections of sod shall be strong enough to support their own weight and retain their size and shape if suspended vertically when grasped in the upper 10% of the section.

E. Moisture Content: Sod shall not be harvested or transplanted when moisture content (excessively dry or wet) may adversely affect its survival.

F. Time Limitations: Sod shall be harvested, delivered, and transplanted within a 36-hour period unless a suitable preservation method is approved prior to delivery. Sod not transplanted within this period shall be inspected and approved by the Design Professional prior to its installation.

G. Thatch: Sod shall be relatively free of thatch. A maximum of 1/2 in. (uncompressed) thatch will be permitted.

H. Diseases, Nematodes, and Insects: Sod shall be free of diseases, nematodes, and soil-borne insects. State Nursery and Plant Materials Laws require that all sod be inspected and approved for sale. The inspection and approval must be made by the State Agricultural Department, Office of the State Entomologist.

I. Weeds: Sod shall be free of objectionable grassy and broad leaf weeds. Turfgrass sod shall be considered free of such weeds if less than five such plants are found per 100 sq. ft. of area.

1. Turfgrass sod shall not be acceptable if it contains any of the following weeds: common bermudagrass (wiregrass), quackgrass, johnsongrass, poison ivy, nutsedge, nimblewill, Canada thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel and bromegrass.

2.3 SOD FARM GROWING MEDIUM

A. Soil in which sod was grown shall be classified as loam or sandy loam (silt loam is not acceptable) and shall conform to the following grain size distribution for material passing the #10 sieve:

U.S. Sieve No.	% Passing by Weight	
	Minimum	Maximum
10	100	---
20	75	100
40	30	85
100	12	45
270	5	25
0.002 mm	1	4

1. The maximum retained on the #10 sieve shall be 15% by weight of the total sample.
2. Tests shall be by combined hydrometer and wet sieving in compliance with ASTM D422.
3. The organic content shall be between 3.0 and 8.0 percent.

2.4 PLANTING SOIL

A. Existing Topsoil

1. Existing topsoil from on-site source(s) may be used for planting soil, to the extent available, if testing of soil indicates that it meets the requirements of this Section for planting soil, or if approved by the Design Professional.

B. Native Planting Soil

1. Planting soil shall be composed of a natural, fertile, friable soil typical of cultivated topsoils of the locality, suitable for the germination of seeds and support of vegetative growth, with additives, if required, to achieve particle distribution and organic content specifications. Topsoil shall be taken from a well-drained, arable site, free of subsoil, large stones, earth clods, sticks, stumps, clay lumps, roots, other objectionable, extraneous matter, or debris nor contain toxic substances. Topsoil shall be screened using a mobile mechanical screening machine with a 1/2” sizes sieve. Planting soil shall have a pH value between 5.5 and 6.5 and organic matter content of 5 to 10% of total dry weight.
2. Planting soil shall have the following mechanical analysis (see Article 1.6 for particle sizes):

Approximate Particle Distribution	
Gravel	Less than 10%
Coarse to medium sand	55 – 65%
Fine to very fine sand	15 – 25%
Silt	10– 20%
Clay	15 – 20%

3. Minimum planting soil nutrient levels shall be: Nitrogen @ 5% average of organic matter, Phosphorus @ .02 to .05% average of total soil content, Potassium @ 1.2% average of total soil content.
4. The Contractor shall provide the Design Professional with planting soil test results, as specified in Paragraph 1.06, before the start of planting operations. If planting soil does not fall within the required particle distribution, organic content, or pH range, it shall be adjusted to meet the specifications through the addition of sand, compost, limestone, or aluminum sulfate to bring it within the specified limits.

C. Planting Soil Type:

1. 100% Existing or Native Planting Soil

2.5 COMPOST

A. Compost shall be derived from organic wastes such as food and agricultural residues, animal manures, mixed solid waste and biosolids (treated sewage sludge) that meet all State Environmental Agency requirements. The product shall be well composted, free of viable weed seeds and contain material of a generally humus nature capable of sustaining growth of vegetation, with no materials toxic to plant growth.

1. Compost shall have the following properties:

Parameters	Range
pH	5.5 – 8.0
Moisture Content	35% - 55%
Soluble Salts	≤ 4.0 mmhos (dS)
C:N ratio	15 – 30:1
Particle Size	< 1”
Organic Matter Content	> 50%
Bulk Density	< 1000 lbs./cubic yard
Foreign Matter	< 1% (dry weight)

2. Compost generator shall also provide minimum available nitrogen and other macro and micro nutrients to determine fertilizer requirements.
3. Guidelines for quantity of compost required to achieve suitable soil organic content in soil mixes for ornamental horticultural planting shall be as recommended by the compost manufacturer.
4. Organic matter shall be commercially prepared compost and meet US Composting Council STA/TMECC criteria or equal for Class I or II stable mature product. Compost made from primarily green yard waste shall not be acceptable.

2.6 LIMESTONE

A. Ground limestone shall be an agricultural limestone containing a minimum of 85% total carbonates, by weight. Ground limestone shall be graded within the following limits:

Sieve Size	% Passing by Weight
No. 10	100
No. 20	90
No. 100	60

2.7 WATER

A. Water shall be suitable for irrigation and free from ingredients harmful to seeded or sodded areas.

2.8 COMMERCIAL FERTILIZER

A. Starter fertilizer shall be HD Scotts Starter Fertilizer or approved equal.

B. Fertilizer shall conform to the following:

1. When applied as a topsoil amendment, fertilizer shall have an analysis that will deliver appropriate amounts of nitrogen, phosphorus, and potassium as required to remedy deficiencies revealed by testing the topsoil.

a. 50% of nitrogen shall be derived from natural organic source of ureaform.
b. Available phosphorus shall be derived from superphosphate, bone meal, or tankage.
c. Potassium shall be derived from muriate of potash containing 60% potash.

C. Fertilizer shall be delivered in manufacturer's standard container printed with manufacturer's name, material weight, and guaranteed analysis.

D. Fertilizers with N-P-K analysis other than that stated above may be used provided that the application rate per square foot of nitrogen, phosphorus, and potassium is equal to that specified.

2.9 SUPERPHOSPHATE

A. Superphosphate shall be composed of finely ground phosphate rock as commonly used for agricultural purposes and containing not less than 20% available phosphoric acid. The superphosphate shall be delivered to the site in the original unopened containers, each bearing the manufacturer's guaranteed analysis. Any superphosphate which becomes caked or otherwise damaged making it unsuitable for use, will be rejected.

2.10 WEED CONTROL

A. Weed control for stockpiled topsoil shall be a non-selective weed killer for control of grassy and broadleaf weeds; weed control shall have short residual, allowing seeding and sodding operations to occur within 7 days of application.

PART 3 - EXECUTION

3.1 PREPARATION OF SUBGRADE

A. Subgrade shall be examined to ensure that rough grading and all other subsurface work in lawn areas and other areas to be seeded or sodded is done prior to start of seeding.

B. The area to be sodded or seeded shall be stripped of any excess organic material or grass prior to installation. Topsoil remaining after organic material removal shall be removed, cleaned, and stockpiled for later use. Remove small loose rocks, stone and

debris of 1/2" or larger with a Harley Rock Machine or equivalent as required leaving the grade reasonably free of such miscellaneous matter.

C. Existing subgrade shall be loosened or scarified to a minimum depth of 3 in. prior to spreading topsoil. Subgrade shall be brought to true and uniform grade and shall be cleared of stones greater than 2 in., sticks, and other extraneous material.

3.2 SPREADING OF PLANTING SOIL

A. Planting soil shall be spread and placed to required depths, as indicated on the drawings.

B. Surfaces shall be graded and smoothed, eliminating all sharp breaks by rounding, scraping off bumps and ridges, and filling in holes and cuts.

C. Prior to installing any planting soil mix, the Design Professional will approve the condition of the subgrade.

D. In areas of soil installation, till the planting soil mix into the top layer of subgrade.

1. Scarify or till the surface of subgrade to a depth of 2 – 3 in. with a backhoe or other suitable device.
2. Spread a layer of the specified planting soil mix 2 – 3 in. deep over subgrade.
3. Thoroughly till the planting soil mix and the subgrade together.
4. Immediately install the remaining planting soil mix in accordance with the following specifications. Protect the tilled area from traffic. Do not allow tilled subgrade to become overly compacted.
5. In the event that the tilled area becomes overly compacted, till the area again prior to installing the planting soil mix.

E. Install the remaining planting soil mix in 8 – 10 in. lifts to the required depths.

F. The depths and grades indicated on the Drawings are the final grades after settlement and shrinkage of the organic material. Contractor shall install the planting soil mix at a higher level to compensate for this anticipated reduction of planting soil volume depending upon the predicted settling properties of each planting soil mix type.

3.3 PLANTING SOIL COMPACTION

A. Compact each 8 – 10 in. lift with mechanical compaction equipment to the compaction rates indicated.

1. Achieve a soil density of between 1.45 to 1.55 grams per cubic centimeter over dry weight divided by volume (80 to 85% of the standard proctor maximum dry density.)
2. Planting mix compaction shall be tested at each lift using a cone penetrometer calibrated to the mockup soil and its moisture level. The same penetrometer and moisture meter used for the testing of the mockup shall be used to test installed soil throughout the work.

3. Maintain at the site a hand penetrometer with pressure dial and a soil moisture meter to measure the compaction rates relative to the mock up soil compaction.

B. Maintain moisture conditions within the planting mixes during installation to allow for satisfactory compaction. Suspend installation operations if the planting mix becomes wet. Do not place planting mixes on wet of frozen subgrade.

C. Provide adequate equipment to achieve consistent and uniform compaction of the planting mixes. Use the smallest equipment that can reasonably perform the task of spreading and compaction.

1. Testing shall be performed by the Contractor.
2. Record the test results on a soil compaction log. This report shall include the location of the test. The depth of the test measures from the proposed finish grade, the penetrometer reading and the moisture meter reading.
3. Submit the compaction log at the end of the soil installation period. Soil compaction log shall be kept current and available at the site for review at all times.

3.4 APPLICATION OF FERTILIZER AND CONDITIONERS

A. Do not apply nitrogen between October 15 and March 15.

B. Fertilizer and conditioners shall be applied at the following rates:

1. Compost - as required by test results of topsoil.
2. Limestone - as required by test results of topsoil.
3. Fertilizer - as required by test results of topsoil.

C. Mixing with planting soil:

1. Fertilizer and conditioners shall be spread over the entire lawn areas at the application rates indicated above.
2. Materials shall be uniformly and thoroughly mixed into the top 4 in. of planting soil by disking, rototilling, or other approved method.

3.5 FINISH GRADING

A. Refer to Section 329119, Landscape Grading.

B. Planting soil shall not be fine graded until it is possible to follow immediately or within 24 hours with seeding or sodding operations. If topsoil is spread prior to this time it shall be cultivated to loosen soil prior to seeding or sodding.

C. Planting soil shall not be placed when subgrade or topsoil material are frozen, excessively wet, or excessively dry.

D. Contractor shall set grade lines for Design Professional’s review and approval.

1. Final surface of topsoil immediately before seeding and sodding shall be within + 1/2 in. of required elevation, with no ruts, mounds, ridges, or other faults, and no pockets or low spots in which water can collect. Stones, roots, and other debris greater than 1 in. in any dimension, which are visible at the surface, shall be removed and the resulting holes filled with topsoil, leaving a uniform planar surface.

E. Finish grade surface with a drag or rake. Round out all breaks in grade, smooth down all lumps and ridges, fill in all holes and crevices. Rolling with a light roller is acceptable, if the surface is scarified afterward.

F. In the event of settlement, the Contractor shall readjust the work to required finished grade.

G. Allow for sod thickness in areas to be sodded.

H. Remove small loose rocks, stone and debris of 1/2” or larger with a Harley Rock Machine or equivalent as required leaving the grade reasonably free of such miscellaneous matter. Remove all debris legally from the Site.

3.6 SEED APPLICATION

A. Seed shall be applied in two applications by mechanical spreader.

B. First Application: Seed shall be broadcast by means of an approved mechanical spreader, to give a uniform application at the following rates:

Seed
Refer to Article 2.1 Seed.

1. Seed shall be applied in two equal applications for uniform coverage; direction of travel of spreader for second pass shall be perpendicular to that of the first pass. Seeding shall not be done when it is raining or snowing, or when wind velocity exceeds 5 mph.
2. Following seeding the area shall be lightly raked to mingle seed with top 1/8 to 1/4 in. of soil. Area shall then be fine graded. Stones and other debris greater than 1 in. in any dimension which are visible on surface shall be removed.

C. Following seeding and raking, entire area shall be rolled with a hand roller having a weight of 60 to 90 lb./ft. of width, and a minimum diameter of 2 ft. Entire area shall then be watered by use of lawn sprinklers, or other approved means. Initial watering shall continue until the equivalent of a 2 in. depth of water has been applied to entire seeded surface, at a rate which will not dislodge the seed. Watering shall be repeated thereafter as frequently as required to prevent drying of the surface, until the grass attains an average height of 1/4 in. Watering methods and apparatus which may cause erosion of the surface shall not be permitted.

D. Evenly apply wheat straw 2 in. thick over all seeded areas. (Approximately 60 bales per acre). The Contractor under any circumstances, use local hay as it will most likely be Johnson Grass (Sorghum Halepense).

E. Apply asphalt emulsion binder to mulch at rate to effectively hold mulch in place. Immediately replace mulch that blows away.

F. Rope off entire seeded area to prevent vehicles and pedestrians from entering area.

3.7 SODDING

A. Edges of the sodded areas shall be smooth, and all sodded areas shall conform to the design cross sections and grade. At edges adjacent to curbs, paved areas, etc., top surface of earth in sod shall be 1/2 in. below adjacent hard surface.

B. Sod shall be placed and all sodding operations completed within 72 hours following stripping from sod source bed.

C. On slopes steeper than 2 to 1, sod shall be fastened in place with suitable wood pins or other approved methods, spaced at not less than 1 pin per square foot.

D. Surface of completed sodded area shall be smooth. Sod shall be laid edge-to-edge, with tight-butted, staggered joints. Sod shall be carefully placed to insure that it is neither stretched or overlapped. Immediately after laying sod shall be pressed firmly into contact with sod bed by tamping or rolling, to eliminate air pockets. Following compaction, topsoil shall be used to fill all cracks, and excess soil shall be worked into grass with rakes or other suitable equipment. Sod shall not be smothered with excess fill soil.

E. Immediately after sodding operations have been completed, entire surface shall be compacted with a cultipacker roller or other approved equipment weighing 100 to 160 lb./ft. of roller.

F. Lay sod to form a solid mass with tightly fitted joints. Snugly fit ends and sides of sod strips; do not overlap. Stagger strips to offset joints in adjacent courses. Work from boards to avoid damage to subgrade or sod. Tamp or roll lightly to ensure contact with subgrade. Work sifted soil into minor cracks between pieces of sod; remove excess to avoid smothering of adjacent grass.

G. Lay sod if from rolls as specified. Monofilament mesh is to be removed from the sod as it is placed. Lay sod to form a solid mass with tightly fitted joints. Trim ends of rolls as necessary to provide square joints and snugly fit ends and sides. Tamp or roll lightly to ensure contact with subgrade. Work sifted sand into minor cracks between pieces of sod; remove excess to avoid smothering of adjacent grass.

H. Anchor sod with sod staples to prevent slippage on slopes equal to or greater than 3:1 and wherever erosion can be anticipated. Lay sod perpendicular to slope direction, with staggered joints.

I. Immediately after sod installation, water thoroughly with a fine spray until the soil is damp to a depth of 4". The watering shall be the responsibility of the Contractor during the installation and maintenance period. The sod shall be kept moist until rooting occurs and then irrigate as needed a healthy and vigorous stand of grass.

J. Roll the surface after "rooting in" has occurred.

3.8 HYDROSEEDING

A. Hydroseeding may be used on any grassing area. Under this method, spread the seed, fertilizer, and wood fiber mulch in the form of a slurry. Seeds of all sizes may be mixed together.

B. Apply hydroseeding as follows:

1. Use wood fiber mulch as a metering agent and seed bed regardless of which mulching method is chosen. Apply wood fiber mulch at approximately 1000-1500 lbs./acre.
2. Prepare the ground for hydroseeding as specified for conventional seeding. Starter fertilizer may be added to the surface of the seed bed. Verify that all areas to receive the hydroseed mixture are free of vegetation and other objectionable materials. Verify that grades are within final specified standards and that the area is uniformly compacted.
3. Use specially designed equipment to mix and apply the slurry uniformly over the entire seeding area.
4. Agitate the slurry mixture during application.
5. Discharge slurry within one hour after being combined in the hydroseeder. Do not hydroseed when winds prevent an even application.
6. Closely follow the equipment manufacturer's directions unless the Engineer modifies the application methods.
7. Mulch the entire hydroseeded area.
8. Take precautions against overspray onto adjacent roads, curbs, sidewalks, buildings, and other surfaces except the ground areas scheduled to receive the seed. Contractor shall promptly clean all areas of overspray to the satisfaction of the Owner and Design Professional.

3.9 FERTILIZER

A. After sod is installed, apply liquid fertilizer for grow-in purposes. Alternate applications of 32-0-0 and 12-4-12 at a rate of 8 ½ gallons of each product per acre per week for a three week period, with three to four days between applications of 32-0-0 and 12-4-12.

B. Fertilizers shall be applied only during the growing season when Bermuda is completely out of dormancy. If fertilizer brand type recommends a different rate, the Contractor shall advise the Owner's Representative of the rate recommended prior to applying any fertilizer to clarify the proper rate of use.

C. 32-0-0 liquid fertilizer to be comprised of 7.89% ammoniacal nitrogen, 7.89% nitrate nitrogen and 16.22% urea nitrogen.

D. 12-4-12 liquid fertilizer to be comprised of 12% total nitrogen (N), 4% available phosphate (P_2O_5) and 12% soluble potash (K_2O).

3.10 MAINTENANCE

A. Begin maintenance immediately after installation.

B. Maintain sod until Date of Substantial Completion of the Project in total.

C. Maintain lawns by watering, weeding, fertilizing, weekly mowing, repair of eroded areas and re-seeding or re-sodding as necessary to establish a uniform stand of the specified grasses. Contractor shall perform “Grow-In” activity (weed control, fertilizing, watering & mowing) throughout the contract period and at a minimum, shall include 6 weeks of “Grow-In” activity and monitoring, after initial laying of sod. Grow-in activity per turf manufacturer recommendations. Provide written Grow-in and normal maintenance instructions to the Owner. Grow in activity shall continue until final acceptance by the Owner.

3.11 CLEAN UP AND PROTECTION

A. During Work, keep pavements clean and work area in an orderly condition.

B. Upon completion of Work, clear grounds of debris, superfluous materials and all equipment. Remove from Site to satisfaction of Owner.

C. Protect Sod from damage due to landscape operations, operations by other contractors and trades and trespassers. Maintain protection during installation and maintenance periods. Treat, repair or replace damaged Work as directed by Owner’s Representative, at no additional cost to the Owner.

END OF SECTION 329200

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SECTION 329300 – TREES, PLANTS, AND GROUND COVERS

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all materials and equipment, and do all work required to complete the planting soils and planting as indicated on the Drawings and as specified.

1.2 REFERENCES

A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

1. American National Standards Institute, Inc. (ANSI):

   a. Z60.1 American Standard for Nursery Stock (Sponsor: American Association of Nurserymen, Inc.)
   b. A300 American National Standards for Tree Care Operations

2. American Society for Testing and Materials (ASTM):

   a. F 405 Corrugated Polyethylene (Pe) Tubing and Fittings

3. "Hortus Third", A Concise Dictionary of Plants Cultivated in the United States and Canada, Cornell University, L.H. Bailey Hortorium, MacMillian Publishing Co., New York, NY.
4. International Society of Arboriculture (ISA)

1.3 SUBMITTALS

A. Samples: The following samples shall be submitted:

Material	Sample Size or Quantity
Mulch	1 ft.^{3}
Compost	1 ft.^{3}
Soil separator	1 ft.^{3}
Topsoil	1 ft.^{3}
Planting soil (each type)	1 ft ^{3}
Tree stake	24 in. length

B. Manufacturer's Product Data: Manufacturer's product data shall be submitted for the following materials:

1. Aluminum sulfate
2. Antidessicant
3. Fertilizer
4. Fungicide
5. Herbicide
6. Insecticide
7. Compost

C. Certificates: Labels from the manufacturer certifying that the product meets the specified requirements shall be submitted for the following materials:

1. Commercial fertilizer
2. Limestone
3. Compost

D. Test Reports: Test reports from an approved testing agency indicating compliance with the specifications shall be submitted for on-site soil, planting soil, topsoil, and any other materials designated by the Design Professional.

E. Planting Schedule: Submit planting schedule showing scheduled dates for each type of planting in each area of site, prior to beginning of the Work.

F. Maintenance Instructions: Upon completion of the installation, submit typewritten recommendations for maintenance of any portion of the landscape which, in the opinion of the Contractor, requires special attention.

1.4 OWNER'S INSPECTION AND TESTING

A. Work will be subject to inspection at all times by the Design Professional. The Owner reserves the right to engage an independent testing laboratory to analyze and test materials used in the construction of the work. Where directed by the Design Professional, the testing laboratory will make material analyses and will report to the Design Professional whether materials conform to the requirements of this specification.

1. Cost of tests and material analyses made by the testing laboratory will be borne by the Owner when they indicate compliance with the specification, and by the Contractor when they indicate non-compliance.
2. Testing equipment will be provided by and tests performed by the testing laboratory.

1.5 CONTRACTOR'S INSPECTION AND TESTING

A. Contractor shall submit soil test analysis report for each sample of planting soil, existing or other, and each specified planting soil type mix.

B. The Contractor shall engage an independent testing agency, experienced in the testing of agricultural soils and acceptable to the Design Professional, to perform the

topsoil/planting soil tests and analyses specified herein. All costs associated with testing shall be the Contractor's responsibility.

1. Particle size analysis shall include the following gradient of mineral content:

USDA Designation	Size in mm
Gravel	+ 2 mm Very coarse sand
	1-2 mm Coarse sand
	0.5-1 mm Medium sand
	0.25-0.5 mm Fine sand
	0.1-0.25 mm Very fine sand
	0.05-0.1 mm
Silt	0.002-0.05 mm
Clay	< 0.002 mm

2. Chemical analysis shall include the following:

   a. pH and buffer pH
   b. percentage of organic content by oven-dried weight
   c. Nutrient levels by parts per million, including phosphorus, potassium, magnesium, manganese, iron, zinc, and calcium. Nutrient test shall include testing laboratory recommendations for supplemental additions to the soil, if necessary, based on the requirements for ornamental horticultural plants. Recommendations shall include rates at which additives are to be applied.
   d. Soluble salt by electrical conductivity of a 1:2 soil/water sample.

1.6 SOURCE QUALITY CONTROL

A. Reference Standards

1. Standardized Plant Names, latest edition, by the American Joint Committee on Horticultural Nomenclature.
2. American Standard for Nursery Stock, ANSI Z601, latest edition, by the American Association of Nurserymen.

B. Selection of Plant Materials: Submit to the Design Professional the names and locations of nurseries proposed as sources of acceptable plant material. Inspect all nursery materials to determine that the materials meet the requirements of this section. Proposed materials shall be flagged at the nurseries by the Contractor prior to viewing by the Design Professional.

1. Schedule with the Design Professional a time for viewing plant material at the nursery. Trips to nurseries shall be efficiently arranged to allow Design Professional to maximize viewing time. A minimum of six weeks shall be allowed for this viewing prior to time that plants are to be dug.
2. Design Professional may choose to attach seal to each plant, or representative samples. Where requested by the Design Professional, photographs of plant material or representative samples of plants shall be submitted. Photographs shall

be clear images of actual plant material and not stock photos or internet images. In addition, photographs shall include; nursery tag with species of plant material, and scale.

3. Viewing and/or sealing of plant materials by the Design Professional at the nursery, in photograph, or representative sample does not preclude the Design Professional's right to reject material at the site of planting.
4. In the event plant material is found to be unacceptable, the Contractor will pursue other sources until acceptable plant material is found, at no additional cost to the Owner. If, due to unacceptable plant material at the Contractor's source, additional tagging trips are required by the Landscape Architect, the Contractor will reimburse the Landscape Architect for time ($1,000.00/day) plus travel expenses.

1.7 PLANT MATERIAL QUANTITIES

A. In the event of a discrepancy in plant material quantities between the Drawings and the Plant List(s), the Drawing quantity shall be required.

1.8 AVAILABILITY OF PLANT MATERIAL

A. Contractor is not to make substitutions. If specified landscape material is not obtainable, submit to Landscape Architect proof of non-availability and a proposal for use of equivalent material. Contractor must submit proof of non-availability, in the form of a written statement, from a minimum of 12 reliable Nursery Sources (American Nurserymen’s Association Members) that the plant in question is not obtainable in the Eastern United States.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Digging Plant Material: Plants shall not be dug at the nursery or approved source until the Contractor is ready to transport them from their original locations to the site of the work or acceptable storage location.

B. Transportation of Plant Material: Ship landscape material with certificates of inspection required by governing authorities. Inspection by Federal and/or State Governments at Grower does not preclude rejection of plants at the site by Landscape Architect. Comply with regulations applicable to landscape materials. Prepare plants for shipment to prevent damage to plants.

1. Plants transported to the project in open vehicles shall be covered with tarpaulins or other suitable covers securely fastened to the body of the vehicle to prevent injury to the plants. Closed vehicles shall be adequately ventilated to prevent overheating of the plants. Plants shall not remain in darkened enclosed trailer for more than 48 hours cumulative.
2. From March 15th to September 15, ship plant material to be transported over 100 miles at night only.

3. Plants shall be kept moist, fresh, and protected at all times. Such protection shall encompass the entire period during which the plants are in transit, being handled, or are in temporary storage.
4. Do not ship plant materials in temperatures below 20 degrees Fahrenheit.
5. Unless otherwise authorized by the Design Professional, notify the Design Professional at least three working days in advance of the anticipated delivery date of any plant material. A legible copy of the bill of lading, showing the quantities, kinds, and sizes of materials included for each shipment shall be furnished to the Design Professional.

C. Storage: Unless specific authorization is obtained from the Design Professional, plants shall not remain on the site of work longer than three days prior to being planted.

1. Plants that are not planted immediately shall be protected as follows:

   a. Earth balls shall be kept appropriately moist and their solidity carefully preserved.
   b. Plants shall not be allowed to dry out or freeze.
   c. Do not store plant material on asphalt or concrete surface.
   d. If planting is delayed more than 24 hours the Contractor shall provide temporary irrigation system to keep plant material roots moist.

2. Both the duration and method of storage of plant materials shall be subject to the approval of the Design Professional.

D. Handling of Plant Materials: Exercise care in handling plant materials to avoid damage or stress.

1. Do not remove container grown stock from containers until planting time.
2. Do not prune prior to delivery.
3. Do not bend or bind-tie trees or shrubs in such a manner as to damage bark, break branches or destroy natural shape.

E. Label at least one tree and one shrub of each variety with a securely attached waterproof tag bearing legible designation of botanical and common name. Do not remove any label that has been attached to plant material until directed by the Landscape Architect to do so.

F. Analysis and Standards: Package standard products with manufacturer's certified analysis. For the materials, provide analysis by recognized laboratory made in accordance with methods established by the Association of Official Agriculture Chemists wherever applicable.

G. Topsoil: Before delivery of topsoil, furnish Landscape Architect with written statement stating location of property from which topsoil is to be obtained, depth to be stripped and crops grown during the past 2 years.

H. Soil Report: Contractor shall engage a reputable laboratory to include testing and analysis of soils representative of planting areas and lawn areas on site, and new topsoil to be used on site and within soil mix, with reference to specified plant materials as

necessary. (Refer to Section 399113.19 Planting Soils) Report shall list fertilization and soil amendment recommendations to ensure vigorous growth of all plants specified. Soil report to include analysis of a minimum of three soil samples from different locations on site.

1.10 REJECTION OF MATERIALS

A. Evidence of inadequate protection following digging, carelessness while in transit, or improper handling or storage, shall be cause for rejection.

B. Upon arrival at the temporary storage location or the site of the work, plants shall be inspected for proper shipping procedures. Should the roots be dried out, large branches be broken, balls of earth broken or loosened, or areas of bark be torn, the Design Professional will reject the injured plant.

C. When a plant has been rejected, remove it from the area of the work within 3 days and replace it with one of the required size and quality.

D. Approval and Selection of Materials and Work: the selection of all materials and the execution of all operations required under the Drawings and Specification is subject to the approval of the Landscape Architect and the Owner. They have the right to reject any and all materials and / or work which, in their opinion, does not meet the requirements of the Contract Documents at ay stage of the operations. The Contractor shall remove rejected work and/ or materials from the Project site and replace promptly.

1.11 PLANTING SEASON

A. Planting: Planting may commence as soon as the ground has thawed at the nursery and at the site of planting, and weather conditions make it practicable to work both at the nursery and at the site.

1. Planting shall occur within the following seasonal limitations:

Material	Planting Period
Deciduous Trees and Shrubs	Between October 15 and March 15
Evergreen Trees and Shrubs	Between October 15 and March 15

B. Regardless of the dates specified above, planting shall only be performed when weather and soil conditions are suitable for planting the material specified in accordance with locally accepted practice.

C. Planting season may be extended only with the written permission of the Design Professional. Plant material guarantee shall be honored regardless of extended planting season.

1.12 ACCEPTANCE

A. Acceptance of plant material by the Design Professional will be for general conformance to specified size, character, and quality, and shall not diminish responsibility for full conformance to the Contract Documents.

B. Acceptance in Part

1. The work may be accepted in parts when it is deemed to be in the Owner's best interest to do so, and when permission is given to the Contractor in writing to complete the work in parts.
2. Acceptance and use of such areas by the Owner shall not waive any other provisions of this Contract.

1.13 MAINTENANCE

A. Following the Date of Substantial Completion, Contractor is responsible for watering all newly installed plant materials, as needed, until the warranty period is complete to help advance plant materials toward full establishment.

B. Remove and replace all trees, shrubs, groundcovers and lawn, or other plants found to be dead or in unhealthy condition during warranty period as determined by Landscape Architect or Owner. Make replacements as soon as weather conditions permit.

C. Replacements: Match adjacent specimens of same species. Replacements are subject to all requirements stated in the Contract Documents and are subject to inspection by the Landscape Architect prior to digging.

D. Repair grades, lawn areas, paving and any other damage resulting from replacement planting operations, at no additional cost to the Owner.

E. Inspect Project Site monthly during warranty period to determine what changes, if any, should be made in the maintenance program. Submit all recommended changes in writing to the Landscape Architect and the Owner.

F. Replacements made during the Warranty Period or following inspection for Final Acceptance will carry on additional one-year warranty beginning at the time of replacement.

1.14 WARRANTY

A. Warranty for a period of one year, following the Date of Substantial Completion, all trees, shrubs, groundcovers, and grass against any defects (including: death and unsatisfactory growth) as determined by the Owner’s Representative. Defects resulting from neglect by the Owner, abuse or damage by others, or unusual phenomenon or incidents beyond the Contractor's control are excepted. Should questions arise concerning the responsibility of replacement, the Landscape Architect will be available for arbitration provided the Owner and Contractor mutually desire.

1.15 QUALITY ASSURANCE

A. Installer Qualifications: Landscape Contractor shall have successfully completed five (5) projects similar in material, size, scope and complexity to that indicated for this Project that have resulted in construction with a record of successful in-service performance.

1. Firm Experience Period: Five (5) years of experience
2. Field Foreman Experience: Five (5) years of experience with installing firm.

B. Conference: Before any work is started a conference shall be held between the Contractor and the Owner concerning the work under this contract.

C. The Contractor shall maintain continuously a competent superintendent, satisfactory to the Owner, on the work during progress with authority to act for him in all matters pertaining to the work.

D. It is the Landscape Contractor's responsibility to coordinate and cooperate with the other Contractors to enable work to proceed rapidly and efficiently.

E. The Landscape Contractor shall confine his operations to the area to be improved and to the areas allotted him by the Designer and General Contractor for material and equipment.

F. Landscape Contractor shall take all necessary steps to protect the existing site conditions and vegetation.

PART 2 - PRODUCTS

2.1 PLANTS

A. Except as otherwise specified, size and grade of plant materials shall conform to ANSI Z60.1. In no case shall ball size be less than 11 in. in diameter for each inch of caliper.

B. Plants shall have outstanding form; symmetrical, heavily branched with an even branch distribution, densely foliated and/or budded, and a strong, straight, distinct leader where this is characteristic of species. Plants shall possess a normal balance between height and spread. The Design Professional will be the final arbiter of acceptability of plant form.

C. Plants shall be healthy and vigorous, free of disease, insect pests and their eggs, and larvae.

D. Plants shall have a well-developed fibrous root system.

E. Plants shall be free of physical damage such as scrapes, broken or split branches, scars, bark abrasions, sunscalds, fresh limb cuts, disfiguring knots, or other defects. These defects shall not interrupt more than 25% of the circumference of the plant cambium.

F. Plants shall meet the sizes indicated on the Plant List. Plants larger or smaller than specified may be used only if accepted by the Design Professional. Use of larger plants shall not reduce the required plant quantity, increase the Contract price or allow the supplier to use smaller than specified material for other plants. If larger plants are approved, the root ball, spread, and container size shall be increased proportionately to the size of the plant.

G. Where a size or caliper range is stated, at least 50% of the material shall be closer in size to the top of the range stated.

1. Determining dimensions for trees shall be caliper, height, and spread.

a. Caliper shall be measured 6 in. above ground for trees up to and including 4 in. caliper.
b. Trees over 4 in. caliper shall be measured 12 in. above ground.
c. Specified height and spread dimensions refer to the main body of the plant and not branch tip to tip. Take measurements with branches in natural position.

H. Plants shall not be pruned before delivery.

I. All trees and shrubs shall be labeled. Labels shall be durable and legible, stating the correct plant name and size in weather-resistant ink or embossed process. Labels shall be securely attached to all plants prior to delivery to the site, being careful not to restrict growth.

J. Plants indicated as "B&B" shall be balled and burlapped. Ball shall be firmly wrapped in biodegradable burlap and securely tied with biodegradable heavy twine, rope or wire baskets. Plants with loose, broken or manufactured root balls will be rejected. Root balls shall be lifted from the bottom only, never by stems or trunks.

K. Container grown plants shall be well rooted and established in the container in which they are growing.

1. All plant materials, shipments and deliveries shall comply with state and federal laws and regulations governing the inspection, shipping, selling and handling of plant stock. A certificate of inspection, or a copy thereof, for injurious insects, plant diseases and other plant pests shall accompany each shipment or delivery of plant material. The certificate shall bear the name and address of the source of the plant stock.

L. Vines and ground covers: Provide healthy, field-grown plants from a commercial nursery, of species and variety shown or listed.

2.2 PERENNIAL PLANTS

A. Perennial Plants: Provide perennial plants of species indicated, established and well rooted in pots or similar containers, and complying with ANSI Z60.1.

2.3 PLANTING SOIL

A. Existing Topsoil

1. Existing topsoil from on-site source(s) may be used for planting soil, to the extent available, if it meets the requirements of this Section for planting soil, or if approved by the Design Professional.

B. Native Planting Soil

1. Planting soil shall be composed of a natural, fertile, friable soil typical of cultivated topsoils of the locality, suitable for the germination of seeds and support of vegetative growth, with additives, if required, to achieve particle distribution and organic content specifications. Topsoil shall be taken from a well-drained, arable site, free of subsoil, large stones, earth clods, sticks, stumps, clay lumps, roots, other objectionable, extraneous matter or debris nor contain toxic substances. Planting soil shall have a pH value between 5.5 and 7.5 and organic matter content of 5 to 10% of total dry weight.
2. Planting soil shall have the following mechanical analysis (see paragraph 1.07 for particle sizes):

Approximate Particle Distribution

Gravel	Less than 10%
Coarse to medium sand	55 – 65%
Fine to very fine sand	15 – 25%
Silt	10– 20%
Clay	15 – 20%

3. Minimum planting soil nutrient levels shall be: Nitrogen @ 5% average of organic matter, Phosphorus @ .02 to .05% average of total soil content, Potassium @ 1.2% average of total soil content.
4. The Contractor shall provide the Design Professional with planting soil test results, as specified in Paragraph 1.07, before the start of planting operations. If planting soil does not fall within the required particle distribution, organic content, or pH range, it shall be adjusted to meet the specifications through the addition of sand, compost, limestone, or aluminum sulfate to bring it within the specified limits.
5. Planting soil for ericaceous shrubs shall have a pH value range of 4.5 to 5.0.

C. Planting Soil Types:

1. Soil Type 1 – Trees and Shrubs

a. 50% Existing or Native Soil
b. 50% Topsoil Mix

1) 3 parts humus
2) 1 part Organic Compost
3) Commercial fertilizer as recommended in soil analysis
4) Lime as recommended in soil analysis

2. Soil Type 2 – Lawns and Grasses

   a. 100% Existing or Native Soil (Refer to Section 329113.19 Planting Soils)

2.4 COMPOST

A. Compost shall be derived from organic wastes such as food and agricultural residues, animal manures, mixed solid waste and biosolids (treated sewage sludge) that meet all State Environmental Agency requirements. The product shall be well composted, free of viable weed seeds and contain material of a generally humus nature capable of sustaining growth of vegetation, with no materials toxic to plant growth.

1. Compost shall have the following properties:

Parameters	Range
pH	5.5 – 7.5
Moisture Content	35% - 55%
Soluble Salts	≤ 4.0 mmhos (dS)
C:N ratio	15 – 30:1
Particle Size	< 1”
Organic Matter Content	> 50%
Bulk Density	< 1000 lbs./cubic yard
Foreign Matter	< 1% (dry weight)

2. Compost generator shall also provide minimum available nitrogen and other macro and micro nutrients to determine fertilizer requirements.
3. Guidelines for quantity of compost required to achieve suitable soil organic content in soil mixes for ornamental horticultural planting shall be as recommended by the compost manufacturer.
4. Organic matter shall be commercially prepared compost and meet US Composting Council STA/TMECC criteria or equal for Class I or II stable mature product. Compost made from primarily green yard waste shall not be acceptable.

2.5 LIMESTONE

A. Limestone shall be an approved agricultural limestone containing no less than 50% of total carbonates, and 25% total magnesium with a neutralizing value of at least 100%. The material shall be ground to such a fineness that 40% will pass through a No. 100 U.S. Standard Sieve, and 98% will pass through a No. 20 U.S. Standard Sieve. The lime shall be uniform in composition, dry and free flowing, and shall be delivered to the site in the original unopened containers, each bearing the manufacturer's guaranteed analysis. Any lime which becomes caked or otherwise damaged making it unsuitable for use, will be rejected.

2.6 ALUMINUM SULFATE

A. Aluminum sulfate shall be unadulterated and shall be delivered in containers with the name of the material and manufacturer and net weight of contents.

2.7 WATER

A. Water shall be suitable for irrigation and shall be free from ingredients harmful to plant life.

2.8 FERTILIZER

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 agency. Manufacturer’s literature shall be submitted for approval.

B. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.

2.9 SUPERPHOSPHATE

A. Superphosphate shall be composed of finely ground phosphate rock as commonly used for agricultural purposes, and containing not less than 20% available phosphoric acid. The superphosphate shall be delivered to the site in the original unopened containers, each bearing the manufacturer's guaranteed analysis. Any superphosphate which becomes caked or otherwise damaged making it unsuitable for use, will be rejected.

2.10 MULCH

A. Mulch shall be 100% fine shredded - hardwood mulch , of uniform size and free from rot, leaves, twigs, debris, stones, or any material harmful to plant growth.

1. Bark shall have been shredded and stockpiled no less than six months and no more than two years before use.
2. No chunks 3 in. or more in size, and thicker than 1/4 in. shall be left on site.

2.11 GUYING AND STAKING MATERIALS

A. Wood Stakes: Straight, sound, rough sawn lumber 2 in. x 2 in. x 6 ft. long (2 per tree). Stakes shall be primed and painted black. Wire for staking shall be 12 gauge steel or plastic tree chain.

B. Strapping: A safe, soft, elastic type strapping material specifically designed to replace traditional wire and hose, with an expanding design as the tree grows in caliper, preventing girdling.

C. Guying System: Tree support system shall be below grade cable system. Supply tree supports in complete kits; one complete kit shall be furnished per tree to be supported. Tree supports shall be sized in conformance with manufacturer's published design guidelines.

1. Provide entire anchor system including but not limited to duckbill anchor, drive rods, rod removers, load locking lever, stressing jack, protective matting, cables, and tensioning device from one supplier.
2. Provide plastic warning flag.

D. Turnbuckles: 1/4" x 7-3/4" Galvanized steel with a 2-1/2" in. lengthwise opening fitted with eyebolts.

2.12 ANTIDESICCANT

A. Anti-desiccant shall be an emulsion specifically manufactured for plant protection which provides a protective film over plant surfaces which is permeable enough to permit transpiration. Anti-desiccant shall be delivered in manufacturer's sealed containers and shall contain manufacturer's printed instructions for use.

2.13 FUNGICIDE

A. Fungicide shall be sprayable broad-spectrum fungicide.

2.14 INSECTICIDE

A. Insecticide shall be horticultural oil spray for control of insects and mites.

2.15 POST-EMERGENT HERBICIDE

A. Herbicide shall be a selective post-emergent herbicide.

2.16 PRE-EMERGENT HERBICIDE

A. Herbicide shall be selective pre-emergent herbicide for ornamental plants, nursery stock and ground covers.

2.17 DRAINAGE GRAVEL

A. Clean #57 crushed stone.

2.18 DRAINAGE MATTING

A. Drainage Matting with integral filter fabric to be Mira Drain 9000 as manufactured by Mirifi, Inc., Charlotte, North Carolina, (800) 438-1855, or approved equal.

2.19 DRAINAGE PIPE

A. 4" corrugated perforated polyethylene drain tubing with green stripe as manufactured by Advanced Drainage Systems (ADS) or equal.

PART 3 - EXECUTION

3.1 EXAMINATION OF SUBGRADE

A. Examine subgrade and rough grading before planting. Alert Design Professional to unacceptable rough grading or subgrade conditions.

3.2 SOIL DRAINAGE/DETRIMENTAL SOILS

A. Test drainage of five planting pits in locations agreed upon with the Design Professional. Pits shall be filled with water twice in succession. The time at which water is put into the pit for a second filling shall be noted. Design Professional shall then be notified of the time it takes for pit to drain completely. Planting operations shall not proceed until Design Professional has reviewed test drainage results.

B. The Contractor shall notify the Design Professional in writing of all soil or drainage conditions that are considered detrimental to growth of plant material. Submit proposal and cost estimate for correction of the conditions for Design Professional's approval before starting work.

3.3 LAYOUT OF PLANTING AREAS

A. Individual plant locations and outlines of shrub and ground cover areas to be planted shall be staked by the Contractor in ample time to allow inspection by the Design Professional.

B. Digging shall not begin until locations are approved by the Design Professional.

C. Location of trees shall be staked using color coded stakes. A different stake color shall be used for each tree species.

3.4 PREPARATION OF SUBGRADE

A. Subgrade shall be brought to true and uniform grade and shall be cleared of stones greater than 1/2 in., sticks, and other extraneous material.

B. Planting soil shall not be placed when subgrade or topsoil material are frozen, excessively wet, or excessively dry, or if weed growth exists. If weed growth develops sufficiently to prevent the proper plant bed preparation, they shall be mowed and removed from the site at no additional cost to the Owner.

3.5 PLANT PIT EXCAVATION

A. Planting pits for trees and shrubs shall be excavated to the depth and dimensions indicated on the Drawings.

B. Excavation shall not begin until locations are approved by the Design Professional.

C. For balled and burlapped (B&B trees and shrubs), make excavations at least 4 feet wider than the ball diameter for the top 12" of the pit. For the remaining depth of the pit, excavate at least 2 feet wider than the ball diameter and equal to the ball depth, plus an allowance for setting of ball on a layer of compacted backfill. Allow for 6" minimum setting layer of excavated soil.

D. Loosen hardpan and moisture barrier until hardpan has been broken and moisture is allowed to drain freely.

E. Test Drainage

1. Tree and specimen shrub pits: Fill every third tree pit with water. If percolation is less than 100% within a period of 12 hours, drill a 10" hole auger to a depth of 4 feet below the bottom of the pit. Fill auger hole with drainage gravel and cover with soil separator. Retest pit. In case drainage is still unsatisfactory, notify Landscape Architect, in writing, of the condition before planting trees in the questionable areas. Contractor is fully responsible for warranty of the trees and specimen shrubs.
2. Dispose of subsoil removed from landscape excavations. Do not mix with planting soil. Do not use as backfill.

3.6 SPREADING OF PLANTING SOIL

A. Planting soil shall be spread and placed to required depths, as indicated on the drawings.

B. Surfaces shall be graded and smoothed, eliminating all sharp breaks by rounding, scraping off bumps and ridges, and filling in holes and cuts.

C. Prior to installing any planting soil mix, the Design Professional will approve the condition of the subgrade.

D. In areas of soil installation, till the planting soil mix into the top layer of subgrade.

1. Scarify or till the surface of subgrade to a depth of 2 – 3 in. with a backhoe or other suitable device.
2. Spread a layer of the specified planting soil mix 2 – 3 in. deep over subgrade.
3. Thoroughly till the planting soil mix and the subgrade together.
4. Immediately install the remaining planting soil mix in accordance with the following specifications. Protect the tilled area from traffic. Do not allow tilled subgrade to become overly compacted.
5. In the event that the tilled area becomes overly compacted, till the area again prior to installing the planting soil mix.

E. Install the remaining planting soil mix in 8 – 10 in. lifts to the required depths.

F. The depths and grades indicated on the Drawings are the final grades after settlement and shrinkage of the organic material. Contractor shall install the planting soil mix at a higher level to compensate for this anticipated reduction of planting soil volume depending upon the predicted settling properties of each planting soil mix type.

3.7 PLANTING SOIL COMPACTION

A. Compact each 8 – 10 in. lift with mechanical compaction equipment to the compaction rates indicated.

1. Achieve a soil density of between 1.45 to 1.55 grams per cubic centimeter over dry weight divided by volume (80 to 85% of the standard proctor maximum dry density.)
2. Planting mix compaction shall be tested at each lift using a cone penetrometer calibrated to the mock up soil and its moisture level. The same penetrometer and moisture meter used for the testing of the mockup shall be used to test installed soil throughout the work.
3. Maintain at the site a hand penetrometer with pressure dial and a soil moisture meter to measure the compaction rates relative to the mock up soil compaction.

B. Maintain moisture conditions within the planting mixes during installation to allow for satisfactory compaction. Suspend installation operations if the planting mix becomes wet. Do not place planting mixes on wet of frozen subgrade.

C. Provide adequate equipment to achieve consistent and uniform compaction of the planting mixes. Use the smallest equipment that can reasonably perform the task of spreading and compaction.

1. Testing shall be performed by the Contractor.
2. Record the test results on a soil compaction log. This report shall include the location of the test. The depth of the test measures from the proposed finish grade, the penetrometer reading and the moisture meter reading.
3. Submit the compaction log at the end of the soil installation period. Soil compaction log shall be kept current and available at the site for review at all times.

3.8 PLANTING

A. Tree, shrub, and groundcover beds shall be excavated to the depth and widths indicated on the Drawings. If the planting pit for any tree is dug too deep, soil shall be added to bring it to correct level, and the soil shall be thoroughly tamped. Walls of plant pits shall be dug so that they are sloped as shown on the Drawings, and scarified. Do not excavate compacted subgrades of adjacent pavement or structures.

B. Plants shall be set as indicated on Drawings. Plants shall be set so that the root flare is at, or slightly above, finished grade. Plants located in poorly drained soils shall be set 2 to 4 inches above finished grade, gradually sloping between the top of the root ball and the surrounding finished grade.

C. Plants shall be turned to the desired orientation when required by Design Professional.

D. Containerized plants shall be removed from container taking care not to damage roots.

E. The side of the root ball shall be scarified to prevent root-bound condition before positioning in planting pit.

F. Plants shall be positioned in center of planting pits, set plumb, and rigidly braced in position until all planting soil has been tamped solidly around the balls.

G. Pits shall be backfilled with planting soil. Soil shall be worked carefully into voids and pockets, tamping lightly every 6 in.

1. When pit is two-thirds full, plants shall be watered thoroughly, and water left to soak in before proceeding.
2. At this time, ropes or strings on top of balls shall be cut and shall be pulled back. Loosen and remove burlap and biodegradable ropes from top half of rootball. Cut and remove the top half of all wire baskets before backfilling. Non-biodegradable ball wrapping and support wire shall be totally removed from ball and planting pit.

H. Backfilling and tamping shall then be finished and a saucer formed around plant pits as indicated on the Drawings.

I. Apply anti-desiccant using power spray to provide an adequate film over trunks, branches, stems, twigs and foliage. If deciduous trees or shrubs are moved in full leaf,

spray with antidesiccant at nursery before moving and again after planting as per manufacturer's recommendations.

J. Mulching: Immediately after planting work has been completed, mulch pits, trenches and planting beds. Provide a minimum depth of 3" bark. Finish edges according to detail.

K. Saucer shall be filled with water and water left to soak in. Saucer shall then be filled with water again, continue watering thereafter as necessary until Substantial Completion.

3.9 FLOWERING PLANTS

A. Prepare flowering plant planting bed by application of fertilizers and pH-altering amendments and thoroughly rototilling into the top 12 in. prior to planting bulbs and flowering plants.

3.10 PERENNIALS, VINES AND GROUND COVER

A. Set out and space plants as indicated on the Drawings.

B. Perennials: Dig planting bed at least 18" deep, but 12" is adequate. Work 4-6" compost into the top layers of soil by digging or tilling.

1. Check root ball after removing plant from its container. Encircling roots need to be gently loosened from the tight mat of root-bound plants. If roots are very dense at bottom of pot, slice off the bottom 1". If roots are seriously disturbed when planting, cut back some foliage to reduce the water stress that will occur. Plant at the same soil level as the plant was in its container.

C. Vines: Check root ball after removing plant from its container. Encircling roots need to be gently loosened from the tight mat of root-bound plants. If roots are very dense at bottom of pot, slice off the bottom 1". If roots are seriously disturbed when planting, cut back some foliage to reduce the water stress that will occur. Plant at the same soil level as the plant was in its container.

D. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.

E. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

F. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.11 FERTILIZER APPLICATION

A. Fertilizer, if required, shall be applied at the rates recommended by soil testing results, as specified in this Section.

3.12 FUNGICIDE

A. Immediately after planting, all trunks of deciduous trees shall be sprayed with fungicide, applied by chemical manufacturer.

3.13 PRE-EMERGENT-HERBICIDE

A. Immediately after planting, pre-emergent herbicide shall be applied to ornamental shrub beds and around base of trees, in strict accordance with chemical manufacturer's printed instructions.

3.14 POST EMERGENT-HERBICIDE

A. Upon the appearance of weeds within planted areas, pre-emergent herbicide shall be applied to ornamental shrub beds and around base of trees, in strict accordance with chemical manufacturer's printed instructions.

3.15 INSECTICIDE

A. Upon the appearance of insect problems, all trunks of deciduous trees shall be sprayed with insecticide, applied by chemical manufacturer.

3.16 STAKING AND GUYING

A. Each tree shall be staked or guyed immediately following planting. All evergreen trees and deciduous trees over 4” caliper shall be guyed. Plants shall stand vertical and plumb after staking or guying. Set vertical stakes and space to avoid penetrating root balls or root masses. Allow enough slack to avoid rigid restraint of tree. Stakes and guys shall be installed as indicated on the Drawings. Staking and guying shall not be used as a means to straighten trees.

3.17 MULCHING

A. Mulch shall be applied to depths and limits indicated on the Drawings.

B. Mulch shall not be allowed to cover the base of trunks – maintain 2-3” of open space between mulch and tree trunk.

3.18 PRUNING

A. Each tree and shrub shall be pruned to preserve the natural character and form of the plant; dead or damaged branching only. Pruning shall be done after delivery of plants and after plants have been inspected and approved by the Design Professional. Pruning procedures shall be reviewed with Design Professional before proceeding.

3.19 CLEAN UP AND PROTECTION

A. During Landscape Work, keep pavements clean and work area in an orderly condition.

B. Upon completion of Work, clear grounds of debris, superfluous materials and all equipment. remove from Site to satisfaction of Landscape Architect and Owner.

C. Protect Landscape Work and materials from damage due to landscape operations, operations by other contractors and trades and trespassers. Maintain protection during installation and maintenance periods. Treat, repair or replace damaged Landscape Work as directed at no additional cost to the Owner.

D. Theft: Contractor is responsible for theft of plant material at the Project Site before, during and after planting, until the Date of Substantial Completion of the Work in total.

3.20 INSPECTION AND ACCEPTANCE

A. Periodic inspections will be made from time to time by the Owner's Representative to review the quality and progress of the work. Work found to be unacceptable must be corrected within five calendar days. Remove rejected plants and materials promptly from project site.

B. Upon completion of Work, the Contractor shall notify the Owner's Representative and the Owner at least ten (10) days prior to requested date of inspection for Substantial Completion of all or portions of the Work. The Owner's Representative will issue a punch list for work to be corrected. All work in the punch list must be completed within five (5) working days from date of inspection. Where inspected Work does not comply with requirements, replace rejected Work and continue specified maintenance until re-inspected by the Owner's Representative and found to be acceptable.

C. Certificate of Substantial Completion will be issued for acceptable Work. If punch list items are issued with the Certificate, they must be corrected within five (5) working days.

D. One Year Warranty commences on the date of issuance of the Certificate of Substantial Completion.

E. Final Acceptance: One year after Date of Substantial Completion of the Work in total the Owner's Representative and the Owner inspect the Work for Final Acceptance. Upon satisfactory completion of repairs and/or replacements the Owner's Representative certifies, in writing, the Final Acceptance of the Work. The Final Acceptance Certification issued by Owner's Representative will serve as evidence that Contractor's one-year warranty obligations have been met.

END OF SECTION 329300

SECTION 329301 - LANDSCAPE MAINTENANCE AND WARRANTY

PART 1 - GENERAL

1.1 SUMMARY

A. BASE BID: Contractor shall maintain and guarantee all landscape areas for One Year from the date of Material Completion. Landscape areas include trees, planting beds, mulch, seed, sod, and all other work performed under Sections 329200, “Lawns and Grasses” and 329300, “Trees, Plants, and Ground Covers”.

1.2 DEFINITIONS

A. Owner / Owner Representative: City of Sandy Springs

B. Material Completion: The completion of landscape installation operations and the beginning of the landscape maintenance and guarantee period.

C. Final Acceptance: The end of the landscape guarantee and maintenance period.

1.3 SUBMITTALS

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

B. Product Certificates: For each type of manufactured product, signed by product manufacturer, and complying with the following:

1. Manufacturer's certified analysis for 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. Qualification Data: For landscape maintenance company.

D. Maintenance Manual and Instructions: Recommended maintenance procedures are to be established by the contractor/installer for maintenance of all installed plant materials during a calendar year. Contractor/installer shall submit an initial Draft Maintenance Manual for review and approval by the Owner and landscape architect prior to beginning installation of the plant materials. The Owner and landscape architect shall review the Draft Manual, and request adjustments as appropriate, prior to the contractor/installer beginning installation. The contractor/installer shall then update and finalize the Maintenance Manual 90 days before expiration of required maintenance periods.

E. The draft and final Maintenance Manuals shall include a completed Landscape Maintenance Service Schedule. The Landscape Contractor shall prepare and submit, along with the draft maintenance manual, a draft maintenance service schedule for review by the Owner and landscape architect. The Landscape Maintenance Service Schedule shall also be updated and included with the final Maintenance Manual 90 days prior to the expiration of the required maintenance periods.

F. Owner Staff Training: Contractor shall provide on-site, hands-on training of the Owner's maintenance grounds crew.

G. Maintenance Log: The Contractor is required to prepare a daily Maintenance Log for the duration of the Project.

H. All submittals shall be copied to the Owner in a timely manner, including but not limited to, punch list, maintenance log, Material Safety Data Sheet (MSDS), landscape acceptance, etc.

1.4 QUALITY ASSURANCE

A. Maintenance Company Qualifications: A qualified landscape maintenance company whose work has resulted in successful establishment of exterior plants on projects of similar scope and type.

1. Maintenance Company's Field Supervision: Require Maintenance Company to provide an English speaking supervisor, with a minimum of ten years' experience on relevant projects, on Project site when exterior maintenance work is in progress

B. Perform work in accordance with all applicable laws, codes, and regulations required by authorities having jurisdiction over such work and provide for all inspections, licenses and permits required by Federal, State, and local authorities in furnishing, transporting and installing materials.

C. Provide same quality, size, genus, species, and variety of replacement plants as shown on landscape drawings, complying with applicable requirements in ANSI Z60.1, "American Standard for Nursery Stock."

D. Replacement Tree and Shrub Measurements: Measure according to ANSI Z60.1 with branches and trunks or canes in their normal position. Do not prune to obtain required sizes. Take caliper measurements 6 inches above ground for trees up to 4-inch caliper size, and 12 inches above ground for larger sizes. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip-to-tip.

E. Observation: Owner may observe replacement trees and shrubs either at place of growth or at site before replanting for compliance with requirements for genus, species, variety, size, and quality as shown on landscape drawings. Owner retains right to observe replacement trees and shrubs further for size and condition of balls and root systems, insects, 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.

F. Notify Owner of sources of planting materials seven days in advance of delivery to site.

PART 2 - PRODUCTS

2.1 GENERAL

A. Refer to Section 329300, “Trees, Plants, and Ground Covers” for products needed to complete the Work of this Section.

PART 3 - EXECUTION

3.1 MAINTENANCE - TREES, SHRUBS AND PLANTING AREAS

A. Maintenance shall begin immediately after each plant is installed and continue for (1) one year from Material Completion.

1. Maintenance shall consist of, including but not limited to, pruning, watering, cultivating, mulching, removal of dead material, repairing and replacing of tree stakes, repairing saucers, tightening and repairing of guys, repairing and replacing of damaged tree wrap material, resetting plants to proper grades and maintaining at an upright position at all times, resetting plants to proper grades and an upright position after windstorm or any inclement weather conditions, and furnishing and applying such sprays as are necessary to keep plantings free of insects and disease, and in a healthy growing condition. All newly planted areas shall be maintained free of weeds.
2. Maintenance shall include replacement of plants that are damaged or have died for any reason.
3. Maintenance shall include two applications of pre-emergent herbicides, and two yearly applications of pine straw or approved mulch, or as necessary and as directed by the Owner’s Representative.
4. Fertilization: Shall be done using a commercial fertilizer during either the spring after a fall planting or the fall after a spring planting.
5. When chemicals (pesticides, herbicides and fertilizer, etc.) are applied, the area shall be flagged for 24 hours and the flags removed by the contractor after the 24 hour period.
6. Maintenance Log: the Contractor is required to keep a daily Maintenance Log during maintenance and warranty period detailing maintenance operations. The Log shall contain all items conducted under Part 3 - Execution including a description of: 1.) type of maintenance performed; 2.) location; and 3.) date, and include MSDS data for every chemical used on Sandy Springs property.

3.2 MAINTENANCE – LAWNS AND GRASSES

A. Maintenance shall begin immediately upon completion of seeding and sodding and shall continue for (1) one year from Material Completion.

B. Except as otherwise specified below, maintenance shall include all operations required to produce an established lawn, including but not limited to:

1. Fertilizing.
2. Mowing.
3. Reseeding or resodding.
4. Watering.
5. Weeding.

C. Watering:

1. Seeded Areas

a. Week No. 1: Provide all watering necessary to keep seed bed moist at all times. Perform watering daily or as necessary to maintain moist soil to a depth of 4 in.
b. Week No. 2 Water as necessary to maintain adequate moisture in the upper 4 in. of soil to promote seed germination.

2. Sodded Areas:

a. Week No. 1: Provide all watering necessary for rooting of sod. Soil on sod pads shall be kept moist at all times. Perform watering daily or as necessary to maintain moist soil to a depth of 4 in. Watering shall be done during the heat of the day to prevent wilting.
b. Week No. 2 and Subsequent Weeks: Water as necessary to maintain adequate moisture in the upper 4 in. of soil to promote deep root growth.

D. Mowing:

1. Seeded Areas:

a. Not more than 40% of the grass leaf shall be removed during the first or subsequent mowings.
b. Grass height shall be maintained between 1-1/2 in. and 2-1/2 in.
c. All clippings shall be removed.

2. Sodded Areas:

a. Mowing shall not be attempted until the sod is firmly rooted and securely in place. Not more than 1/3 of the grass leaf shall be removed during the first or subsequent mowings.
b. Bermuda grass height shall be maintained at 1-1/2 in.
c. All clippings shall be removed.

d. After 2 mowings, the Contractor shall top dress the sod with an application of fertilizer at the rate of 1 pound of actual nitrogen per 1000 square feet.

E. After grass has sprouted, seeded areas which fail to show a uniform stand of grass shall be replanted as often as necessary to establish an acceptable stand of grass.

1. Scattered bare spots, shall not exceed 15 sq. in. each.

F. Weeds and growth other than varieties of grass named in grass seed formula shall be removed. Removal may be accomplished by use of suitable herbicides or by physical removal, in which case top growth and roots shall both be removed, and bare spots exceeding specified limits shall be reseeded.

G. If lawn or grass is established in the fall and maintenance is required to continue into spring months, lawn and grass shall receive an application of lime and fertilizer in the spring. Lime and fertilizer shall be spread in a uniform layer over the entire lawn surface at a rate determined by testing agency based on soil test results.

H. Remove rope barricades only after second cutting of lawns.

3.3 MAINTENANCE TRAINING AND MANUAL

A. Landscape Maintenance Training: During the final 30 days of the maintenance and warranty period the contractor will provide landscape maintenance training for at least (10) members of the Owner's grounds crew. This training will include a minimum of four (4) 2-hour sessions demonstrating industry standard techniques for pruning, fertilization, mulching, and other common maintenance operations for new or uncommon plantings that have occurred, for example: Bioretention.

B. Landscape Maintenance Manual: Upon completion of the maintenance and warranty period the Contractor will provide the Owner's maintenance department with a report outlining detailed annual maintenance procedures by plant and season. The Maintenance Manual shall include the Landscape Maintenance Service Schedule matrix.

3.4 MATERIAL COMPLETION AND FINAL ACCEPTANCE

A. When the Owner's Representative mutually agrees that the work is substantially complete and is ready for inspection, the Contractor shall schedule a walk-thru with the Owner's Representative/Design Professional. The Owner's Representative /Design Professional will establish a Punch List during this walk-thru.

B. Upon the receipt of the Punch List, the contractor shall make good any listed defects on the Punch List within a two-week period to the satisfaction of the Owner's Representative and Design Professional.

C. The Owner's Representative will issue a Letter of Material Completion and the work is deemed substantially complete. Upon the issuance of Material Completion, the warranty period shall begin.

D. Final Acceptance shall occur ONE YEAR (365 days) after the issuance of Material Completion. The Owner's Representative/ Design Professional shall have the final approval for acceptance of the landscape installation and the issuance of Final Acceptance. When the Contractor is ready for a Final Acceptance walk-thru, the Contractor shall provide a two-week notification to schedule the walk-thru with the Owner's Representative /Design Professional.

3.5 GUARANTEE

A. The Contractor shall guarantee all material for a period of ONE YEAR (365 days) from the date of Material Completion against death, decline or failure to thrive, except in the following circumstances: acts of nature, theft, vandalism, damage inflicted by other construction Contractors separately contracted by Owner, or documented neglect or abuse on the part of the Owner. All documentation shall be submitted in writing, with color photographs, to the Owner to support the claim.

B. Dead plants and all plants not in a vigorous, thriving condition, as determined by the Project Landscape Architect during and at the end of the guarantee period, shall be immediately removed without cost to the Owner, and replaced as soon as weather conditions permit and within the specified planting period.

C. The guarantee of all replacement plants shall extend for an additional two or one year, depending on the size of the plant and its associated guarantee requirement, from the date of their acceptance after replacement. In the event that a replacement plant is not acceptable during or at the end of the said extended guarantee period, the Owner may elect one more replacement or credit for each item.

D. Contractor shall notify the Owner's Representative in writing fourteen (14) days prior to end of maintenance and warranty period to schedule a Final Inspection.

E. Replacements: Any material which, in the opinion of the Owner or Design Professional, is not alive and in a healthy, vigorous condition or fails to meet the requirements of this Guarantee shall be promptly replaced by the Contractor at no additional cost.

1. Contractor shall inspect project area weekly and make all replacements within 30 days of discovery unless otherwise directed in writing by the Owner.
2. Replacement plants shall be free of dead and dying branches and branch tips, and shall bear foliage of a normal density, size and color. All replacements shall be plants of the same kind and size as originally specified and shall be furnished and planted as specified. Replacements shall closely match adjacent specimens of the same species in form and size. The cost of all replacement operations shall be borne by the Contractor.

3. The Contractor shall repair all damage to surrounding landscape, turf, and other adjacent areas caused by plant replacement operations at no cost to the Owner.
4. Plant replacement resulting from removal, occupancy damage, vandalism, physical damage by vehicles, etc., may be paid for by the Owner upon request.

F. Upon certification of Final Acceptance in writing the Owner will assume all landscape maintenance responsibilities.

3.6 CLEANUP AND PROTECTION

A. Contractor's work area shall be cleaned at the end of each working day. Landscape debris and trash shall be daily collected and removed from the site. Any materials or equipment staged on site shall be kept in an organized manner in locations approved by the Owner.

B. Remove debris from landscaped areas and sweep clean adjacent pavements, if soiled by landscape activities. Protect landscaping from damage until Final Acceptance.

3.7 CONSTRUCTION WASTE MANAGEMENT

A. Comply with the requirements for removal and disposal of construction debris and waste.

END OF SECTION 329301

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SECTION 330561 – MANHOLES AND COVERS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install modular precast concrete manhole sections, with tongue-and-groove joints, with masonry transition to lid frame, covers, anchorage and accessories.

1.2 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience.

1.3 SUBMITTALS

A. Submit under provisions of Section 013300 – Submittal-RFI Procedures.

B. Shop Drawing: Indicate manhole locations, elevations, piping, and sizes and elevations of penetrations.

C. Product Data: Provide manhole covers, component construction, features, configuration, and dimensions.

D. Certification for Fiberglass Reinforced Polyester (FRP) Manholes: As a basis of acceptance the FRP manhole manufacturer shall provide an independent certification which consists of a copy of the manufacturer's test report accompanied by a copy of the test results that the manhole has been sampled, tested, and inspected in accordance with the provisions of the specification of ASTM D 3753 and meets all requirements.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

A. Cement Mortar: Cement mortar shall conform to ASTM C270, Type M with Type II cement.

B. Portland Cement: Submit certificates of compliance stating the type of cement used in manufacture of concrete pipe, fittings and precast manholes. Portland cement shall conform to ASTM C150/C150M, Type II for concrete used in concrete pipe, concrete pipe fittings, and manholes, and type optional with the Contractor for cement used in

concrete cradle, concrete encasement, and thrust blocking. Where aggregates are alkali reactive, as determined by Appendix XI of ASTM C33/C33M, a cement containing less than 0.60 percent alkalies shall be used.

C. Portland Cement Concrete: Portland cement concrete shall conform to ASTM C94/C94M, compressive strength of 4000 psi at 28 days, except for concrete cradle and encasement or concrete blocks for manholes. Concrete used for cradle and encasement shall have a compressive strength of 2500 psi minimum at 2 days. Concrete in place shall be protected from freezing and moisture loss for 7 days.

2.2 MANHOLES

A. General: Manholes shall be cylindrical, with a 48" minimum inside diameter. Increase diameter as indicated on drawings. Provide eccentric cone top sections.

B. Precast Concrete Manholes:

1. Precast concrete manhole risers, base sections, and tops shall conform to ASTM C478;
2. Base and first riser shall be monolithic.
3. Barrel joints shall be tounge and groove and shall meet the latest revision of ASTM C443 for O-ring gaskets.
4. The manhole sidewall shall be of a length such that a minimum of one course and a maximum of 2 courses of bricks shall be placed on top of the unit to bring the casting to grade. A precast concrete adjusting ring may be used for this purpose, conforming to the height ranges specified for brick.
5. Xypex Admix C-1000 or approved equal shall be used for all manholes. Xypex Admix or approved equal shall be added to the concrete mix at time of batching. The manhole manufacturer shall submit specifications and the procedures for adding the Admix to the concrete. The Admix shall have a red-tinted coloring.
6. Plastic Gasket For Precast Manholes: Preformed plastic gasket shall meet or exceed all requirements of FS SS-S-210-A, "Sealing Compound, Preformed Plastic for Pipe Joints," Type I, and ASTM C990, rope formed. It shall be supplied in extruded rope form of suitable cross section and in such sizes as to seal the joint space when the manhole sections are installed. The sealing compound shall be protected by a suitable removable 2 piece wrapper, which shall be designed so that half may be removed longitudinally without disturbing the other half in order to facilitate application of the sealing compound. The flexible plastic gasket shall also meet the requirements of the following table:

Property	**Test Method**	**Minimum**	**Maximum**
Specific Gravity @ 77°F	ASTM D71	1.20	1.30
Ductility @ 77°F (5 cm/min)	ASTM D113	5.0	--
Softening Point (°F)	ASTM D36	320	--
Penetration @ 77°F (cm) (150 g-5 secs.)	ASTM D217	50	120

C. Glass-Fiber-Reinforced Polyester Manholes:

1. Shall conform to ASTM D3753.
2. Manhole cylinders, man way reducers, and connectors shall be produced from glass fiber-reinforced polyester resin with the construction determined by the particular process of manufacture and configuration. The manhole shall provide an area from which a grade ring can be installed to accept a typical metal ring and cover and have the strength to support a traffic load without damage to the manhole.
3. Dimension: The manhole shall be a circular cylinder, reduced at the top to a circular man way not smaller than 22-1/2" inside diameter. Nominal inside diameter shall be 48 inches. Tolerance on the inside diameter shall be +/- 1%. The minimum wall thickness for all FRP manholes at all depths shall be 0.50 inches. The maximum vertical height of the cone shall be thirty six (36") inches.
4. Configuration: The cone must provide a bearing surface on which a standard ring and cover may be supported and adjusted to grade. The cone shall be joined to the barrel section at the factory with resin and glass fiber reinforcement, providing required monolithic design to prevent infiltration and/or exfiltration through the manhole.
5. Class: The manhole shall be manufactured for a load rating suitable for an AASHTO H-20 wheel load.
6. Stub outs and Connections: Connections to manhole shall be made via installation of SDR PVC sewer pipe stub outs to manhole, or Kor-N-Seal boots. Installation of SDR PVC sewer pipe must be performed by sanding, priming, and using resin fiber-reinforced hand layup. The resin and fiberglass shall be same type and grade as used in the fabrication of the fiberglass manhole. Kor-N-Seal boots may be installed by manhole manufacturer using fiberglass reinforced pipe stub out for Kor-N-Seal boot sealing surface.
7. Manhole Bottom: Manholes shall have resin fiber-reinforced bottoms. Provide a minimum of two 1 1/2 in. deep x 3 1/2 in. wide stiffening ribs completely enclosed with resin fiber-reinforcement. Provide minimum 3 in. anti-flotation ring. Manhole bottom shall be a minimum of 1/2 inch thick.
8. Marking and Identification: All manholes shall be marked in letters no less than 1" in height with the following information:
9. Manufacturer's name and trademark
10. Manufacturer's factory location
11. Manufacturer's serial number
12. Manhole Length
13. ASTM Designation
14. Installation assists marks (vertical lines 90 deg. apart at base of manhole).
15. Quality Assurance/Quality Control:
16. Examination: Each manhole component part shall be examined for dimensional requirements.
17. Composition Control: Controls on glass and resin content shall be maintained for all manufacturing processes and for each portion of manhole fabrication. Records shall be maintained of these control checks. Proper glass content may be shown by glass usage checks, by glass and resin application rate checks, in accordance with the material composition test in ASTM D3753, paragraph 8.8.1.
18. All required ASTM D3753 testing shall be completed and records of all testing shall be kept and copies of test results shall be presented to Owner upon written request.

19. FRP Manholes: All manholes shall be watertight. Glass-Fiber Reinforced Polyester Manholes shall be a one-piece monolithic designed unit constructed of glass-fiber reinforced, supplier certified, and unsaturated isopthalic polyester resin containing chemically enhanced silica to improve corrosion resistance, strength and overall performance. FRP manholes shall be manufactured in strict accordance with ASTM D3753.
20. Exterior Surface: For a UV inhibitor the resin on the exterior surface of the manhole shall have gray pigment added for a minimum thickness of 0.125 in. or a UV inhibitor shall be added directly to the resin to prevent photo degradation. Mixing lots of resins from different manufacturers shall not be permitted.

D. Throat Rings: Adjustment throat rings shall be precast non-reinforced concrete rings having a maximum thickness of two inches (2”). The internal diameter shall not be less than twenty-four inches (24”), and the width shall be a minimum of five inches (5”). No more than six throat rings shall be used on any manhole.

E. Initial Backfill Material (FRP Manholes): The initial backfill material shall be composed of well graded, crushed stone or gravel conforming to the following requirements unless modified by the Engineer.

Crushed Stone or Gravel	Percent
Passing 1-1/2 inch sieve	100
Passing 1 inch sieve	95 to 100
Passing 3/8 inch sieve	25 to 60
Passing No. 4 sieve	1 to 10
Passing No. 8 sieve	0 to 5

F. Gaskets and Connectors: Gaskets for joints between manhole sections shall conform to ASTM C443. Resilient connectors for making joints between manhole and pipes entering manhole shall conform to ASTM C923, and shall be Trelleborg Kor-N-Seal I with Korband Expander, or approved equal.

G. External Preformed Rubber Joint Seals: An external preformed rubber joint seal shall be an accepted method of sealing cast iron covers to precast concrete sections to prevent ground water infiltration into sewer systems. All finished and sealed manholes constructed in accordance with paragraph entitled “Manhole Construction” shall be tested for leakage in the same manner as pipelines. The seal shall be multi-section with a neoprene rubber top section and all lower sections made of Ethylene Propylene Diene Monomer (EPDM) rubber with a minimum thickness of 60 mils. Each unit shall consist of a top and bottom section and shall have mastic on the bottom of the bottom section and mastic on the top and bottom of the top section. The mastic shall be a non-hardening butyl rubber sealant and shall seal to the cone/top slab of the manhole/catch basin and over the lip of the casting. Extension sections shall cover up to two more adjusting rings. Properties and values are listed in the following table:

Properties, Test Methods and Minimum Values for Rubber used in Preformed Joint Seals

Physical Properties	Test Methods	EPDM	Neoprene	Butyl Mastic
Tensile, psi	ASTM D412	1840	2195	
Elongation, %	ASTM D412	553	295	350
Tear Resistance, ppi	ASTM D624 (Die B)	280	160	
Rebound, %, 5 minutes	ASTM C972 (mod.)			11
Rebound, %, 2 hours	ASTM C972			12

2.3 METAL ITEMS

A. Cast Iron Frames, Covers, and Gratings for Manholes:

1. Frames and covers shall be ASTM A48, Class 30B cast iron or ductile iron, made accurately to the required dimensions; sound, smooth, clean, and free from blisters and other defects; not plugged or otherwise treated to remedy defects; machined so that covers rest securely in the frames with no rocking and are in contact with frame flanges for the entire perimeter of the contact surfaces; thoroughly cleaned subsequent to machining and before rusting begins; and with the actual weight in pounds stenciled or printed by the manufacturer on each casting in white paint.
2. Castings shall be Neenah R-1642, or equal, with clear inside diameter of 24 inches. The frames and covers shall have a combined weight of not less than 400 pounds.
3. Watertight castings shall be Neenah R-1915-G or equal, with clear inside diameter of 24 inches.
4. Refer to Standard Drawing for cover size and lettering.

B. Manhole Steps

1. Manhole steps shall meet the latest revision of ASTM C478 and shall conform to the requirements of the Occupational Safety and Health Standards, U.S. Department of Labor. Steps shall be equal to M.A. Industries, Inc. Model (PS-1) or (PS-1 PF). The Contractor shall ensure that steps are installed securely and able to bear design loads.
2. The uppermost step shall be cast into the side of the manhole no greater than eighteen (18) inches below the top of manhole cover. The steps shall be continued in alignment downward along the interior vertical side of the manhole to a point no lower than the crown of the largest sanitary sewer. Spacing of steps shall not exceed twelve (12) vertical inches. Steps shall not descend over any pipe connection into the manhole.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify items provided by other sections of Work are properly sized and located.

B. Verify that built-in items are in proper location, and ready for roughing into Work.

C. Verify excavation for manholes is correct.

3.2 PREPARATION

A. Coordinate placement of inlet and outlet required by other sections.

B. Excavate for manhole in accordance with Section 312000 – Earth Moving.

3.3 PLACING MANHOLE SECTIONS

A. Level base area and place minimum twelve inches (12”) compacted bedding.

B. Concrete Manholes:

1. Construct base slab of cast-in-place concrete or use precast concrete base sections. Make inverts in cast-in-place concrete and precast concrete bases with a smooth-surfaced semi-circular bottom conforming to the inside contour of the adjacent sewer sections.
2. For changes in direction of the sewer and entering branches into the manhole, make a circular curve in the manhole invert of as large a radius as manhole size will permit.
3. For cast-in-place concrete construction, either pour bottom slabs and walls integrally or key and bond walls to bottom slab. No parging will be permitted on interior manhole walls.
4. For precast concrete construction, make joints between manhole sections with the gaskets specified for this purpose. Parging will not be required for precast concrete manholes.
5. Make joints between concrete manholes and pipes entering manholes with the resilient connectors specified for this purpose; install in accordance with the recommendations of the connector manufacturer.
6. Where a new manhole is constructed on an existing line, remove existing pipe as necessary to construct the manhole. Cut existing pipe so that pipe ends are approximately flush with the interior face of manhole wall, but not protruding into the manhole. Use resilient connectors as previously specified for pipe connectors to concrete manholes.
7. Wrap manholes joints with Gator wrap or an approved equal.

C. Coordinate with other sections of Work to provide correct size, shape, and location.

D. Backfill manhole in accordance with Section 312333 - Trenching and Backfilling.

3.4 MASONRY CONSTRUCTION

A. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

B. Lay masonry units in running bond.

C. Form flush mortar joints.

D. Lay masonry units in full bed of mortar, with full head joints, uniformly jointed with other Work.

E. Set cover frames and covers level without tipping, to correct elevations.

F. Coordinate with other sections of Work to provide correct size, shape, and location.

G. Backfill manhole in accordance with Section 312333 - Trenching and Backfilling.

END OF SECTION 330561

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SECTION 331100 – WATER UTILITIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This Section describes products to be incorporated into the water mains and requirements for the installation and use of these items. Furnish all products and perform all labor necessary to fulfill the requirements of these Specifications.

B. Supply all products and perform all work in accordance with applicable American Society for Testing and Material (ASTM), American Water Works Association (AWWA), American National Standards Institute (ANSI), National Science Foundation (NSF) Standard 61, or other recognized standards. Latest revisions of all standards are applicable. Additionally, products shall meet the Federal lead-free requirements as stated in the Reduction of Lead in Drinking Water Act.

1.2 QUALIFICATIONS

A. If requested by the Engineer, submit evidence that manufacturers have consistently produced products of satisfactory quality and performance for a period of at least two years.

1.3 SUBMITTALS

A. Submit in accordance with Section 013300 – Submittal-RFI Procedures.

B. Submit to the Engineer shop drawings and product data for all products.

C. Submit O&M manuals for valves and hydrants.

1.4 DELIVERY AND HANDLING

A. Unloading: Furnish equipment and facilities for unloading, handling, distributing and storing pipe, fittings, valves and accessories. Do not drop or dump materials. Any materials dropped or dumped will be subject to rejection without additional justification. Pipe handled on skids shall not be rolled or skidded against the pipe on the ground.

B. Handling: Handle pipe, fittings, valves and accessories carefully to prevent shock or damage. Handle pipe by rolling on skids, forklift, or front-end loader. Do not use material damaged in handling. Slings, hooks or pipe tongs shall be padded and used in such a manner as to prevent damage to the exterior coatings or internal lining of the pipe.

1.5 STORAGE AND PROTECTION

A. Store all pipe which cannot be distributed along the route. Make arrangements for the use of suitable storage areas. Store PVC pipe away from non-solar heat and direct sunlight.

B. Stored materials shall be kept safe from damage. Store materials on site in enclosures or under protective covering. The interior of all pipe, fittings, valves and other appurtenances shall be kept free from dirt or foreign matter at all times. Valves and hydrants shall be drained and stored in a manner that will protect them from damage by freezing.

C. Pipe shall not be stacked higher than the limits recommended by the manufacturer. The bottom tier shall be kept off the ground on timbers, rails or concrete. Pipe in tiers shall be alternated: bell, plain end; bell, plain end. At least two rows of timbers shall be placed between tiers and chocks affixed to each other in order to prevent movement. The timbers shall be large enough to prevent contact between the pipe in adjacent tiers.

D. Stored gaskets shall be placed in a location out of direct sunlight. Gaskets shall not come in contact with petroleum products. Gaskets shall be used on a first in, first out basis.

PART 2 - PRODUCTS

2.1 DUCTILE IRON PIPE (DIP)

A. Ductile iron pipe shall be manufactured in accordance with AWWA C151. All pipe, except specials, shall be furnished in nominal lengths of 18 to 20 feet. Sizes shall be as shown on the Drawings. All pipe shall have a minimum pressure rating as indicated in the following table, and corresponding minimum wall thickness, unless otherwise specified or shown on the Drawings:

Pipe Sizes (inches)	Pressure Class (psi)
4 - 12	350
14 - 20	250
24	200
30 - 64	150

B. Flanged pipe minimum wall thickness shall be equal to Special Class 53.

C. Pipe shall be cement lined in accordance with AWWA C104. Pipe shall be furnished with a bituminous outside coating. Seal coat over the cement lining is not required.

D. Fittings shall be ductile iron and shall conform to AWWA C110 or AWWA C153 with a minimum rated working pressure of 250 psi. Fittings shall be cement lined in accordance with AWWA C104 and shall be furnished with a bituminous outside coating. Seal coat over the cement lining is not required. In lieu of cement lining and bituminous coating,

fittings may be provided with a fusion bonded coating and lining meeting the requirements of AWWA C116.

E. Joints

1. Unless shown or specified otherwise, joints for buried service shall be push-on or restrained joint type for pipe and standard mechanical or restrained joints for fittings. Joints for exposed service shall be flanged for pipe and fittings, unless otherwise shown. Push-on and mechanical joints shall conform to AWWA C111.
2. Restrained joints: Where restrained joint pipe (RJP) is shown on the Drawings, restrained joints for pipe diameters 16-inch and less shall be manufactured restrained joint, mechanical joint fitting with retainer gland or restraining gasket joint as specified below. For pipe diameters 18-inch or greater restrained joints shall be manufactured restrained joint as specified below.
3. Manufactured restrained joints shall be American “Flex-Ring” or “Lok-Ring”; U.S. Pipe “TR FLEX” or “HP LOK”; or McWane Ductile “TR FLEX” or “THRUST-LOCK.” No field welding of restrained joint pipe will be permitted.

    a. Restraining gasket joints shall be assembled with American Fast-Grip gaskets or U.S. Pipe FIELD LOK gaskets but may only be used in lieu of manufactured restrained joints where approved by the Engineer.
    b. Retainer glands on a mechanical joint may be used as a restrained joint only where retainer glands are specifically shown on the Drawings or where specifically specified.
    c. Where retainer glands are allowed, in lieu of retainer glands specified elsewhere, the joint may be assembled with US Pipe MJ FIELD LOK gasket.
    d. No field welding for manufactured restrained joint pipe assembly will be permitted. Where field cutting of restrained joint pipe is required, the joint may be assembled with American Field Flex-Rings or US Pipe TR FLEX GRIPPER Rings.

4. Flanged joints shall meet the requirements of AWWA C115, except that flanges shall be solid and not hollow-back type. Flanges shall be of ductile iron material. Flange adaptors shall not be allowed in lieu of manufactured flanged joints.
5. Provide the appropriate gaskets for mechanical and flange joints. Flange gaskets shall be bulb type and shall be ACIPCO Toruseal Flange Gasket or U.S. Pipe RING FLANGE-TYTE Gasket. Gaskets shall be plain rubber (styrene butadiene copolymer – SBR).
6. Bolts and Nuts

    a. Provide the necessary bolts for connections. All bolts and nuts shall be threaded in accordance with ANSI B1.1, Coarse Thread Series, Class 2A external and 2B internal fit.
    b. Bolts and nuts for mechanical joints shall be Tee Head Bolts and nuts of high strength low-alloy steel in accordance with ASTM A242 to the dimensions shown in AWWA C111/ANSI A21.11.
    c. Flanged joints shall be bolted with through, stud, or tap bolts of required size as directed. Bolt length and diameter shall conform to AWWA C115.

d. Bolts for exposed service shall be zinc plated, cold pressed, steel machine bolts conforming to ASTM A 307, Grade B. Nuts for exposed service shall be zinc plated, heavy hex conforming to ASTM A 563. Zinc plating shall conform to ASTM B 633, Type II.

e. Bolts for submerged service shall be stainless steel machine bolts conforming to ASTM A 193, Grade B8. Nuts shall be heavy hex, stainless steel conforming to ASTM A 194, Grade 8.

7. Mechanical joint glands shall be ductile iron.

F. Flexible, restrained joint pipe shall be minimum Class 350. Joints shall be ball and socket type providing restraint and leak tight connections for up to 15 degrees of joint deflection. Flexible, restrained joint pipe shall be equal to American “FLEX-LOK”, U.S. Pipe “USIFLEX”, or Ball and Socket Joint pipe as manufactured by McWane Ductile. Appropriate transition pieces shall be utilized on each end of run of flexible joint pipe. All joint material required for proper installation shall be furnished by the pipe manufacturer.

G. Pipe boss outlets shall be welded-on ductile iron pipe. Outlets shall be plain end, push-on, mechanical joint or flanged joint as shown on the Drawings. Outlets shall be free of burrs. Sizes shall be as indicated on the Drawings. The outlets and parent pipe shall be minimum Class 53 ductile iron pipe for parent pipe 54-inches and smaller. For pipe larger than 54-inches, parent pipe shall be Pressure Class 350.

H. Thrust collars shall be welded-on ductile iron body type designed to withstand thrust due to 250 psi internal pressure on a dead end.

I. Acceptance will be on the basis of the Engineer's inspection and the manufacturer's written certification that the pipe was manufactured and tested in accordance with the applicable standards.

J. Ductile iron pipe shall be manufactured by American Cast Iron Pipe Company, U.S. Pipe or McWane Ductile.

2.2 POLYVINYL CHLORIDE (PVC) PIPING – AWWA TYPE

A. Pipe 4-Inches Through 48-Inches in Diameter:

1. Pipe shall have gasket belled ends for push-on type jointing and shall conform to AWWA C900, ductile iron pipe equivalent outside diameters. The pipe shall have a Dimension Ratio (DR) of 18 and shall be capable of withstanding a working pressure of 235 psi. Pipe shall be supplied in minimum lengths of 20 feet. Each length of pipe furnished shall bear identification markings in conformance with AWWA Standard C900.

B. Fittings for PVC Pipe: Fittings shall be ductile iron and shall conform to AWWA C110 or AWWA C153 with a minimum rated working pressure of 250 psi. Fittings shall be cement lined in accordance with AWWA C104 and shall be furnished with a bituminous outside coating. Seal coat over the cement lining is not required. In lieu of cement lining and

bituminous coating, fittings may be provided with a fusion bonded coating and lining meeting the requirements of AWWA C116.

C. Joints and Jointing Material: Joints for pipe shall be gasketed push-on joints, meeting the requirements of ASTM D3139. Joints between pipe and fittings, valves, and other accessories shall be mechanical joints, meeting the requirements of ASTM D3139 or AWWA C111. Provide each joint connection with an elastomeric gasket suitable for the bell or coupling with which it is to be used. Gaskets for push-on joints for pipe, shall comply with ASTM F477. Gaskets for mechanical joints for joint connections between pipe and metal fittings, valves, and other accessories shall comply with AWWA C111.

D. Restrained Joints: Restrained joints shall be made with a restraint harness manufactured of ductile iron and conforming to ASTM A536. The combination of the restraint and fasteners shall have a pressure rating equal to or greater than the pressure rating of the pipe and shall have a 2:1 safety factor.

E. Restrained Joints at Fittings: Where shown on the Drawings, retainer glands shall be used to restrain pipe to fittings.

F. Acceptance will be on the basis of the Engineer's inspection and the manufacturer's written certification that the pipe was manufactured and tested in accordance with the applicable standards, including the National Sanitation Foundation (NSF). Additionally, each piece of pipe shall be stamped “NSF Approved”.

2.3 DETECTION TAPE

A. Detection Tape: Detection tape shall be composed of a solid aluminum foil encased in a protective plastic jacket. Tapes shall be color coded in accordance with APWA color codes with the following legends: Potable water, Safety Precaution Blue, “Caution Water Line Buried Below”. Colors may be solid or striped. Tape shall be permanently printed with no surface printing allowed. Tape width shall be a minimum of 2 inches when buried less than 10 inches below the surface. Tape width shall be a minimum of 3 inches when buried greater than 10 inches and less than 20 inches.

2.4 TRACER WIRE

A. Tracer wire shall be a #12 AWG (minimum) copper conductor, insulated with a minimum 30 mil, high-density, high molecular weight polyethylene (HDPE) insulation, and rated for direct burial use. HDPE insulation shall be RoHS compliant and utilize virgin grade material.

2.5 VALVES

A. General: All external nuts, bolts, studs, fasteners or accessories shall be of stainless steel or other corrosion-resistant material.

B. Gate Valves - 3-Inches in Diameter and Larger: Gate valves shall be resilient wedge type conforming to the requirements of AWWA C509 (sizes 3-inches to 12-inches) or AWWA C515 (sizes 3-inches to 48-inches) rated for 200 psi working pressure.

1. Valves shall be provided with two O-ring stem seals with one O-ring located above and one O-ring below the stem collar. The area between the O-rings shall be filled with lubricant to provide lubrication to the thrust collar bearing surfaces each time the valve is operated. At least one anti-friction washer shall be utilized to further minimize operating torque. All seals between valve parts, such as body and bonnet, bonnet and bonnet cover, shall be flat gaskets or O-rings.
2. The valve gate shall be made of cast or ductile iron having a vulcanized, synthetic rubber coating, or a seat ring attached to the disc with retaining screws. Sliding of the rubber on the seating surfaces to compress the rubber will not be allowed. The design shall be such that compression-set of the rubber shall not affect the ability of the valve to seal when pressure is applied to either side of the gate. The sealing mechanism shall provide zero leakage at the water working pressure when installed with the line flow in either direction.
3. All internal ferrous surfaces shall be coated with epoxy to a minimum thickness of 4 mils. The epoxy shall be non-toxic, impart no taste to the water and shall conform to AWWA C550.
4. Valves shall be mechanical joint type except where shown otherwise on the Drawings.
5. Valves shall have 2-inch square operating nuts, be non-rising stem type and shall open left.
6. Gate valves shall be manufactured by American Flow Control, Mueller or M & H Valve.

2.6 FIRE HYDRANTS

A. All fire hydrants shall conform to the requirements of AWWA C502 for 250 psi working pressure. Hydrants shall be the compression type, closing with line pressure. The valve opening shall not be less than 4 1/2 inches.

B. In the event of a traffic accident, the hydrant barrel shall break away from the standpipe at a point above grade and in a manner which will prevent damage to the barrel and stem, preclude opening of the valve, and permit rapid and inexpensive restoration without digging or cutting off the water.

C. The means for attaching the barrel to the standpipe shall permit facing the hydrant a minimum of eight different directions.

D. Hydrants shall be fully bronze mounted with all working parts of bronze. Valve seat ring shall be bronze and shall screw into a bronze retainer. All external nuts, bolts, studs, fasteners or accessories shall be of stainless steel or other corrosion-resistant material.

E. All working parts, including the seat ring shall be removable through the top without disturbing the barrel of the hydrant.

F. Hydrants shall have a 1-1/2-inch Hex head operating nut. The operating nut shall match those on the existing hydrants. The operating threads shall be totally enclosed in an operating chamber, separated from the hydrant barrel by a rubber O ring stem seal and lubricated by a grease or an oil reservoir.

G. Hydrant shall be a non-freezing design and be provided with a simple, positive, and automatic drain which shall be fully closed whenever the main valve is opened.

H. Hose and pumper connections shall be breech locked, pinned, or threaded and pinned to seal them into the hydrant barrel. Each hydrant shall have two 2 1/2 inch hose connections and one 4 1/2 inch pumper connection, all with National Standard threads and each equipped with cap and non-kinking chain.

I. Hydrants shall be furnished with a mechanical joint connection to the spigot of the 6 inch hydrant lead.

J. Minimum depth of bury shall be 4.0 feet. Provide extension section where necessary for proper vertical installation and in accordance with manufacturer's recommendations.

K. All outside surfaces of the barrel above grade shall be painted yellow with a coating system per the manufacturer’s recommendations.

L. Hydrants shall be traffic model and shall be American Flow Control B 84 B, Mueller Super Centurion or M & H Valve 929.

2.7 VALVE BOXES AND EXTENSION STEMS

A. All valves shall be equipped with valve boxes. The valve boxes shall be cast iron two-piece screw type with drop covers. Valve boxes shall have a 5.25 inch inside diameter. Valve box covers shall weigh a minimum of 13 pounds. The valve boxes shall be adjustable to 6 inches up or down from the nominal required cover over the pipe. Valve boxes shall be of sufficient length that bottom flange of the lower belled portion of the box is below the valve operating nut. Ductile or cast iron extensions shall be provided as necessary. Covers shall have “WATER VALVE” or “WATER” cast into them.

2.8 RETAINER GLANDS

A. Retainer glands shall be provided at all mechanical joints, including fittings, valves, hydrants and other locations as shown on the Drawings.

B. Retainer glands for ductile iron pipe shall be Megalug Series 1100, as manufactured by EBAA Iron, Uni-Flange Series 1400, as manufactured by Ford Meter Box Company, Star Pipe Products Star-Grip Series 3000, or Sigma One-Lok Series SLD.

C. Retainer glands for PVC pipe shall be Megalug Series 200PV, as manufactured by EBAA Iron, Uni-Flange Series 1300, Star Pipe Products Star-Grip Series 4000, or Sigma One-Lok Series SLCE.

2.9 HYDRANT TEES

A. Hydrant tees shall be equal to ACIPCO A10180 or U.S. Pipe U 592.

2.10 ANCHOR COUPLINGS

A. Lengths and sizes shall be as shown on the Drawings. Anchor couplings shall be equal to ACIPCO A 10895 or U.S. Pipe U 591.

2.11 CONCRETE

A. Concrete shall have a compressive strength of not less than 3,000 psi, with not less than 5.5 bags of cement per cubic yard and a slump between 3 and 5 inches. For job mixed concrete, submit the concrete mix design for approval by the Engineer. Ready mixed concrete shall be mixed and transported in accordance with ASTM C 94. Reinforcing steel shall conform to the requirements of ASTM A 615, Grade 60.

2.12 FLOWABLE FILL

A. Flowable fill shall meet the specifications of the Georgia Department of Transportation Standard Specifications for Road and Bridge Construction.

2.13 POLYETHYLENE ENCASEMENT

A. Polyethylene encasement for use with ductile iron pipe shall meet all the requirements for ANSI/AWWA C105/A21.5, Polyethylene Encasement for Ductile Iron Pipe Systems. Polyethylene encasement shall consist of three layers of co-extruded linear low density polyethylene (LLDPE), fused into a single thickness of not less than 8 mils.

B. The inside surface of the polyethylene wrap to be in contact with the pipe exterior shall be infused with a blend of anti-microbial biocide to mitigate microbiologically influenced corrosion and a volatile corrosion inhibitor to control galvanic corrosion.

PART 3 - EXECUTION

3.1 EXISTING UTILITIES AND OBSTRUCTIONS

A. The Drawings indicate utilities or obstructions that are known to exist according to the best information available to the Owner. The Contractor shall contact, by dialing 811, the Georgia Utilities Protection Center, as applicable, and all utilities, agencies or departments that own and/or operate utilities in the vicinity of the construction work site at least 72 hours (three business days) prior to construction to verify the location of the existing utilities.

B. Existing Utility Location: The following steps shall be exercised to avoid interruption of existing utility service.

1. Provide the required notice to the utility owners and allow them to locate their facilities according to applicable local and state law. Field utility locations are valid for only 10 days after original notice. The Contractor shall ensure, at the time of any excavation that a valid utility location exists at the point of excavation.
2. Expose the facility, for a distance of at least 200 feet in advance of pipeline construction, to verify its true location and grade. Repair, or have repaired, any damage to utilities resulting from locating or exposing their true location.
3. Avoid utility damage and interruption by protection with means or methods recommended by the utility owner.
4. Maintain a log identifying when phone calls were made, who was called, area for which utility relocation was requested and work order number issued, if any. The Contractor shall provide the Engineer an updated copy of the log bi-weekly, or more frequently if required.

C. Conflict with Existing Utilities

1. Horizontal Conflict: Horizontal conflict shall be defined as when the actual horizontal separation between a utility, main, or service and the proposed water main does not permit installation of the water main by the use of sheeting, shoring, tying back, supporting, or temporarily suspending service of the parallel or crossing facility. The Contractor may change the proposed alignment of the water main to avoid horizontal conflicts if the new alignment remains within the available right of way or easement, complies with regulatory agency requirements and after a written request to and subsequent approval by the Engineer. Where such relocation of the water main is denied by the Engineer, the Contractor shall arrange to have the utility, main, or service relocated.
2. Vertical Conflict: Vertical conflict shall be defined as when the actual vertical separation between a utility, main, or service and the proposed water main does not permit the crossing without immediate or potential future damage to the utility, main, service, or the water main. The Contractor may change the proposed grade of the water main to avoid vertical conflicts if the changed grade maintains adequate cover and complies with regulatory agencies requirements after written request to and subsequent approval by the Engineer. Where such relocation of the water main is denied by the Engineer, the Contractor shall arrange to have the utility, main, or service relocated.

D. Electronic Locator: Have available at all times an electronic pipe locator and a magnetic locator, in good working order, to aid in locating existing pipe lines or other obstructions.

E. Water and Sewer Separation

1. Water mains should maintain a minimum 10-foot edge to edge separation from sewer lines, whether gravity or pressure. If the main cannot be installed in the prescribed easement or right of way and provide the 10-foot separation, the separation may be reduced, provided the bottom of the water main is a minimum of 18 inches above the top of the sewer. Should neither of these two separation

criteria be possible, the water main shall be installed below the sewer with a minimum vertical separation of 18 inches.

2. The water main, when installed below the sewer, shall be encased in concrete with a minimum 6-inch concrete depth to the first joint in each direction. Where water mains cross the sewer, the pipe joint adjacent to the pipe crossing the sewer shall be cut to provide maximum separation of the pipe joints from the sewer.
3. No water main shall pass through, or come in contact with, any part of a sanitary sewer manhole.

3.2 CONSTRUCTION ALONG HIGHWAYS, STREETS AND ROADWAYS

A. Install pipe lines and appurtenances along highways, streets and roadways in accordance with the applicable regulations of, and permits issued by the Georgia Department of Transportation (GDOT), and Cobb County with reference to construction operations, safety, traffic control, road maintenance and repair.

B. Traffic Control

1. The Contractor shall provide, erect and maintain all necessary barricades, suitable and sufficient lights and other traffic control devices; provide qualified flagmen where necessary to direct traffic; take all necessary precautions for the protection of the work and the safety of the public. Georgia DOT (as applicable) approved flagman training program.
2. Construction traffic control devices and their installation shall be in accordance with the Manual on Uniform Traffic Control Devices for Streets and Highways and permits issued for this Project.
3. Placement and removal of construction traffic control devices shall be coordinated with the permitting agencies as required by the permitting agencies.
4. Placement of construction traffic control devices shall be scheduled ahead of associated construction activities. Construction time in street right of way shall be conducted to minimize the length of time traffic is disrupted. Construction traffic control devices shall be removed immediately following their useful purpose. Traffic control devices used intermittently, such as “Flagmen Ahead”, shall be removed and replaced when needed.
5. Existing traffic control devices within the construction work zone shall be protected from damage. Traffic control devices requiring temporary relocation shall be located as near as possible to their original vertical and horizontal locations. Original locations shall be measured from reference points and recorded in a log prior to relocation. Temporary locations shall provide the same visibility to affected traffic as the original location. Relocated traffic control devices shall be reinstalled in their original locations as soon as practical following construction.
6. Construction traffic control devices shall be maintained in good repair and shall be clean and visible to affected traffic for daytime and nighttime operation. Traffic control devices affected by the construction work zone shall be inspected daily.
7. Construction warning signs shall be black legend on an orange background. Regulatory signs shall be black legend on a white background. Construction sign panels shall meet the minimum reflective requirements of the permitting agencies.

Sign panels shall be of durable materials capable of maintaining their color, reflective character and legibility during the period of construction.

8. Channelization devices shall be positioned preceding an obstruction at a taper length as required by the Manual on Uniform Traffic Control Devices for Streets and Highways, as appropriate for the speed limit at that location. Channelization devices shall be patrolled to ensure that they are maintained in the proper position throughout their period of use.

C. Construction Operations

1. Perform all work along highways, streets and roadways to minimize interference with traffic.
2. Stripping: Where the pipe line is laid along road right of way, strip and stockpile all sod, topsoil and other material suitable for right of way restoration.
3. Trenching, Laying and Backfilling: Do not open the trench any further ahead of pipe laying operations than is necessary. Backfill and remove excess material immediately behind laying operations. Complete excavation and backfill for any portion of the trench in the same day.
4. Shaping: Reshape damaged slopes, side ditches, and ditch lines immediately after completing backfilling operations. Replace topsoil, sod and any other materials removed from shoulders.

D. Excavated Materials: Do not place excavated material along highways, streets and roadways in a manner which obstructs traffic. Sweep all scattered excavated material off of the pavement in a timely manner.

E. Drainage Structures: Keep all side ditches, culverts, cross drains, and other drainage structures clear of excavated material. Care shall be taken to provide positive drainage to avoid ponding or concentration of runoff.

F. Landscaping Features: Landscaping features shall include but are not necessarily limited to: fences; property corners; cultivated trees and shrubbery; manmade improvements; subdivision and other signs within the right of way and easement. The Contractor shall take extreme care in moving landscape features and promptly re-establishing these features.

G. Maintaining Highways, Streets, Roadways and Driveways

1. Maintain streets, highways, roadways and driveways in suitable condition for movement of traffic until completion and final acceptance of the work.
2. During the time period between pavement removal and completing permanent pavement replacement, maintain highways, streets and roadways by the use of steel running plates. Running plate edges shall have asphalt placed around their periphery to minimize vehicular impact. The backfill above the pipe shall be compacted as specified elsewhere up to the existing pavement surface to provide support for the steel running plates.
3. Furnish a road grader or front-end loader for maintaining highways, streets, and roadways. The grader or front-end loader shall be available at all times.

4. Immediately repair all driveways that are cut or damaged. Maintain them in a suitable condition for use until completion and final acceptance of the work.

3.3 PIPE DISTRIBUTION

A. Pipe shall be distributed and placed in such a manner that will not interfere with traffic.

B. No pipe shall be strung further along the route than 1,000 feet beyond the area in which the Contractor is actually working without written permission from the Owner. The Owner reserves the right to reduce this distance to a maximum distance of 200 feet in residential, commercial or otherwise congested areas based on the effects of the distribution to the adjacent property owners.

C. No street or roadway may be closed for unloading of pipe without first obtaining permission from the proper authorities. The Contractor shall furnish and maintain proper warning signs and obstruction lights for the protection of traffic along highways, streets and roadways upon which pipe is distributed.

D. No distributed pipe shall be placed inside drainage ditches.

E. Distributed pipe shall be placed as far as possible from the roadway pavement, but no closer than five feet from the roadway pavement, as measured edge to edge.

3.4 LOCATION AND GRADE

A. The Drawings show the alignment of the water main and the location of valves, hydrants and other appurtenances.

3.5 LAYING AND JOINTING PIPE AND ACCESSORIES

A. Lay all pipe and fittings to accurately conform to the lines and grades established by the Engineer.

B. Pipe Installation

1. Proper implements, tools and facilities shall be provided for the safe performance of the work. All pipe, fittings, valves and hydrants shall be lowered carefully into the trench by means of slings, ropes or other suitable tools or equipment in such a manner as to prevent damage to water main materials and protective coatings and linings. Under no circumstances shall water main materials be dropped or dumped into the trench.
2. All pipe, fittings, valves, hydrants and other appurtenances shall be examined carefully for damage and other defects immediately before installation. Defective materials shall be marked and held for inspection by the Engineer, who may prescribe corrective repairs or reject the materials.
3. All lumps, blisters and excess coating shall be removed from the socket and plain ends of each pipe, and the outside of the plain end and the inside of the bell shall

be wiped clean and dry and free from dirt, sand, grit or any foreign materials before the pipe is laid. No pipe containing dirt shall be laid.

4. Foreign material shall be prevented from entering the pipe while it is being placed in the trench. No debris, tools, clothing or other materials shall be placed in the pipe at any time.
5. As each length of pipe is placed in the trench, the joint shall be assembled and the pipe brought to correct line and grade. The pipe shall be secured in place with approved backfill material.
6. It is not mandatory to lay pipe with the bells facing the direction in which work is progressing.
7. Applying pressure to the top of the pipe, such as with a backhoe bucket, to lower the pipe to the proper elevation or grade, shall not be permitted.
8. Provide detection tape for all non-metallic pressure pipe. Detection tape shall be buried 4 to 10 inches deep. Should detection tape need to be installed deeper, the Contractor shall provide 3-inch wide tape. In no case shall detection tape be buried greater than 20 inches from the finish grade surface.
9. Where pipes of dissimilar materials are joined together, provide adapters as shown on the Drawings.

C. Alignment and Gradient

1. Lay pipe straight in alignment and gradient or follow true curves as nearly as practicable. Do not deflect any joint more than the maximum deflection recommended by the manufacturer.
2. Maintain a transit, level and accessories on the job to lay out angles and ensure that deflection allowances are not exceeded.

D. Expediting of Work: Excavate, lay the pipe, and backfill as closely together as possible. Do not leave unjointed pipe in the trench overnight. Backfill and compact the trench as soon as possible after laying and jointing is completed. Cover the exposed end of the installed pipe each day at the close of work and at all other times when work is not in progress. If necessary to backfill over the end of an uncompleted pipe or accessory, close the end with a suitable plug, either push on, mechanical joint, restrained joint or as approved by the Engineer.

E. Joint Assembly

1. Push on, mechanical, flange and restrained type joints shall be assembled in accordance with the manufacturer's recommendations.
2. The Contractor shall inspect each pipe joint within 1,000 feet on either side of main line valves to ensure 100 percent seating of the pipe spigot, except as noted otherwise.
3. Unless noted otherwise, each restrained joint shall be inspected by the Contractor to ensure that it has been “homed” 100 percent.
4. The Contractor shall internally inspect each pipe joint to insure proper assembly for pipe 30 inches in diameter and larger after the pipe has been brought to final alignment.

F. Cutting Pipe: Cut ductile iron pipe using an abrasive wheel saw. Cut PVC pipe using a suitable saw; remove all burrs and smooth the end before jointing. The Contractor shall cut the pipe and bevel the end, as recommended by the manufacturer, to provide the correct length of pipe necessary for installing the fittings, valves, accessories and closure pieces in the correct location. Only push-on joint pipe shall be cut.

G. Polyethylene Encasement: Ductile iron pipe, fittings, and valves shall be encased in polyethylene film where shown on the Drawings, where specified, or where ordered by the Engineer. Installation shall be in accordance with AWWA C105 and the manufacturer's instructions. All ends shall be securely closed with tape and all damaged areas shall be completely repaired to the satisfaction of the Engineer.

H. Valve and Fitting Installation

1. Prior to installation, valves shall be inspected for direction of opening, number of turns to open, freedom of operation, tightness of pressure containing bolting and test plugs, cleanliness of valve ports and especially seating surfaces, handling damage and cracks. Defective valves shall be corrected or held for inspection by the Engineer. Valves shall be closed before being installed.
2. Valves, fittings, plugs and caps shall be set and joined to the pipe in the manner specified in this section for cleaning, laying and joining pipe, except that 12 inch and larger valves shall be provided with special support, such as treated timbers, crushed stone, concrete pads or a sufficiently tamped trench bottom so that the pipe will not be required to support the weight of the valve. Valves shall be installed plumb.
3. A valve box shall be provided on each underground valve. They shall be carefully set, centered exactly over the operating nut and truly plumbed. The valve box shall not transmit shock or stress to the valve. The bottom flange of the lower belled portion of the box shall be placed below the valve operating nut. This flange shall be set on brick, so arranged that the weight of the valve box and superimposed loads will bear on the base and not on the valve or pipe. Extension stems shall be installed where depth of bury places the operating nut in excess of 30 inches beneath finished grade so as to set the top of the operating nut 30 inches below finished grade. The valve box cover shall be flush with the surface of the finished area or such other level as directed by the Engineer.
4. In no case shall valves be used to bring misaligned pipe into alignment during installation. Pipe shall be supported in such a manner as to prevent stress on the valve.

I. Hydrant Installation

1. Prior to installation, inspect all hydrants for direction of opening, nozzle threading, operating nut and cap nut dimensions, tightness of pressure containing bolting, cleanliness of inlet elbow, handling damage and cracks. Defective hydrants shall be corrected or held for inspection by the Engineer.
2. All hydrants shall stand plumb and shall have their nozzles parallel with or at right angles to the roadway, with pumper nozzle facing the roadway, except that hydrants having two hose nozzles 90 degrees apart shall be set with each nozzle facing the roadway at an angle of 45 degrees.

3. Hydrants shall be set to the established grade, with the centerline of the lowest nozzle at approximately 18 inches above the ground or as directed by the Engineer.
4. Each hydrant shall be connected to the main with a 6-inch branch controlled by an independent 6-inch gate valve. When a hydrant is set in soil that is pervious, drainage shall be provided at the base of the hydrant by placing coarse gravel or crushed stone mixed with coarse sand from the bottom of the trench to at least 6 inches above the drain port opening in the hydrant to a distance of 12 inches around the elbow.
5. When a hydrant is set in clay or other impervious soil, a drainage pit 2 x 2 x 2 feet shall be excavated below each hydrant and filled with coarse gravel or crushed stone mixed with coarse sand under and around the elbow of the hydrant and to a level of 6 inches above the drain port.
6. Hydrants shall be located as shown on the Drawings or as directed by the Engineer. For hydrants that are intended to fail at the ground line joint upon vehicle impact, specific care must be taken to provide adequate soil resistance to avoid transmitting shock moment to the lower barrel and inlet connection. In loose or poor load bearing soil, this may be accomplished by pouring a concrete collar approximately 6 inches thick to a diameter of 24 inches at or near the ground line around the hydrant barrel.

3.6 CONNECTIONS TO WATER MAINS

A. Make connections to existing pipe lines with tapping sleeves and valves, unless specifically shown otherwise on the Drawings.

B. Location: Before laying pipe, locate the points of connection to existing water mains and uncover as necessary for the Engineer to confirm the nature of the connection to be made.

C. Interruption of Services: Make connections to existing water mains only when system operations permit. Operate existing valves only with the specific authorization and direct supervision of the Owner.

D. Tapping Sleeves

1. Holes in the new pipe shall be machine cut, either in the field or at the factory. No torch cutting of holes shall be permitted.
2. Prior to attaching the saddle or sleeve, the pipe shall be thoroughly cleaned, utilizing a brush and rag, as required.
3. Before performing field machine cut, the water-tightness of the sleeve assembly shall be pressure tested. The interior of the assembly shall be filled with water.
4. An air compressor shall be attached, which will induce a test pressure as specified in this Section. No leakage shall be permitted for a period of five minutes.
5. After attaching the sleeve to an existing main, but prior to making the tap, the interior of the assembly shall be disinfected. All surfaces to be exposed to potable water shall be swabbed or sprayed with a one percent hypochlorite solution. See also Article 3.10 - Disinfecting Pipeline of this Section of these Specifications.

E. Connections Using Solid Sleeves or Couplings: Where connections are shown on the Drawings using solid sleeves, the Contractor shall furnish materials and labor necessary to make the connection to the existing pipe line.

3.7 POLYETHYLENE ENCASEMENT

A. Ductile iron pipe and the polyethylene encasement used to protect it shall be installed in accordance with AWWA C600 and ANSI/AWWA C105/A21.5 and also in accordance with all recommendations and practices of the AWWA M41, Manual of Water Supply Practices – Ductile Iron Pipe and Fittings. Specifically, the wrap shall be overlapped one foot in each direction at joints and secured in place around the pipe and any wrap at tap locations shall be taped tightly prior to tapping and inspected for any needed repairs following the tap.

B. All installations shall be carried out by personnel trained and equipped to meet these various requirements.

C. The installing contractor shall submit an affidavit stating compliance with the requirements and practices of ANSI/AWWA C150/A21.50, ANSI/AWWA C151/A21.51, ANSI/AWWA C105/A21.5, AWWA C600, and M41.

3.8 THRUST RESTRAINT

A. Provide restraint at all points where hydraulic thrust may develop.

B. Retainer Glands: Provide retainer glands where shown on the Drawings and on fire hydrants and all associated fittings, valves and related piping. Retainer glands shall be installed in accordance with the manufacturer's recommendations.

C. Harnessing

1. Provide harness rods only where specifically shown on the Drawings or directed by the Engineer.
2. Harness rods shall be manufactured in accordance with ASTM A 36 and shall have an allowable tensile stress of no less than 22,000 psi. Harness rods shall be hot dip galvanized or field coated with bitumastic before backfilling.
3. Where possible, harness rods shall be installed through the mechanical joint bolt holes. Where it is not possible, provide 90-degree bend eye bolts.
4. Eye bolts shall be of the same diameter as specified in AWWA C111 for that pipe size. The eye shall be welded closed. Where eye bolts are used in conjunction with harness rods, an appropriate size washer shall be utilized with a nut on each end of the harness rod. Eye bolts shall be of the same material and coating as the harness rods.

D. Hydrants: Hydrants shall be attached to the water main as shown on the Drawings.

E. Thrust Collars: Concrete shall have a compressive strength of not less than 4,000 psi. Welded on collars shall be attached to the pipe by the pipe manufacturer. Where thrust

collars are to be installed on existing pipe, retainer glands shall be used in lieu of a welded-on collar. For use with thrust collars, retainer glands shall be of a split style as specified elsewhere in this Section. The retainer glands, as shown on the Drawings, shall be installed in opposite orientations from each other in order to account for differences in flow direction.

F. Concrete Blocking

1. Provide concrete blocking for all bends, tees, valves, and other points where thrust may develop, except where other exclusive means of thrust restraint are specifically shown on the Drawings.
2. Concrete shall be as specified in Section 033001 “Cast-in-Place Concrete (Sitework)”.
3. Form and pour concrete blocking at fittings as shown on the Drawings and as directed by the Engineer. Pour blocking against undisturbed earth. Increase dimensions when required by over excavation.

3.9 INSPECTION AND TESTING

A. Pressure and Leakage Test

B. All sections of the water main shall be pressure. A section of main will be considered ready for testing after completion of all thrust restraint and backfilling.

C. Each segment of water main between main valves shall be tested individually.

D. Test Preparation

1. For water mains less than 24 inches in diameter, flush sections thoroughly at flow velocities, greater than 3.0 feet per second, adequate to remove debris from pipe and valve seats. For water mains 24 inches in diameter and larger, the main shall be carefully swept clean, and mopped if directed by the Engineer. Partially open valves to allow the water to flush the valve seat. The Owner shall be notified and given the opportunity to be present during flushing operations.
2. Partially operate valves and hydrants to clean out seats.
3. Provide temporary blocking, bulkheads, flanges and plugs as necessary, to assure all new pipe, valves, and appurtenances will be pressure tested.
4. Before applying test pressure, air shall be completely expelled from the pipeline and all appurtenances. Insert corporation cocks at highpoints to expel air as main is filled with water as necessary to supplement automatic air valves. Corporation stops shall be constructed as detailed on the Drawings with a meter box.

E. Fill pipeline slowly with water. Provide a suitable pump with an accurate water meter to pump the line to the specified pressure.

F. The differential pressure across a valve or hydrant shall equal the maximum possible, but not exceed the rated working pressure. Where necessary, provide temporary backpressure to meet the differential pressure restrictions.

G. Valves shall not be operated in either the opening or closing direction at differential pressures above the rated pressure.

H. Test Pressure: Test the pipeline at 200 psi measured at the lowest point for at least two hours. Maintain the test pressure within 5 psi of the specified test pressure for the test duration. Should the pressure drop more than 5 psi at any time during the test period, the pressure shall be restored to the specified test pressure. Provide an accurate pressure gage with graduation not greater than 5 psi.

I. Leakage

1. Leakage shall be defined as the sum of the quantity of water that must be pumped into the test section, to maintain pressure within 5 psi of the specified test pressure for the test duration plus water required to return line to test pressure at the end of the test. Leakage shall be the total cumulative amount measured on a water meter.
2. The Owner assumes no responsibility for leakage occurring through existing valves.
3. Test Results: No test section shall be accepted if the leakage exceeds the limits determined by the following formula:

$$L = \frac{S * D\sqrt{P}}{148{,}000}$$

Where:

L = allowable leakage, 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 leakage test, in pounds per square inch (gauge)

As determined under Section 5 of AWWA C600.

If the water main section being tested contains lengths of various pipe diameters, the allowable leakage shall be the sum of the computed leakage for each diameter. The leakage test shall be repeated until the test section is accepted. All visible leaks shall be repaired regardless of leakage test results.

J. Completion: After a pipeline section has been accepted, relieve test pressure. Record the type, size and location of all outlets on record drawings.

3.10 DISINFECTING PIPELINE

A. After successfully pressure testing each pipeline section, disinfect in accordance with AWWA C651 for the continuous feed method and these Specifications.

B. Specialty Contractor: Disinfection shall be performed by an approved specialty contractor. Before disinfection is performed, the Contractor shall submit a written

procedure for approval before being permitted to proceed with the disinfection. This plan shall also include the steps to be taken for the neutralization of the chlorinated water.

C. Chlorination

1. Apply chlorine solution to achieve a concentration of at least 25 milligrams per liter free chlorine in new line. Retain chlorinated water for 24 hours.
2. Chlorine concentration shall be recorded at every outlet along the line at the beginning and end of the 24-hour period.
3. After 24 hours, all samples of water shall contain at least 10 milligrams per liter free chlorine. Rechlorinate if required results are not obtained on all samples.

D. Disposal of Chlorinated Water:

1. Dechlorination and disposal of heavily chlorinated water shall be in accordance with AWWA C655.
2. Reduce chlorine residual of disinfection water to less than one milligram per liter if discharged directly to a body of water or to less than two milligrams per liter if discharged onto the ground prior to disposal. Treat water with sulfur dioxide or other reducing chemicals to neutralize chlorine residual. Flush all lines until residual is equal to existing system.

E. Bacteriological Testing: After flushing of heavily chlorinated water and before the water main is placed in service, the Contractor shall collect samples from the main and have samples tested for bacteriological quality in accordance with the rules of the Georgia EPD and AWWA C651. The bacteriological samples shall be analyzed for both coliform and non-coliform growth. Testing shall be performed by a laboratory certified by the State of Georgia. Rechlorinate mains until required results are obtained.

3.11 PROTECTION AND RESTORATION OF WORK AREA

A. General: Return all items and all areas disturbed, directly or indirectly by work under these Specifications, to their original condition or better, as quickly as possible after work is started.

1. The Contractor shall plan, coordinate, and prosecute the work such that disruption to personal property and business is held to a practical minimum.
2. All construction areas abutting lawns and yards of residential or commercial property shall be restored promptly. Backfilling of underground facilities, ditches, and disturbed areas shall be accomplished on a daily basis as work is completed. Finishing, dressing, and grassing shall be accomplished immediately thereafter, as a continuous operation within each area being constructed and with emphasis placed on completing each individual yard or business frontage. Care shall be taken to provide positive drainage to avoid ponding or concentration of runoff.
3. Handwork, including raking and smoothing, shall be required to ensure that the removal of roots, sticks, rocks, and other debris is removed in order to provide a neat and pleasing appearance.

B. Man-made Improvements: Protect, or remove and replace with the Engineer's approval, all fences, walkways, mail boxes, pipe lines, drain culverts, power and telephone lines and cables, property pins and other improvements that may be encountered in the work.

C. Disposal of Rubbish: Dispose of all materials cleared and grubbed during the construction of the Project in accordance with the applicable codes and rules of the appropriate county, state and federal regulatory agencies.

END OF SECTION 331100

SECTION 331213 – WATER SERVICE CONNECTIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe and fittings for domestic water service connections to buildings.
2. Corporation stop assembly.
3. Curb stop assembly.
4. Water meters and meter setting equipment.
5. Backflow preventers.
6. Underground pipe markers.
7. Bedding and cover materials.

B. Supply all products and perform all work in accordance with applicable American Society for Testing and Material (ASTM), American Water Works Association (AWWA), American National Standards Institute (ANSI), National Science Foundation (NSF) Standard 61, or other recognized standards. Latest revisions of all standards are applicable. Additionally, products shall meet the Federal lead-free requirements as stated in the Reduction of Lead in Drinking Water Act.

1.2 DEFINITIONS

A. Utility Company: Dekalb County Department of Watershed Management (DWM)

1.3 SUBMITTALS

A. Submit in accordance with Section 013300 – Submittal-RFI Procedures.

B. Shop Drawings: Provide shop drawings for precast concrete vaults to include detail drawings showing the vault and accessories.

C. Product Data: Submit data on pipe materials, pipe fittings, corporation stop assemblies, curb stop assemblies, meters, meter setting equipment, service saddles, backflow preventer, and accessories.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

E. Submit Project Record Documents. Record actual locations of piping mains, curb stops, connections, thrust restraints, and invert elevations.

F. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with utility company standards, state and local laws, and the DOT Standard Specifications.

B. Maintain one copy of referenced documents on site.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Requirements for transporting, handling, storing, and protecting products.

B. During loading, transporting, and unloading of materials and products, exercise care to prevent any damage.

C. Store products and materials off ground and under protective coverings and custody, away from walls and in manner to keep these clean and in good condition until used.

D. Exercise care in handling precast concrete products to avoid chipping, cracking, and breakage.

PART 2 - PRODUCTS

2.1 WATER PIPING AND FITTINGS

A. General: All pipe and fittings shall comply with NSF 61 and Federal lead-free requirements.

B. Copper Tubing: ASTM B88, Type K, annealed:

1. Fittings: ASME B16.18, cast copper, or ASME B16.22, wrought copper.
2. Joints: Compression connection or AWS A5.8, BCuP silver braze.

C. Polyethylene Water Service Lines: Pipe or tubing in accordance with AWWA C901, ASTM D2239, ASTM D3035, or ASTM D2737.

1. IPS pipe produced per ASTM D3035:

a. Joints: Heat Fusion and Electrofusion
b. Fittings: Mechanical Compression fittings or Stab fittings. Internal stiffeners shall be provided on all stab and mechanical fittings.

2. CTS pipe produced per ASTM D2737:

a. Joints: Heat Fusion and Electrofusion
b. Fittings: Mechanical Compression fittings or Stab fittings. Internal stiffeners shall be provided on all stab and mechanical fittings.

2.2 CORPORATION STOP ASSEMBLY

A. Manufacturers:

1. Ford Meter Box Company.
2. Mueller Company.
3. McDonald Company.
4. Or Equal

B. Corporation Stops:

1. Brass or red brass alloy body conforming to Federal No-Lead requirements.
2. Inlet end threaded for tapping according to AWWA C800.
3. Outlet end suitable for service pipe specified.

C. Service Saddles: Double strap type, designed to hold pressures in excess pipe working pressure. Manufacturers:

1. Rockwell.
2. McDonald Company.
3. Or Equal

2.3 CURB STOP ASSEMBLY

A. Manufacturers:

1. Ford Meter Box Company.
2. Mueller Company.
3. McDonald Company.
4. Or Equal

B. Curb Stops:

1. Brass or red brass alloy body conforming to Federal No-Lead requirements.
2. Plug type valve.
3. Positive pressure sealing.

C. Curb Boxes and Covers:

1. Cast iron body, Extension Type or Buffalo Type.
2. Minneapolis or Arch Pattern Base.
3. Lid with inscription WATER, with Pentagon Plug.

2.4 METER SETTING EQUIPMENT

A. Manufacturers:

1. Ford Meter Box Company.
2. Mueller Company.
3. Or Equal

B. Outside Meter Setting:

1. Meter Yokes: Copper or iron, riser type assembly with bronze inlet inverted key angle valve expansion type outlet connection and Ell fitting; flared copper tubing connections both ends.
2. Meter Yokes: Copper or iron, inlet and outlet horizontal or vertical setting with matching couplings, fittings, and stops.

2.5 WATER METERS

A. Physical and Common Requirements

1. Metering system components shall be installed according to the Metering System Schedule shown0 on the drawings.
2. Surge withstand shall conform to IEEE C37.90.1.

B. Cold-Water Meters - Displacement Type 5/8-inch x 3/4-inch, 1-inch, 1-1/2-inch, 2-inch Size

1. Small meters shall be as follows or shall be approved equivalents: Positive displacement meters provided hereunder shall be full-size nutating-disc, magnetic drive, sealed register, cold water meters and shall fully comply with the requirements of AWWA C700 unless otherwise specified hereunder.
2. No oscillating-piston style meters will be accepted.
3. Materials

a. Cases 5/8-Inch x 3/4-Inch, 1-Inch, 1-1/2-Inch: The main case of the meter shall be cast all-bronze, bottom caps shall be cast all-bronze, excepting register boxes and register box lids which shall be bronze or an approved plastic material as specified in AWWA C700. Meter cases constructed of plastic will not be accepted.
b. Cases 2-Inch: The main case of the meter shall be cast all-bronze, including bottom caps, excepting register boxes and register box lids which shall be bronze or an approved plastic material. Meter cases constructed of plastic will not be accepted.
c. Register Box Rings and Lids: Register box rings and lids shall be made of a copper alloy containing not less than 57 percent copper, or all bronze, or an approved suitable synthetic polymer.
d. Measuring Chambers: Measuring chambers shall be made of a copper alloy containing not less than 85 percent copper and suitable amounts of tin, zinc, or of a suitable synthetic polymer.

e. Discs: Discs shall be made of vulcanized hard rubber or a suitable synthetic polymer with specific gravity approximately equal to that of water. They shall have sufficient dimensional stability to retain operating clearances at working temperatures of up to +27 degrees Centigrade and not warp or deform when exposed to operating temperatures of +37 degrees Centigrade.
f. Measuring Chamber Diaphragms: Measuring chamber diaphragms shall be made of phosphor bronze, stainless steel, hard rubber, or a suitable synthetic polymer.
g. Spindles, Thrust Rollers, and Thrust-Roller Bearing Plates: Spindles, thrust rollers and thrust-roller bearing plates shall be made of phosphor bronze, stainless steel, hard rubber, or a suitable synthetic polymer.
h. Intermediate Gear Trains: Frames, gears, and pinions shall be made of a suitable copper alloy, other suitable non-corrosive metals, or other suitable materials.
i. External Fasteners (Casing Bolts, Studs, Nuts, Screws, and Washers): External fasteners shall be made of a copper alloy containing not less than 57 percent copper, stainless steel, or steel treated to resist corrosion by a process approved by the Owner. Fasteners for no-pressure assemblies may be made of a suitable synthetic polymer. All external case closures, such as rings, clamps, screws, bolts, cap bolts, nuts and washers, shall be designed for easy removal following lengthy service.
j. Water Meter Coupling - 5/8-Inch x 3/4-Inch: A water coupling shall be composed of one meter coupling nut, one meter coupling tail piece (straight), and one rubber-type washer for meter coupling. The meter coupling tailpiece and nut shall be a copper alloy containing not less than 57 percent copper. The coupling nut shall have internal straight pipe threads conforming to ASME B1.20.1. Pitch diameter shall be that shown on AWWA C700. The coupling tailpiece shall have external taper pipe threads conforming to ASME B1.20.1 and an internal diameter approximately equal to the nominal thread size of the tailpiece. Lengths and thread sizes shall be those listed in AWWA C700. One water meter coupling and one additional rubber-type washer for meter coupling (total of two rubber-type washers) shall be provided with each meter.
k. Companion Flanges - 1-1/2-Inch and 2-Inch: Companion flanges shall be made of cast iron.

4. General Design

a. Pressure Requirements: Meters supplied under this specification shall operate without leakage or damage to any part at a working pressure of 150 psi.
b. Accessibility: All 1-1/2-inch and 2-inch meters shall be designed for easy removal of all interior parts without disturbing the connections to the pipeline.

5. Detail Design

a. Cases: All meters shall have an outer case with separate, removable measuring chambers. Cases shall not be repaired in any manner. The inlet and outlet shall have a common axis. A meter case shall include the top case

and bottom case, or main case and bottom plate, whichever is applicable. Connection flanges shall be parallel.

b. Connections: Meter case connections for 5/8-inch x 3/4-inch and 1-inch meters shall be meter casing spuds on both ends. Spuds shall have external straight threads conforming to ASME B1.20.1 as far as the specifications apply. Pitch diameters shall be those shown in AWWA C700. Main case connections for 1-1/2-inch and 2-inch meters shall be oval-flanged on both ends. Flanges shall be faced and drilled and shall be the oval type. The drilling shall be on a horizontal axis; the number of bolt holes and the diameters of the bolt holes and bolt circle shall be as listed in AWWA C700. Two oval companion flanges, gaskets, bolts and nuts shall be provided with each meter. Companion flanges shall be faced, drilled, and tapped in conformance with ASME B1.20.1. Dimensions shall be those listed in AWWA C700. Companion flanges shall be cast iron.

c. Registers: Registers shall be straight-reading and shall read in 1000-gallon increments. The register shall be equipped with a center-sweep test hand with the test circle located on the periphery of the register and graduated in 100 equal parts, with each tenth graduation being numbered. Register construction shall conform to all applicable requirements of AWWA C700.

d. Register Boxes: The lid shall be recessed and shall overlap the register box in order to protect the lens. The lens shall be held securely in place.

e. Intermediate Gear Trains: Intermediate gear trains may be mounted on the measuring chamber, in the upper main casing, or when not exposed to water, combined with or adjacent to the register gearing.

    1) Oil-enclosed type - Gear trains exposed to water shall be of the oil-enclosed type, shall have a separate housing or form housing with the main casing or measuring chamber, and shall operate in a suitable lubricant.
    2) Magnetic coupled drives - When intermediate gear trains are located in the water compartment of the meter, the revolutions of the train output spindles shall be transmitted to the registers by means of magnetic couplings through the meter cases. When the intermediate gear trains are located in the register compartments, the disc nutations shall be transmitted by magnetic couplings.

f. Measuring Chambers: The measuring chambers shall be self-contained units, smoothly finished, firmly seated, and easily removed from the main cases, and shall not be cast as part of the main cases. The measuring chambers shall be so secured in the main cases that the accuracy of the meter will not be affected by any distortion of the cases that might occur when operating with a pressure less than 150 psi.

g. Discs: Discs shall be smoothly finished, disc plated, whether flat or conical, shall be either reinforced or equipped with thrust rollers. Discs may be one piece or composed of a plate with two half balls. The disc spindles shall be fastened securely. The disc nutations shall not exceed the quantities listed in AWWA C700.

h. Strainers: All meters shall be provided with strainer screens installed in the meter. Strainer screens shall be rigid, fit snugly, be easy to remove, and have an effective straining area at least double that of the main case inlet.
i. Seal Wire Holes: Register box screws and inlet and outlet coupling nuts, if provided, shall be drilled for seal wires. Seal wire holes shall not be less than 3/32 inch in diameter.
j. Registration Accuracy: Meters shall meet the following requirements for accuracy with water of a temperature of less than +27 degrees Centigrade.

1) Normal Flow Limits - At any rate of flow within the normal test flow limits specified on AWWA C700, the meter shall not register less than 98.5 percent and not more than 101.5 percent of the water that actually passes through it.
2) Minimum Test Flow - At the minimum test flow rate specified in AWWA C700, the meter shall not register less than 95 percent and not more than 101 percent of the water that actually passes through it.

k. Markings: The size, model, and direction of flow through the meter shall be marked permanently on the outer case of all meters. All meters shall have the manufacturer's serial numbers stamped on the meter main case and top of the reading lid.
l. Register Boxes: The name of the manufacturer shall be marked permanently on the lid of the register box. The serial number of the meter shall be imprinted on the lid and the main case.

C. Cold-Water Meters - Compound Type 2-Inch, 3-Inch, 4-Inch, and 6-Inch Size

1. Compound meters shall consist of a combination of a main-line meter of the turbine type for measuring high rates of flow and a meter of appropriate size for measuring low rates of flow. The compound meter shall have an automatic valve mechanism for diverting low rates of flow through the bypass meter. Both metering devices with registers shall be contained in the same case. The operating and physical characteristics shall conform to those specified within AWWA C702.
2. Materials

a. Cases: The main case of the meter shall be made of a copper alloy containing not less than 75 percent copper.
b. Register Box Rings and Lids: Register box rings and lids shall be made of a cast copper alloy containing not less than 75 percent copper, forged or die-cast copper alloy containing not less than 57 percent copper or a suitable synthetic polymer.
c. Measuring Cages or Chambers: Measuring cages or chambers shall be made of a copper alloy containing not less than 84 percent copper and suitable amounts of tin and zinc or of a suitable synthetic polymer.
d. Measuring Turbines, Pistons and Discs: Turbines, pistons and discs shall be made of vulcanized hard rubber or a suitable synthetic polymer with specific gravity approximately equal to that of water. They shall have sufficient dimensional stability to retain operating clearances at working temperatures

of up to +27 degrees Centigrade and not warp or deform when exposed to operating temperatures of +37 degrees Centigrade.

e. Disc and Turbine Spindles: Measuring chamber spindles shall be made of phosphor bronze, stainless steel, ceramic, or suitable synthetic polymer.

f. Intermediate Gear Trains: Frames, gears and pinions of intermediate gear trains exposed to water shall be made of copper alloy containing not less than 85 percent copper and suitable amounts of tin and zinc, or suitable synthetic polymer.

g. When not exposed to water, intermediate gear trains may be made of a suitable synthetic polymer.

h. External Fasteners (Casing Bolts, Studs, Nuts, Screws, and Washers): External fasteners shall be made of a copper alloy containing not less than 57 percent copper, stainless steel, or steel treated to resist corrosion by a process approved by the Government. Fasteners for no-pressure assemblies may be made of a suitable synthetic polymer. All external case closures, such as rings, clamps, screws, bolts, cap bolts, nuts and washers, shall be designed for easy removal following lengthy service.

i. Companion Flanges: Companion flanges shall be made of cast iron.

j. Automatic Valves: The valve weights shall be lead, or a copper alloy containing not less than 75 percent copper, or a copper alloy shell loaded with lead. The valve and supplemental hinge pins or spindles shall be a copper alloy containing not less than 75 percent copper, or stainless steel, and all valve and supplemental weight hinge bearings shall be bushed with hard rubber or bronze or other suitable bushing material. If the valve contains a clapper, it shall be faced with a removable semi-hard seat. Valve seats shall be made of a copper alloy containing not less than 75 percent copper and suitable amounts of tin, lead, and zinc.

3. General Design

a. Pressure Requirements: Meters supplied under this specification shall operate without leakage or damage to any part at a working pressure of 150 psi.

b. Accessibility: All compound meters shall be designed for easy removal of all interior parts without disturbing the connections to the pipeline.

c. Registration Accuracy: Meters shall meet the following requirements for accuracy with water of a temperature of less than +27 degrees Centigrade.

1) Normal Flow Limits - The meter shall not register less than 97 percent and not more than 103 percent of the water actually passed through it at any rate of flow within the normal test flow limits specified in AWWA C702, except in the registration of flows within the changeover from bypass meter to main meter.

2) Changeover Flow - The beginning of the changeover is when the accuracy of registration falls below 97 percent due to the operation of the automatic valve mechanism, and the end of changeover is when accuracy of registration again reaches 97 percent. The registration of these changeover rates of flow shall not be less than 90 percent and not more than 103 percent. The difference in the rate of flow at the

beginning and at the end of the changeover shall not exceed the figures listed in AWWA C702.

3) Minimum Test Flow - There shall not be less than 95 percent of actual flow recorded when a test is made at the minimum test flow shown in AWWA C702.

d. Markings: The size, model, and direction of flow through the meter shall be cast or stamped in the outer case of all meters.

1) Register Boxes - The name of the manufacturer shall be permanently impressed on the lid of the register box. The serial number of the meter shall be imprinted on the lid.

4. Detail Design

a. Main Case: All meters shall have an outer case with separate, removable measuring chambers. Cases shall not be repaired in any manner. The inlet and outlet shall have a common axis. Connection flanges shall be parallel.

b. External Case Screw, Bolts, Nuts and Washers: All external screws, bolts, cap bolts, nuts and washers shall be designed for easy removal after lengthy service.

c. Main Case Connections: All main case connections shall be flanged. The bolt holes shall comply with AWWA C702.

1) 2-Inch Meters - The flanges for 2-inch meters shall be oval. The drilling of oval flanges shall be on the horizontal axis.

2) Meters Larger than 2-Inch - The flanges for 3-inch, 4-inch, and 6-inch meters shall be the round type, faced and drilled, and shall conform to ASME B16.1 for bronze pipe flange, Class 125.

d. Companion Flanges: Companion flanges of the same size and type as the meter flanges shall be provided, and gaskets, nuts, and bolts shall be provided. Round companion flanges shall be faced, drilled, and tapped in accordance with ASME B1.20.1 and shall conform to ASME B16.1 for cast-iron pipe flange, Class 125. All companion flanges shall comply with AWWA C702 for drilling, diameter, and thickness specifications.

e. Tapped Bosses: All meters shall be provided with tapped bosses in the top of the case near the outlet for field testing purposes.

f. Registers: Registers shall be straight reading and shall read in units that comply with Public Works standards. Except for those instances when test conditions require the use of a different register, the register provided with the meter shall be the same register that was on the meter when it was tested for accuracy. The register lock and side gears shall be fastened securely to the number wheel discs and hubs. The tumbler pins shall mesh accurately at the turnover points with the lock and side gears of the adjacent number wheels. Both main and pinion shafts shall be so secured in the register frame and/or register plates that they cannot get out of position. The pinion shaft shall be so designed that there is no possibility of its bending and allowing the pinion to skip the turnover point. The numerals on the number wheels

shall not be less than 3/16 inch in height and should be readable at a 45-degree angle from vertical. Registers that are hermetically sealed shall have gears and pinion which shall run free on fixed shafts or be fixed on shafts that run free in the register frame and/or register plates and shall be constructed so that they cannot be unmeshed. The registers shall have a center-sweep test hand with a test circle located on the periphery of the register and graduated in 100 equal parts, each tenth graduation numbered. The maximum quantity indicated by a single revolution of the test hand and the minimum capacity of the register shall be as listed in AWWA C702. The maximum indication on the test circle and the minimum register capacity of the bypass unit shall be in accordance with the approved AWWA Standard for the type of meter used as the bypass unit.

1) Coordinator Registers - The meter may be equipped with a coordinator so that the readings of both sections can record on a single register. The register construction shall conform to previously mentioned requirements, and the maximum quantity indicated by a single revolution of the test hand and the minimum capacity of the register shall conform to AWWA C702.

g. Register Boxes: The lid shall be recessed and shall overlap the register box to protect the lens.

h. Intermediate Gear Trains: Intermediate gear trains may be mounted on the measuring chamber or cage or in the main casings. When not exposed to water, they may also be combined with or adjacent to the register gearing. Gear trains exposed to water shall be the oil-enclosed type, shall have separate housings or shall form housings with the main casings or measuring chambers, and shall operate in a suitable lubricant. Gear trains made of non-corrosive metals or synthetic polymers may be exposed to water.

i. Measuring Chambers or Cages: The main-line section chambers or cages shall be self-contained units firmly seated and easily detached and removed from the main case. Chambers or cages with turbines that have revolving spindles shall have removable bearings for such spindles. Chambers or cages with stationary spindles on which the turbines revolve shall provide rigid, centrally located fastenings for the spindles. The spindles shall be removable. The main-line section chambers or cages shall be interchangeable in all meters of the same size, make, and model.

1) Bypass Chamber - The bypass chamber shall be a type covered by an approved AWWA Standard. The chamber shall be a self-contained unit, firmly seated and easily removed from the case, and shall not be cast as part of the outer case. The chamber shall be secured in position in the outer case so that any slight distortion of the case which might occur under 150 psi pressure will not affect the accuracy of the meter.

j. Measuring Turbines and Discs: Measuring turbines that have revolving spindles shall rotate on spindles supported by bushings or replaceable

bearings. Turbines that rotate on stationary spindles shall also have bushings or replaceable bearings. The plates of disc pistons, whether flat or conical, shall have metal reinforcements or shall be equipped with thrust rollers.

k. Magnetic Coupled Drives: When intermediate gear trains are located in the water compartment of the main or bypass section of the meter, the revolutions of the train output spindles shall be transmitted to the registers by means of magnetic couplings through the meter case. When intermediate gear trains are located in the register compartments, the revolutions shall be transmitted by magnetic coupling.

l. Automatic Valves: The automatic valve shall be of a type suitable for such purpose. It shall close by force. The weight of the valve and any supplemental force imposed on it shall offer sufficient resistance to the incoming water to divert all small rates of flow through the bypass meter until such time as the rate of flow through the meter is great enough to ensure efficient operation of the main measuring section. Valve hinge pins or spindles shall be bushed. Valve sets shall be bronze or other corrosion-resistant material, shall have a satisfactory width of face, and shall be held firmly in place. A clapper or swing-type valve shall be provided with a removable semi-hard seat.

m. Bypass Meter: The physical and operating characteristics and dimensions of the bypass meter shall be in accordance with the approved AWWA Standard for the type of meter used as the bypass.

n. Strainers: Strainers, if provided, shall be rigid, shall be easily removed and shall have an effective straining area at least double that of the water main-case inlet.

o. Seal Wire Holes: Register box screws shall be drilled for seal wires. Seal wire holes shall be not less than 3/32 inch in diameter.

D. Cold-Water Meter - Turbine Type 2-Inch Size

1. Turbine meters provided hereunder shall be Class II, in-line, horizontal-axis, high-velocity type and shall fully conform to the requirements of AWWA C701, except as otherwise specified herein. The 2-inch turbine meter shall have oval flanged ends and shall be supplied with one companion flange, gaskets, and with bolts and nuts as specified herein.
2. Material

a. Cases: All turbine main cases shall be bronze. No exceptions will be allowed.

b. Register Box Rings and Lids: Register box rings and lids shall be made of a cast copper alloy containing not less than 75 percent copper, forged or die-cast copper alloy containing not less than 57 percent copper or a suitable synthetic polymer.

c. Measuring Cages or Chambers: Measuring cages or chambers shall be made of a copper alloy containing not less than 84 percent copper and suitable amounts of tin, lead, and zinc or of a suitable synthetic polymer.

d. Measuring Turbines, Pistons and Discs: Turbines, pistons and discs shall be made of vulcanized hard rubber or a suitable synthetic polymer with specific gravity approximately equal to that of water. They shall have sufficient

dimensional stability to retain operating clearances at working temperatures of up to +27 degrees Centigrade and not warp or deform when exposed to operating temperatures of +37 degrees Centigrade.

e. Disc and Turbine Spindles: Measuring chamber spindles shall be made of phosphor bronze, stainless steel, ceramic, or suitable synthetic polymer.

f. Intermediate Gear Trains: Frames, gears and pinions of intermediate gear trains exposed to water shall be made of copper alloy containing not less than 85 percent copper and suitable amounts of tin, lead, and zinc, or suitable synthetic polymer. When not exposed to water, intermediate gear trains may be made of a suitable synthetic polymer.

g. External Fasteners: (casing bolts, studs, nuts, screws, and washers). External fasteners shall be made of a copper alloy containing not less than 57 percent copper, stainless steel, or steel treated to resist corrosion by a process to be approved by the Government. Fasteners for no-pressure assemblies may be made of a suitable synthetic polymer. All external case closures, such as rings, clamps, screws, bolts, cap bolts, nuts and washers, shall be designed for easy removal following lengthy service.

h. Companion Flanges: Companion flanges shall be made of cast iron.

3. General Design

a. Pressure Requirements: Meters supplied under this specification shall operate without leakage or damage to any part at a working pressure of 150 psi. Pressure drop through turbine meters and strainers, when operated within specified normal flow limits, shall not exceed the characteristics outlined in AWWA C701.

b. Accessibility: All turbine meters shall be designed for easy removal of all interior parts without disturbing the connections to the pipeline. Turbine meters shall have readily accessible change gears, adjustable vanes or other approved means to adjust meter registration. Such adjustment feature shall be an integral part of the removable rotor/register assembly and not of the main or bottom case of the meter.

c. Registration Accuracy: Meters shall meet the following requirements for accuracy with water of a temperature of less than +27 degrees Centigrade.

1) Normal Flow Limits - The meter shall not register less than 97 percent and not more than 103 percent of the water actually passed through it at any rate of flow within the normal test flow limits specified in AWWA C702, except in the registration of flows within the changeover from bypass meter to main meter. Turbine meters shall be designed to allow prolonged operation at or near the upper limit of the specified normal flow range without premature degradation of registration accuracy or other evidence of undue wear. Meters shall also be capable of accepting sudden increases in flow at high rates of flow without decoupling the register.

E. Cold-Water Meter Strainers 2-Inch, 3-Inch, 4-Inch and 6-Inch Size

1. General: All strainers provided shall have top access. Cases for 2-inch, 3-inch, 4-inch and 6-inch strainers shall be bronze. Strainer plates for all sizes shall be 18-8 stainless steel or bronze. All strainers shall conform to AWWA C702.

F. Meter Programming

G. Register Requirements for Remote Registration

1. Meters must have encoder-type remote-registration conforming to the latest version of AWWA C707. Registers using generator pulses or low voltage conversions are not permitted. Power requirement for data transmission must be supplied by an interrogation device. Registers must be compatible with various brands of interrogation equipment. The register must provide at least six-digit visual registration at the meter. The units, the month and year of manufacture, and other identification information must clearly be printed on the face of the register. The register must also have a full test sweep hand or dial. The register must, in a digital format, simultaneously encode at least six significant digits of the meter reading for transmission through the remotely located receptacle. A meter identification number must also be provided with each reading.
2. All registers shall be easily upgraded to Automatic Meter Reading (AMR), which includes telephone, radio, cable, Energy Management and Control System (EMCS), Direct Digital Control (DDC), and Supervisory, Control and Data Acquisition (SCADA), with the substitution of the remote receptacle with a Meter Interface Unit (MIU). Data transmission shall be instantaneous and supplied in ASCII format without conversion or modification. The register must operate reliably down to at least 3.0 volts. Color-coded wire terminals (red, green and black) shall be provided; however, only the red and black terminals will be utilized for a two-wire connection to the interface ScanPad. The green terminal shall only be utilized to convert to AMR via the use of a MIU. A suitable wire terminal cover shall be provided and be factory potted when ordered for underground pit installations.
3. All registers must be removable without disassembly of the meter or depressurizing the service line. The register must be free of openings to protect the internal electronics of the register. Lens covers shall be made of polycarbonate or other suitable engineering polymer for indoor installations and mineral glass for underground pit installations. All other register assembly and material requirements stated herein shall also apply.

2.6 COMMUNICATIONS

A. Energy Monitoring and Control (EMCS) or Automatic Meter Reading Interfaces

1. Water meters shall be capable of interfacing (output signal equivalent to flow rate) with the existing Energy Management Control System (EMCS) and Automatic Meter Reading systems for data gathering in units of GPM.
2. Meters shall not require power to function and deliver data. Output signal shall be either a voltage or amperage signal which can be converted to a flow rate specification.

3. Communication protocols used must be OPC-compliant, such as MODUBUS, LonWorks, and BACnet. System must be nonproprietary open architecture and able to interface with third-party vendor software.
4. Meter shall be equipped with one pulse output channel ("Pulse" in Metering Systems Schedule) that can be configured for operation.

2.7 BACKFLOW PREVENTERS

A. Manufacturers:

1. Watts Industries
2. Febco
3. Or Equal

B. Reduced Pressure Backflow Preventers:

1. Comply with ASSE 1013.
2. Bronze body, with bronze internal parts and stainless steel springs.
3. Two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve opening under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.

C. Double Check Valve Assemblies: Comply with ASSE 1012; Bronze body with corrosion resistant internal parts and stainless steel springs; two independently operating check valves with intermediate atmospheric vent.

2.8 UNDERGROUND PIPE MARKERS

A. Plastic Ribbon and Trace Wire Tape: Brightly colored blue continuously printed with "WATER SERVICE" in large letters, minimum 6 inches wide by 4 mils thick, with magnetic detectable conductor manufactured for direct burial service.

2.9 PRECAST CONCRETE VAULT

A. Product Description: Precast vault designed in accordance with ASTM C858, comprising modular, interlocking sections complete with accessories.

B. Shape and Size: As indicated on Drawings.

C. Frames and Covers: ASTM A48; Class 30B gray cast iron, machine finished with flat bearing surfaces. Furnish cover marked WATER SERVICE.

D. Steps: Polypropylene plastic step with 1/2 inch steel reinforcement. Cast steps at 16 inches on center vertically.

2.10 CONCRETE

A. Concrete: Class A Concrete conforming to DOT Standard Specifications.

1. Compressive strength of 3,000 psi at 28 days.
2. Air entrained.
3. Water cement ratio of 0.488 with rounded aggregate and 0.532 with angular aggregate.
4. Maximum slump of 3.5 inch for vibrated concrete and 4 inch for non-vibrated concrete.
5. Minimum cement content of 564 pounds per cubic yard for vibrated concrete and 602 pounds per cubic yard for non-vibrated concrete.

2.11 BEDDING AND COVER MATERIALS

A. Backfill around pipe and above pipe: As specified in Section 312333 –Trenching and Backfilling.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify building service connection and municipal utility water main size, location, and invert are as indicated on Drawings.

B. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs.

C. Remove scale and dirt on inside and outside before assembly.

D. Prepare pipe connections to equipment with flanges or unions.

3.2 INSTALLATION - CORPORATION STOP ASSEMBLY

A. Make connection for each different kind of water main using suitable materials, equipment and methods approved by the Engineer.

B. Provide service clamps for mains other than of cast iron or ductile iron mains.

C. Screw corporation stops directly into tapped and threaded iron main at 10 and 2 o'clock position on main's circumference; locate corporation stops at least 12 inches apart longitudinally and staggered.

D. For plastic pipe water mains, provide full support for service clamp for full circumference of pipe, with minimum 2-inch width of bearing area; exercise care against crushing or causing other damage to water mains at time of tapping or installing service clamp or corporation stop.

E. Use proper seals or other devices so no leaks are left in water mains at points of tapping; do not backfill and cover service connection until approved by the Engineer.

3.3 EXCAVATION, BEDDING AND BACKFILL

A. Excavate pipe trench in accordance with Section 312333 for Work of this Section.

B. Place bedding material at trench bottom, level in one continuous layer not exceeding 6-inch loose thickness; compact to 95 percent in accordance with Section 312333.

C. Backfill around sides and to top of pipe with cover fill, tamp in place and compact to 95 percent in accordance with Section 312333.

D. Maintain optimum moisture content of fill material to attain required compaction density.

3.4 INSTALLATION - PIPE AND FITTINGS

A. Maintain separation of water main from sewer piping in accordance with state and local codes or a minimum of 10 feet horizontal and 18 inches vertical distance, whichever is more stringent.

B. Group piping with other site piping work whenever practical.

C. Install pipe to indicated elevation to within tolerance of 5/8 inch.

D. Route pipe in straight line.

E. Install pipe to allow for expansion and contraction without stressing pipe or joints.

F. Install access fittings to permit disinfection of water system performed under direction of Public Works requirements.

G. Form and place concrete for thrust restraints at each elbow or change of direction of pipe main.

H. Establish elevations of buried piping with not less than 3 feet of cover.

I. Install plastic ribbon with trace wire continuous over top of pipe buried 6 inches below subgrade above pipe line; coordinate with Section 312333.

J. Backfill trench in accordance with Section 312333.

3.5 INSTALLATION - CURB STOP ASSEMBLY

A. Set curb stops on solid bearing of compacted soil.

B. Center and plumb curb box over curb stops. Set box cover flush with finished grade.

3.6 INSTALLATION - BACKFLOW PREVENTERS AND WATER METERS

A. Install positive displacement meters in accordance with AWWA M6, as indicated on Drawings, and in accordance with manufacturer's instructions.

B. Install backflow preventer where indicated on Drawings and in accordance with manufacturer's instructions.

C. Comply with local water company requirements and plumbing codes regarding testing and installation requirements.

3.7 SERVICE CONNECTIONS

A. Install water service to 5 feet of building and plug.

3.8 PRECAST CONCRETE VAULT

A. Construct valve vaults of precast concrete.

B. Seal vault joints watertight with preformed plastic joint sealant compound. Apply asphalt waterproofing to exterior walls.

C. Seal annular space between pipe and wall sleeves as indicated on Drawings.

D. Install vault covers and frames; adjust to finished grade elevation.

3.9 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Flush and disinfect system in accordance the Utility providers requirements.

3.10 FIELD QUALITY CONTROL

A. Section 014000 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Compaction testing for bedding and backfill: Conform to Section 312333.

C. Pressure testing: Perform pressure test on water service connections in accordance with AWWA C600.

D. Notification: Notify Engineer and Owner 72 hours in advance of test and have them witness test.

E. Test Pressure: Not less than 200 psi or 50 psi in excess of maximum static pressure, whichever is greater.

F. Procedure:

1. After completion of pipeline installation, but prior to backfill and final connection to existing system, conduct concurrent pressure and leakage tests in accordance with AWWA C600.
2. Provide equipment required to perform leakage and pressure tests.
3. Conduct tests for at least two-hour duration.
4. No pipeline installation will be approved when pressure varies by more than 5 psi at completion of pressure test.
5. Before applying test pressure, completely expel air from section of piping under test. Provide corporation cocks so air can be expelled as pipeline is filled with water. After air has been expelled, close corporation cocks and apply test pressure. At conclusion of tests, remove corporation cocks and plug resulting piping openings.
6. Slowly bring piping to test pressure and allow system to stabilize prior to conducting leakage test. Do not open or close valves at differential pressures above rated pressure.
7. Examine exposed piping, fittings, valves, and joints carefully during pressure test. Repair or replace damage or defective pipe, fittings, valves, hydrants, or joints discovered, following pressure test.
8. No pipeline installation will be approved when leakage is greater than that determined by the following formula:

$L = (SD\sqrt{P})/C$
L = allowable, in gallons per hour
S = length of pipe tested, in feet
D = nominal diameter of pipe, in inches
P = average test pressure during leakage test, in pounds per square inch gauge
C = 133,200

9. When leakage exceeds specified acceptable rate, locate source and make repairs. Repeat test until specified leakage requirements are met.

END OF SECTION 331213

SECTION 333100 - SANITARY SEWER UTILITY PIPING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Construction of gravity sanitary utility piping, including piping, manholes, and appurtenances

B. Testing and inspection

1.2 REFERENCES

A. American Concrete Pipe Association (ACPA)

1. ACPA 01-102 - Concrete Pipe Handbook
2. ACPA 01-103 - Concrete Pipe Installation Manual

1.3 SYSTEM DESCRIPTION

A. Pipe material for sewer lines 18 inches and smaller shall be PVC unless otherwise shown on the Drawings. Ductile iron pipe shall be used only when so indicated on the Drawings.

B. Pipe material for sewer lines larger than 18 inches shall be reinforced concrete unless otherwise shown on the Drawings. Ductile iron pipe shall be used only when so indicated on the Drawings.

1.4 SUBMITTALS

A. Submit under provisions of Section 013300 – Submittal Procedures.

B. Shop Drawings

1. Detailed pipe drawings showing pipe details, special fittings and bends, dimensions, coatings, and other pertinent information.
2. Detailed manhole drawings showing details, connections, dimensions, castings, anti-flotation provisions and other pertinent information.

C. Product Data

1. Pipe data, including pressure class, wall thickness, reinforcing, and strength calculations.
2. Manufacturer’s data for couplings, saddles, gaskets and other pipe accessories.

3. Manhole data, including wall thickness, reinforcing, and strength calculations.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Install specified materials by a licensed underground utility Contractor licensed for such work in the state where the work is to be performed. Installing Contractor's License shall be current and be state certified or state registered.

B. All testing of concrete pipe and materials will be made by a commercial testing laboratory. Before beginning work, furnish the Owner's Representative with the name of the pipe materials supplier. No pipe shall be delivered to the job site which does not bear the testing laboratory's stenciled or other marked sign of acceptance. Furnish the Owner with 2 certified copies of the testing laboratory's report of inspection, testing, and acceptance on all pipe and specials.

1. Reinforced concrete pipe shall be tested by and meet the requirements of the Permeability Test and Hydrostatic Test of ASTM C14.

C. For PVC and ductile iron pipe, furnish a certificate from the pipe manufacturer indicating that the pipe meets all applicable requirements of these specifications.

1. The minimum pipe stiffness for PVC pipe at 5 percent deflection shall be 46 psi for all sizes when tested in accordance with ASTM D2412; external loading properties of plastic pipe shall be by parallel plate loading.
2. A specimen of PVC pipe 6 inches long shall be flattened between parallel plates in a suitable press until the distance between the plates is 40 percent of the outside diameter of the pipe. The rate of loading shall be uniform and such that the compression is complete in 2 to 5 minutes.
3. After being immersed for 2 hours in a sealed container of anhydrous acetone (99.5 percent pure), a sample ring of PVC pipe shall show no visible spalling or cracking when tested in accordance with ASTM D2152 (swelling or softening is not considered a failure).

D. Drawings

1. Submit Installation Drawings showing complete detail, both plan and side view details with proper layout and elevations.
2. Submit As-Built Drawings for the complete sanitary sewer system showing complete detail with all dimensions, both above and below grade, including invert elevation.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Storage

1. Piping: Inspect materials delivered to site for damage; store with minimum of handling. Store materials on site in enclosures or under protective coverings. Store plastic piping and jointing materials and rubber gaskets under cover out of

direct sunlight. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.

2. Metal Items: Check upon arrival; identify and segregate as to types, functions, and sizes. Store off the ground in a manner affording easy accessibility and not causing excessive rusting or coating with grease or other objectionable materials.
3. Cement, Aggregate, and Reinforcement: As specified in Section 033001 – Cast In Place Concrete (Sitework).

B. Handling: Handle pipe, fittings, and other accessories in such manner as to ensure delivery to the trench in sound undamaged condition. Take special care not to damage linings of pipe and fittings; if lining is damaged, make satisfactory repairs. Carry, do not drag, pipe to trench.

PART 2 - PRODUCTS

2.1 PIPE

A. Reinforced Concrete Gravity Pipe and Fittings

1. Pipe with an internal diameter of 18 inches or more; to be of reinforced concrete pipe conforming to the requirements of ASTM C76, Class III, IV, or V, with Wall Thickness B, unless otherwise authorized by the Engineer in writing, and as specified on the Drawings; circular concrete pipe with elliptical reinforcements not acceptable.
2. Fittings and specials shall conform to the applicable requirements specified for the pipe and shall be of the same strength as the pipe.
3. Jointing Materials for Concrete Gravity Piping: Gaskets and pipe ends for rubber gasket joint shall conform to ASTM C443. Gaskets shall be suitable for use with sewage.

B. Polyvinyl Chloride (PVC)

1. To meet and/or exceed the requirements of ASTM D3034, SDR 35; suitable for use as a gravity sewer conduit with provisions for contraction and expansion at each joint; with a rubber ring and standard lengths of 20 feet and 12.5 feet plus or minus 1 inch; designed to pass all tests at 73 degrees F (plus or minus 3 degrees F); 6 inches long sections of pipe to be subjected to impact from a free falling type (20 pounds, Type A) in accordance with ASTM D2444 with no evident splitting or shattering (denting not considered a failure); and with a minimum envelope of 4 inches of granular material around the pipe, but with all other bedding and backfilling requirements remaining the same as for other pipe material.
2. PVC Plastic Gravity Joints and Jointing Material: Joints shall conform to ASTM D3212. Gaskets shall conform to ASTM F477.

2.2 CONCRETE MATERIALS

A. Cement Mortar: Cement mortar shall conform to ASTM C270, Type M with Type II cement.

B. Portland Cement: Submit certificates of compliance stating the type of cement used in manufacture of concrete pipe, fittings and precast manholes. Portland cement shall conform to ASTM C150/C150M, Type II for concrete used in concrete pipe, concrete pipe fittings, and manholes and type optional with the Contractor for cement used in concrete cradle, concrete encasement, and thrust blocking.

C. Portland Cement Concrete: Portland cement concrete shall conform to ASTM C94/C94M, compressive strength of 4000 psi at 28 days, except for concrete cradle and encasement or concrete blocks for manholes. Concrete used for cradle and encasement shall have a compressive strength of 2500 psi minimum at 28 days. Concrete in place shall be protected from freezing and moisture loss for 7 days.

2.3 MANHOLES

A. General: Manholes shall be cylindrical, with a 48” minimum inside diameter. Increase diameter as indicated on drawings. Provide eccentric cone top sections.

B. Precast Concrete Manholes

1. Precast concrete manhole risers, base sections, and tops shall conform to ASTM C478; except that the minimum wall thickness shall be 6”.
2. Base and first riser shall be monolithic.
3. The manhole sidewall shall be of a length such that a minimum of one course and a maximum of 2 courses of bricks shall be placed on top of the unit to bring the casting to grade. A precast concrete adjusting ring may be used for this purpose, conforming to the height ranges specified for brick.
4. Xypex Admix C-1000 or approved equal shall be used for all manholes. Xypex Admix or approved equal shall be added to the concrete mix at time of batching. The manhole manufacturer shall submit specifications and the procedures for adding the Admix to the concrete. The admix shall have a red-tinted coloring.
5. Precast manholes are to be manufactured by Cloud, Sherman Dixie or approved equal.
6. Plastic Gasket For Precast Manholes: Preformed plastic gasket shall meet or exceed all requirements of FS SS-S- 210-A, "Sealing Compound, Preformed Plastic for Pipe Joints," Type I, and ASTM C990, rope formed. It shall be supplied in extruded rope form of suitable cross section and in such sizes as to seal the joint space when the manhole sections are installed. The sealing compound shall be protected by a suitable removable 2 piece wrapper, which shall be designed so that half may be removed longitudinally without disturbing the other half in order to facilitate application of the sealing compound. The flexible plastic gasket shall also meet the requirements of the following table:

Property	Test Method	Minimum	Maximum
Specific Gravity @ 77°F	ASTM D71	1.20	1.30
Ductility @ 77°F (5 cm/min)	ASTM D113	5.0	--
Softening Point (°F)	ASTM D36	320	--
Penetration @ 77°F (cm) (150 g-5 secs.)	ASTM D217	50	120

C. Throat Rings: Adjustment throat rings shall be precast non-reinforced concrete rings having a maximum thickness of two inches (2”). The internal diameter shall not be less than twenty-four inches (24”), and the width shall be a minimum of five inches (5”). No more than six throat rings shall be used on any manhole.

D. Initial Backfill Material (FRP Manholes): The initial backfill material shall be composed of well graded, crushed stone or gravel conforming to the following requirements unless modified by the Engineer.

Crushed Stone or Gravel	Percent
Passing 1-1/2 inch sieve	100
Passing 1 inch sieve	95 to 100
Passing 3/8 inch sieve	25 to 60
Passing No. 4 sieve	0 to 10
Passing No. 8 sieve	0 to 5

E. Gaskets and Connectors: Gaskets for joints between manhole sections shall conform to ASTM C443. Resilient connectors for making joints between manhole and pipes entering manhole shall conform to ASTM C923, and shall be Pelleborg Kor-N-Seal I with Korband Expander, or approved equal.

F. External Preformed Rubber Joint Seals: An external preformed rubber joint seal shall be an accepted method of sealing cast iron covers to precast concrete sections to prevent ground water infiltration into sewer systems. All finished and sealed manholes constructed in accordance with paragraph entitled "Manhole Construction" shall be tested for leakage in the same manner as pipelines as described in paragraph entitled "Leakage Tests." The seal shall be multi-section with a neoprene rubber top section and all lower sections made of Ethylene Propylene Diene Monomer (EPDM) rubber with a minimum thickness of 60 mils. Each unit shall consist of a top and bottom section and shall have mastic on the bottom of the bottom section and mastic on the top and bottom of the top section. The mastic shall be a non-hardening butyl rubber sealant and shall seal to the cone/top slab of the manhole/catch basin and over the lip of the casting. Extension sections shall cover up to two more adjusting rings. Properties and values are listed in the following tables:

Properties, Test Methods and Minimum Values
for Rubber used in Preformed Joint Seals

Physical Properties	Test Methods	EPDM	Neoprene	Butyl Mastic
Tensile, psi	ASTM D412	1840	2195	
Elongation, %	ASTM D412	553	295	350

Physical Properties	Test Methods	EPDM	Neoprene	Butyl Mastic
Tear Resistance, ppi	ASTM D624 (Die B)	280	160	
Rebound, %, 5 minutes	ASTM C972 (mod.)			11
Rebound, %, 2 hours	ASTM C972			12

2.4 METAL ITEMS

A. Frames, Covers, and Gratings for Manholes: Frames and covers shall be ASTM A48, Class 30B cast iron or ductile iron, made accurately to the required dimensions; sound, smooth, clean, and free from blisters and other defects; not plugged or otherwise treated to remedy defects; machined so that covers rest securely in the frames with no rocking and are in contact with frame flanges for the entire perimeter of the contact surfaces; thoroughly cleaned subsequent to machining and before rusting begins; and with the actual weight in pounds stenciled or printed by the manufacturer on each casting in white paint. Castings shall be Deeter Foundry #1150, Neenah R-1642, or equal acceptable to Owner for traffic rated areas and Deeter Foundry #1158 for non-traffic rated areas or approved equal. Watertight castings shall be Neenah R-1642G, Deeter 1150/1155 with bolt down lid and gasket or approved equal. Refer to Standard Drawing. The frames and covers shall have a combined weight of not less than 400 pounds. The word "Sanitary Sewer" shall be stamped or cast into covers so that it is plainly visible.

B. Manhole Steps: Zinc-coated steel. Aluminum steps or rungs will not be permitted. Steps are not required in manholes less than 4 feet deep.

2.5 COMPRESSION COUPLINGS

A. When dissimilar pipe materials like PVC and concrete pipe are joined, use compression couplings that are resistant to the corrosive action of soils and sewage and that will provide a permanent watertight joint. The compression couplings shall be of natural or synthetic rubber or rubber-like material and shall comply with the requirements and test methods specified in Table 2 of ASTM C425. The coupling shall meet the leak requirements specified in ASTM C425, and the bands for attaching the couplings to the dissimilar pipes shall be of stainless steel meeting ASTM A167 or A240. Each coupling shall bear the manufacturer’s identifying mark and an indication of its size.

PART 3 - EXECUTION

3.1 PROTECTION

A. Carefully protect from damage all existing sewers, water lines, gas lines, sidewalks, curbs, gutters, pavements, electrical lines, and other utilities or structure in the vicinity of the work at all times. If it is necessary to repair, remove, and/or replace any such utility or structure in order to complete the work properly, do so in compliance with the provisions set forth in other sections of these specifications. Any such work shall be

considered incidental to the construction of pipe sewers, and no additional payment will be allowed therefore.

B. Water service connections that are damaged shall be repaired or replaced by the Contractor, in accordance with the Owner's Specifications.

C. Service or house connections to existing sewers that are damaged or removed shall be repaired or replaced by the Contractor, in accordance with the Owner's Specifications.

3.2 PIPE SEPARATION

A. Lay sewers at least 10 feet horizontally from any existing or proposed water main. If this is not practical, the sewer may be laid closer than 10 feet to a water main provided it is laid in a separate trench and the elevation of the top of the sewer is at least 18 inches below the bottom of the water main.

B. Where a sewer crosses under water mains, the top of the sewer shall be at least 18 inches below the bottom of the water main. If the elevation of the sewer cannot be varied to meet the above requirements, relocate the water main to provide this separation, or else reconstruct it with mechanical joint ductile iron pipe for a distance of 10 feet on each side of the sewer with a full joint of the water main centered over the sewer.

C. If it is impossible to obtain proper horizontal and vertical separation as stipulated above, construct both the water main and the sewer of mechanical joint ductile iron pipe, and pressure test each.

3.3 PIPE LAYING

A. Before placing sewer pipe in position in the trench, carefully prepare the bottom and sides of the trench, and install any necessary bracing and sheeting or trench boxes.

B. Wherever necessary to provide satisfactory bearing surface, place concrete cradles as shown on the Drawings. Cradles shall be of concrete and conform to the dimensions shown on the Drawings. Concrete placed outside the dimensions shown shall be at the Contractor's expense.

C. Lasers shall be used to set line and grade, after the type and procedures are approved by the Engineer. Set reference points for both line and grade at each manhole. Where grades are 0.6 percent or less, check the elevation of the beam each 100 feet with an offset point or engineer's level.

D. Do not allow water to run or stand in the trench while pipe laying is in progress or before the trench has been backfilled. Do not at any time open up more trench than the available pumping facilities are able to dewater.

E. Correct trench bottoms found to be unsuitable for foundations after pipe laying operations have started, bringing them to exact line and grade with compacted earth or stone as necessary.

F. Special Requirements:

1. Installation of Concrete Gravity Sewer Piping: Install pipe and fittings in accordance with this section and with the provisions for rubber gasket jointing and jointing procedures of ACPA 01-103 or of ACPA 01-102, Chapter 9, "Installation, Inspection and Construction Testing." Make joints with the gaskets specified for concrete gravity sewer pipe joints. Clean and dry surfaces receiving lubricants, cements, or adhesives. Affix gaskets to pipe not more than 24 hours prior to the installation of the pipe. Protect gaskets from sun, blowing dust, and other deleterious agents at all times. Before installation of the pipe, inspect gaskets and remove and replace loose or improperly affixed gaskets. Align each pipe section with the previously installed pipe section, and pull the joint together. If, while pulling the joint, the gasket becomes loose and can be 0closure, remove the pipe and remake the joint.
2. Installation of PVC Plastic Piping: Install pipe and fittings in accordance with this section and with the requirements of ASTM D2321 for laying and joining pipe and fittings. Make joints with the gaskets specified for joints with this piping and assemble in accordance with the requirements of ASTM D2321 for assembly of joints. Make joints to other pipe materials in accordance with the recommendations of the plastic pipe manufacturer.

G. Carefully inspect each piece of pipe and special fitting before it is placed, and lay no defective pipe in the trench. Pipe laying shall proceed upgrade, staring at the lower end of the grade and with the bells upgrade. When pipe laying is not in progress, keep the ends of the pipe tightly closed with an approved temporary plug.

H. Bell holes shall be large enough to allow ample room for the pipe joints to be properly made. Cut out the bell holes no more than 2 joints ahead of the pipe laying. Carefully grade the bottom of the trench between bell holes so that each pipe barrel rests on a solid foundation for its entire length. Lay each pipe joint so as to form a close concentric joint with adjoining pipe and to avoid sudden offsets or inequalities in the flow line.

I. Install tee branches in sewer lines to serve properly each lot facing or abutting on the street or alley in which sewer is being laid. If tee branches are not to be used immediately, close them with approved stopper that are held in place to prevent infiltration and withstand all test requirements.

J. For all tees that are plugged and laid in rock, blast a minimum of 6 LF of ditch line in the direction and to the approximate grade of the future lateral, but do not excavate the material. This shall be done at no extra cost to the Owner. Furnish the Owner with a record of the exact location of each tee installed.

K. If the work consists of constructing a new sewer to replace an existing one, connect existing only active service lines to the new line, unless directed otherwise by the Owner.

L. New service laterals shall conform to the standard drawings.

M. As the work progresses, thoroughly clean the interior of the pipe in place. After each line of pipe has been laid, carefully inspect it, and remove all earth, trash, rags, and other foreign matter from its interior.

N. After the joints have been completed, they shall be inspected, tested, and accepted by the Owner's Representative before being covered. The pipe shall meet the test requirements for watertightness; immediately repair any leak or defect discovered at any time after completion of the work. Any pipe that has been disturbed after joints were formed shall be taken up, the joints cleaned and remade, and the pipe relaid at the Contractor' expense. Carefully protect all pipe in place from damage until backfilling operations are completed.

O. Do not begin the backfilling of trenches until the pipe in place has been reviewed and approved by the Owner's Representative.

P. Make connections to all existing active sewer lines as shown on the Drawings. Make connections either by removing a section of the sewer from the existing line and inserting a wye or tee branch of the proper size or by constructing a manhole, junction box, regulator chamber, or other structure as shown on the Drawings.

Q. Make connections to existing manholes or inlets by cutting a hole in the wall of the existing structure, inserting a length of sewer pipe into the hole, filling around the pipe with concrete or mortar, and troweling the inside and outside surfaces of the joint to a neat finish. Shape or reshape the bottom of the manholes as necessary to fit the invert of the sewer pipe.

R. Joint dissimilar pipe by using suitable compression couplings. If compression couplings are not available, make jointing with a special fabricated coupling approved by the Owner.

S. Provide concrete protection or concrete cap as shown on the Drawings for pipe sewers that, when completed, have less than 2.5 feet of covering in nontraffic areas and 4 feet of cover in traffic areas.

T. Existing water service connections which are damaged by the Contractor will be repaired or replaced at his expense as an incidental part of the work.

U. Existing service or house connections to existing sewers that are damaged or removed shall be repaired or replaced by the Contractor at his own expense as an incidental part of the work.

3.4 CONCRETE WORK

A. Cast-in-place concrete is included in Section 033001 – Cast In Place Concrete (Sitework). The pipe shall be supported on a concrete cradle, or encased in concrete where indicated on the drawings or directed by the Engineer.

3.5 MANHOLE CONSTRUCTION – GENERAL

A. Dewater sufficiently to maintain the ground water level at or below the bottom of the manhole foundation prior to and during placement of the foundation.

B. Obtain an adequate foundation for all manhole structures by removing and replacing unsuitable material with well graded granular material, by tightening with coarse rock, or by such other means as provided for foundation preparation of the connected sewers or as directed by the Engineer. Wherever water is encountered at the site, place all cast-in-place bases on a one-piece waterproof membrane to prevent any movement of water into the fresh concrete.

C. Carefully set the cast iron frame and cover at the required elevation, and properly bond it to the masonry with preformed plastic gasket or cement grout. Wherever manholes are constructed in paved areas, tilt the top surface of the frame and cover so as to conform to the exact slope, crown, and grade of the existing adjacent pavement. Wherever manholes are constructed in new subdivision streets, set the top surface of the frame and cover so as to conform to the exact slope, crown, and grade of the proposed finished surface.

D. Where the difference in the invert elevation of two or more sewers intersecting in one manhole is 24 inches or more, construct a drop manhole. Drop manholes shall be similar in construction to standard manholes except that a drop connection of pipe and fittings of the proper sizes and materials shall be constructed outside the manhole and supported by 4,000 psi concrete as indicated by the Standard Details.

3.6 CONCRETE/PRECAST MANHOLE CONSTRUCTION

A. Construct base slab of cast-in-place concrete or use precast concrete base sections. For cast-in-place manhole bases, carefully block the lower barrel section above the prepared surface so that it is fully and uniformly supported in true alignment; make sure that all entering pipe can be inserted at proper grade. Then place the concrete foundation and invert under and upon this base section as shown in the standard drawings. For monolithic manhole bases, carefully level the base stone and place the base section on this prepared base so it is fully and uniformly supported in true alignment and elevation.

B. Make inverts in cast-in-place concrete and precast concrete bases with a smooth-surfaced semi-circular bottom conforming to the inside contour of the adjacent sewer sections. For changes in direction of the sewer and entering branches into the manhole, make a circular curve in the manhole invert of as large a radius as manhole size will permit.

C. No parging will be permitted on interior manhole walls.

D. For precast concrete construction, make joints between manhole sections with the gaskets specified for this purpose; install in the manner specified for installing joints in concrete piping. Parging will not be required for precast concrete manholes.

E. Cast-in-place concrete work shall be in accordance with the requirements specified under paragraph entitled "Concrete Work" of this section.

F. Make joints between concrete manholes and pipes entering manholes with the resilient connectors specified for this purpose; install in accordance with the recommendations of the connector manufacturer.

G. Thoroughly wet and then completely fill all lift holes with mortar. Trim all protruding mastic between precast elements and between the manhole casting and the manhole riser on the inside of the manhole and smooth over these joints with mortar.

H. Where a new manhole is constructed on an existing line, remove existing pipe as necessary to construct the manhole. Cut existing pipe so that pipe ends are approximately flush with the interior face of manhole wall, but not protruding into the manhole. Use resilient connectors as previously specified for pipe connectors to concrete manholes.

I. Place backfill by hand around the manhole and to a distance of at least one pipe length into each trench, and tamp the downstream side with clean 1/2 inch to 3/4 inch crushed stone up to an elevation of 12 inches above the crown on all entering pipes. Continue backfilling in accordance with the requirements for trench backfilling.

3.7 FRP MANHOLE CONSTRUCTION

A. Manholes shall be constructed of materials and workmanship as prescribed by these specifications, at such places shown on the plans and in conformity with the typical details.

B. Fiberglass manholes must be installed according to manufacturer installation instructions. In addition to these instructions, local codes may apply and should be consulted as applicable in manhole installation.

C. Excavation at manhole location should be at least wide enough to accommodate the slab specified and to provide working room around manhole. Ensure the depth of manhole is sufficient to allow at least two concrete rings for adjustment of ring and cover at top of final grade.

D. Manhole Base: Use initial backfill material to provide 4 to 6 inches of leveling base.

E. Setting Manhole: To lift manhole, insert 4” x 4” timber crosswise inside the manhole to the underside of the collar with a rope or woven fabric slings attached to backhoe or other lifting device and lower the manhole. Level manhole and connect sewer lines to manhole. A concrete base encasement shall be placed at least 12 inches from the manhole and shall come over the top of the anti-flotation ring a minimum of 12 inches.

F. Invert and Bench Area: The invert and bench area can be formed with wet concrete and finished with an epoxy sealant.

G. Backfill Material: Initial backfill material shall be used for backfill around the manhole for a minimum distance of one foot from the outside surface and extending from the bottom of the excavation to the top of the reducer section. Secondary backfill material may be used for the remainder of the backfill. This material will be subject to approval by Engineer.

H. Backfill Procedure: Backfill shall be placed in layers of not more than 12 loose measure inches and mechanically tamped to 95% Standard Proctor Density, unless otherwise approved by Engineer. Flooding will not be permitted. Backfill shall be placed in such a manner as to prevent any wedging action against the fiberglass manhole structure.

3.8 FIELD QUALITY CONTROL – SEWER LINES

A. Before constructing or placing any joints, demonstrate to the Owner's Representative, by completing at least 1 sample joint, that the methods to be used conform to the specifications and will provide a watertight joint and further that the workmen to be involved in this phase of work are thoroughly familiar with experienced with the type of joint proposed.

B. No other type of joint may be used unless authorized in writing by the Owner.

C. Testing Of Gravity Sewers

1. Visual Tests

a. Upon completion of the construction or earlier if the Owner's Representative deems advisable, the Owner's Representative will make a visual inspection of the sewer and construction site. Immediately repair all leaks and defects found by such inspection.
b. In addition to general cleanup and leakage, the following standard shall be used to determine failure or defects of this project. Sewers shall be built so as to remain true to line and grade. The inclining grade of the bottom of the sewer after completion shall be such that no remaining puddle of water is deeper than 1/2 inch on pipe 36 inches internal diameter or smaller and 3/4 inch on pipe larger than 36 inches internal diameter. Any section of pipe that does not comply with the specifications at any time previous to final acceptance of the work shall be replaced or relaid at the Contractor's expense.
c. The Contractor will be held strictly responsible that all parts of the work bear the load of the backfill. If defects develop in the pipe within 1 year from the date of final acceptance of the work, the Contractor will be required to replace, at his expense, all such cracked pipe. To this end, the Contractor is advised to purchase pipe under a guarantee from the manufacturer, guaranteeing proper service of sewer pipe under conditions established by the Drawings, specifications, and local conditioning at the site of the work.

2. Leakage Tests: Test lines for leakage by either infiltration tests or exfiltration tests, or by low-pressure air tests. Prior to testing for leakage, backfill trench up to at

least lower half of pipe. When necessary to prevent pipeline movement during testing, place additional backfill around pipe sufficient to prevent movement, but leaving joints uncovered to permit inspection. When leakage or pressure drop exceeds the allowable amount specified, make satisfactory correction and retest pipeline section in the same manner. Correct visible leaks regardless of leakage test results.

a. Infiltration tests and exfiltration tests: Perform these tests for sewer lines made of the specified materials, not only concrete, in accordance with ASTM C969. Make calculations in accordance with the Appendix to ASTM C969.
b. Low pressure air tests: Perform low pressure air testing as follows:

1) Furnish all equipment, facilities, and personnel necessary to conduct the test. The test shall be observed by a representative of the Owner.
2) Perform the first series of air tests after 2,000 LF but before 4,000 LF of sewer has been laid. The purpose of this first series of tests is to assure both the Contractor and the Owner that the materials and method of installation meet the intent of these specifications. Conduct the remainder of the tests after approximately each 10,000 LF has been laid.
3) Plug all tees and ends of sewer services with flexible joint plugs or caps securely fastened to withstand the internal test pressures. Such plugs or caps shall be readily removable, and their removal shall provide a socket suitable for making a flexible jointed lateral connection or extension.
4) Prior to testing, check the pipe to see that it is clean. If not, clean it by passing a full-gauge squeegee through the pipe. It shall be the Contractor's responsibility to have the pipe cleaned.
5) Concrete pipelines: Test in accordance with ASTM C924. Allowable pressure drop shall be as given in ASTM C924. Make calculations in accordance with the Appendix to ASTM C924.
6) PVC plastic pipelines. Test in accordance with UBPPA Uni-B-6. Allowable pressure drop shall be as given in UBPPA Uni-B-6. Make calculations in accordance with the Appendix to UBPPA Uni-B-6.

D. Visual Inspection Of Miscellaneous Materials: All material used on this project are subject to visual inspection by the Owner's Representative at the site for conformance to the required specifications. When reasonable doubt exists that said material meets the specifications, the Owner's Representative may require certified mill tests, samples, and/or tests by an independent laboratory or other suitable form of verification that the material meets the required specifications.

E. Field Tests for Concrete: Field testing requirements are covered in Section 033001 Cast-In-Place Concrete (Sitework).

3.9 FIELD QUALITY CONTROL - MANHOLES

A. All manholes are to be vacuum tested immediately after assembly or construction and before backfilling. No standing water shall be allowed in the manhole excavation which may affect the accuracy of the test.

B. All pipe and other openings into the manhole shall be suitably plugged in such a manner as to prevent displacement of the plugs while the vacuum is pulled. Service lines at manholes may be vacuum tested in lieu of air testing at the option of the Contractor.

C. The Contractor is required to furnish all equipment necessary for these tests including the manhole sealing apparatus, gauges, pump plugs, and personnel shall be in accordance with equipment specifications and instructions provided by the manufacturer.

D. The test head shall be placed in the cone section of the manhole.

E. A vacuum of 10 inches of mercury shall be drawn. The time for the vacuum to drop to 9 inches of mercury shall be recorded.

F. Acceptance for 4 foot diameter manholes shall be defined as when the time to drop to 9 inches of mercury meets or exceeds the following:

Manhole Depth	Diameter	Time to Drop 1 Inch HG
10 ft. or less	4 ft.	75 seconds
10 ft. to 15 ft.	4 ft.	90 seconds
15 ft. to 25 ft.	2 ft.	105 seconds

G. For manholes 5 foot in diameter, add an additional 15 seconds and for manholes 6 foot in diameter, add an additional 30 seconds to the time requirements for 4 foot diameter manholes.

H. If the manhole fails the test, necessary repairs shall be made and the vacuum test repeated until the manhole passes the test.

I. If the manhole joint mastic is displaced enough to leave a void between the sections during the vacuum test, the manhole shall be disassembled and the seal replaced.

J. A second vacuum test will be required after the manhole casting has been set and the binder placed around it.

K. Regardless of the outcome of the vacuum tests, any visual or audio defects are to be repaired.

3.10 CLEANUP

A. After completing each section of the sewer line, remove all debris, construction materials, and equipment from the site work, grade and smooth over the surface on both sides of the line, and leave the entire right-of-way in a clean, neat, and serviceable condition.

END OF SECTION 333100

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SECTION 334000 – STORM DRAINAGE UTILITIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Furnish and install storm drainage facilities including drain piping, fittings, accessories and bedding; catch basins; manholes and other facilities.

1.2 SUBMITTALS

A. Submit the following in accordance with Section 013300 – Submittal-RFI Procedures:

B. Action Submittals:

1. Shop Drawings: Indicate openings in inlets and junction boxes, inverts and sizes. Indicate grating type and installation.
2. Product data: Provide product data for precast structures, pipe, and pipe accessories.

C. Informational Submittals:

1. Product Data Placing Pipe: Submit printed copies of the manufacturer's recommendations for installation procedures of the material being placed, prior to installation.
2. Manufacturer’s Certificate: Certify that products meet or exceed applicable state DOT requirements.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Storage

1. Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling.
2. Materials shall not be stored directly on the ground.
3. The inside of pipes and fittings shall be kept free of dirt and debris.
4. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material.
5. Keep a copy of the manufacturer's instructions available at the construction site at all times and follow these instructions unless directed otherwise by the Engineer.
6. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install plastic pipe shall be stored in accordance with the

manufacturer's recommendations and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

B. Handling

1. Materials shall be handled in a manner that ensures delivery to the trench in sound, undamaged condition.
2. Pipe shall be carried to the trench, not dragged.

PART 2 - PRODUCTS

2.1 PIPE FOR CULVERTS AND STORM DRAINS

A. Pipe for culverts and storm drains shall be of the sizes indicated and shall conform to the requirements specified.

2.2 ROUND CONCRETE PIPE

A. Manufactured in accordance with and conforming to AASHTO M 170, Class III, as modified in Section 843.2.01 of the GDOT Standard Specifications.

B. Gaskets:

1. Materials: Flexible watertight joints shall be made with plastic or rubber-type gaskets for concrete pipe. The rubber-type gaskets shall conform to AASHTO M 198, with the additional requirement that they shall be of sufficient volume to fill the pipe joint space. Gaskets shall have not more than one factory-fabricated splice.
2. Test Requirements: Watertight joints shall be tested and shall meet test requirements of paragraph HYDROSTATIC TEST ON WATERTIGHT JOINTS. Rubber gaskets shall comply with the oil resistant gasket requirements of AASHTO M 198. Certified copies of test results shall be delivered to the Engineer before gaskets or jointing materials are installed.

2.3 REINFORCED ARCH CULVERT AND STORM DRAINPIPE

A. Manufactured in accordance with and conforming to AASHTO M 206, Class A-III.

B. Joint Sealing Materials: Flexible watertight joints shall be made with bituminous plastic cement conforming to ASTM C990.

2.4 CORRUGATED STEEL PIPE

A. Fully Bituminous Coated

1. AASHTO M 190 Type A and AASHTO M 36 zinc or aluminum (Type 2) coated pipe of Type IR pipe with helical 3/4 by 3/4 by 7-1/2 inch corrugations.

B. Fully Bituminous Coated, Part Paved

1. AASHTO M 190 Type C and AASHTO M36 zinc or aluminum (Type 2) coated Type **I** pipe with helical 2-2/3 by 1/2 inch corrugations.

C. Concrete-Lined

1. AASHTO M 36 zinc coated Type I corrugated steel pipe with helical 2-2/3 by 1/2 inch corrugations, exterior bituminous coating, and a concrete lining in accordance with ASTM A849.

D. Polymer Precoated

1. AASHTO M 245 corrugated steel pipe fabricated from AASHTO M 246 Grade 250/250 10/10 polymer precoated sheet of Type IR pipe with helical 3/4 by 3/4 by 7-1/2 inch corrugations.

E. Connecting Bands:

1. Connecting bands shall be of the type, size and sheet thickness of band, and the size of angles, bolts, rods and lugs as indicated or where not indicated as specified in the applicable standards or specifications for the pipe. Exterior rivet heads in the longitudinal seam under the connecting band shall be countersunk or the rivets shall be omitted and the seam welded.
2. Watertight joints shall be tested and shall meet the test requirements of paragraph HYDROSTATIC TEST ON WATERTIGHT JOINTS.
3. Connecting bands shall be made of material conforming to AASHTO M 218 or to AASHTO M 274 depending on the type of metallic coat on the pipe. All bands shall have a minimum of two circumferential corrugations which shall effectively engage the second, as a minimum, circumferential corrugated valley from the end of each pipe. Connecting bands shall be no more than three nominal sheet thicknesses lighter than the thickness of the pipe to be connected but in no case lighter than 17 gage.
4. Bolts and nuts for connecting bands, furnished in sufficient sizes and numbers to adequately perform the intended function, shall conform to the requirements of ASTM A 307. Band connection hardware consisting of bolts, nuts, bars, and rivets shall be galvanized in accordance with the requirements of AASHTO M 232 or be coated by the electroplating process as provided in ASTM B633 Class Fe/Zn 8.
5. Protective coatings for connecting bands shall be the same as used on the pipes which are being connected.

2.5 PERFORATED PIPING

A. Polyvinyl Chloride (PVC) Pipe: ASTM D2729.

2.6 PVC PIPE

A. Submit the pipe manufacturer's resin certification, indicating the cell classification of PVC used to manufacture the pipe, prior to installation of the pipe.

B. Type PSM PVC Pipe: ASTM D3034, Type PSM, maximum SDR 35, produced from PVC certified by the compounder as meeting the requirements of ASTM D1784, minimum cell class 12454-B.

C. Corrugated PVC Pipe: ASTM F949 produced from PVC certified by the compounder as meeting the requirements of ASTM D1784, minimum cell class 12454-B.

D. Joints shall be solvent cement or elastomeric gasket type in accordance with the specification for the pipe and as recommended by the pipe manufacturer.

2.7 POLYETHYLENE (PE) PIPE

A. Submit the pipe manufacturer's resin certification, indicating the cell classification of PE used to manufacture the pipe, prior to installation of the pipe. The minimum cell classification for polyethylene plastic shall apply to each of the seven primary properties of the cell classification limits in accordance with ASTM D3350.

B. Corrugated PE Pipe

1. AASHTO M 294, Type S. For slow crack growth resistance, acceptance of resins shall be determined by using the notched constant ligament-stress (NCLS) test meeting the requirements of AASHTO M 294. Pipe walls shall have the following properties:

Nominal Size (inch)	Minimum Wall Area (square in/ft)	Minimum Moment of Inertia of Wall Section (in. to the 4th/in.)
12	1.5	0.024
15	1.91	0.053
18	2.34	0.062
24	3.14	0.116
30	3.92	0.163
36	4.50	0.222
42	4.69	0.543
48	5.15	0.543
54	5.67	0.800
60	6.45	0.800

C. Pipe joints shall be water tight and shall conform to the requirements in AASHTO M 294. Water tight joints shall be made using a PE coupling and rubber gaskets as recommended by the pipe manufacturer. Rubber gaskets shall conform to ASTM F477.

2.8 DRAINAGE STRUCTURES

A. Flared End Sections: Sections shall be of a standard design fabricated from zinc coated steel sheets meeting requirements of ASTM A929/A929M.

B. Precast Reinforced Concrete Box: Manufactured in accordance with and conforming to ASTM C1433.

2.9 MISCELLANEOUS MATERIALS

A. Concrete

1. Unless otherwise specified, concrete and reinforced concrete shall conform to the requirements for 4,000 psi concrete under Section 033001 - Cast-In-Place Concrete (Sitework). The concrete mixture shall have air content by volume of concrete, based on measurements made immediately after discharge from the mixer, of 5 to 7 percent when maximum size of coarse aggregate exceeds 1-1/2 inches. Air content shall be determined in accordance with ASTM C231. The concrete covering over steel reinforcing shall not be less than 1 inch thick for covers and not less than 1-1/2 inches thick for walls and flooring. Concrete covering deposited directly against the ground shall have a thickness of at least 3 inches between steel and ground.
2. Expansion-joint filler material shall conform to ASTM D1751, or ASTM D1752, or shall be resin-impregnated fiberboard conforming to the physical requirements of ASTM D1752.

B. Mortar: Mortar for connections to other drainage structures, and brick or block construction shall conform to ASTM C270, Type M, except that the maximum placement time shall be 1 hour. The quantity of water in the mixture shall be sufficient to produce a stiff workable mortar. Water shall be clean and free of harmful acids, alkalis, and organic impurities. The mortar shall be used within 30 minutes after the ingredients are mixed with water. The inside of the joint shall be wiped clean and finished smooth. The mortar head on the outside shall be protected from air and sun with a proper covering until satisfactorily cured.

C. Brick: Brick shall conform to ASTM C62, Grade SW; ASTM C55, Grade S-I or S-II; or ASTM C32, Grade MS. Mortar for jointing and plastering shall consist of one part portland cement and two parts fine sand. Lime may be added to the mortar in a quantity not more than 25 percent of the volume of cement. The joints shall be filled completely and shall be smooth and free from surplus mortar on the inside of the structure. Brick structures shall be plastered with 13 mm 1/2 inch of mortar over the entire outside surface of the walls. For square or rectangular structures, brick shall be laid in stretcher courses with a header course every sixth course. For round structures, brick shall be laid radially with every sixth course a stretcher course.

D. Precast Reinforced Concrete Manholes

1. Conform to ASTM C478. Joints between precast concrete risers and tops shall be made with flexible watertight, rubber-type gaskets.

E. Frame and Cover for Gratings

1. Submit certification on the ability of frame and cover or gratings to carry the imposed live load.
2. Frame and cover for gratings shall be cast gray iron, AASHTO M105, Class A; or cast ductile iron, ASTM A536, Grade 65-45-12. Weight, shape, size, and waterway openings for grates and curb inlets shall be as indicated on the plans. The word "Storm Sewer" shall be stamped or cast into covers so that it is plainly visible.

F. Flap Gates: Flap Gates shall be medium-duty with rectangular opening and double-hinged. The seat shall be one-piece cast iron with a raised section around the perimeter of the waterway opening to provide the seating face. The seating face of the seat shall be cast iron. The cover shall be one-piece cast iron with necessary reinforcing rib, lifting eye for manual operation, and bosses to provide a pivot point connection with the links. The seating face of the cover shall be cast iron. Links or hinge arms shall be cast or ductile iron. Holes of pivot points shall be bronze bushed. All fasteners shall be either galvanized steel, bronze or stainless steel.

2.10 STEEL LADDER

A. Steel ladder shall be provided where the depth of the storm drainage structure exceeds 12 feet. These ladders shall be not less than 16 inches in width, with 3/4 inch diameter rungs spaced 12 inches apart. The two stringers shall be a minimum 3/8 inch thick and 2-1/2 inches wide. Ladders and inserts shall be galvanized after fabrication in conformance with ASTM A123.

2.11 DOWNSPOUT BOOTS

A. Boots used to connect exterior downspouts to the storm-drainage system shall be of gray cast iron conforming to ASTM A48, Class 30B or 35B. Shape and size shall be as indicated.

2.12 RESILIENT CONNECTORS

A. Flexible, watertight connectors used for connecting pipe to manholes and inlets shall conform to ASTM C923.

2.13 HYDROSTATIC TEST ON WATERTIGHT JOINTS

A. Concrete, PVC, and PE Pipe: A hydrostatic test shall be made on the watertight joint types as proposed. Only one sample joint of each type needs testing; however, if the sample joint fails because of faulty design or workmanship, an additional sample joint may be tested. During the test period, gaskets or other jointing material shall be protected from extreme temperatures which might adversely affect the performance of such materials. Performance requirements for joints in reinforced and non-reinforced

concrete pipe shall conform to ASTM C990 or ASTM C443. Test requirements for joints in PVC and PE plastic pipe shall conform to ASTM D3212.

B. Corrugated Steel and Aluminum Pipe

1. A hydrostatic test shall be made on the watertight joint system or coupling band type proposed. The moment strength required of the joint is expressed as 15 percent of the calculated moment capacity of the pipe on a transverse section remote from the joint by the AASHTO HB-17 (Division II, Section 26).

   a. The pipe shall be supported for the hydrostatic test with the joint located at the point which develops 15 percent of the moment capacity of the pipe based on the allowable span in feet for the pipe flowing full or 40,000 foot-pounds, whichever is less.
   b. Performance requirements shall be met at an internal hydrostatic pressure of 10 psi, for a 10 minute period for both annular corrugated metal pipe and helical corrugated metal pipe with factory reformed ends.

2.14 EROSION CONTROL RIPRAP

A. Provide non-erodible rock not exceeding 15 inches in its greatest dimension and choked with sufficient small rocks to provide a dense mass with a minimum thickness of 8 inches.

PART 3 - EXECUTION

3.1 EXCAVATION FOR PIPE CULVERTS, STORM DRAINS, AND DRAINAGE STRUCTURES

A. Excavation of trenches, and for appurtenances and backfilling for culverts and storm drains, shall be in accordance with the applicable portions of Section 312000 – Earth Moving and the requirements specified below.

B. Trenching

1. The width of trenches at any point below the top of the pipe shall be not greater than the outside diameter of the pipe plus 12 inches to permit satisfactory jointing and thorough tamping of the bedding material under and around the pipe. Sheeting and bracing, where required, shall be placed within the trench width as specified, without any over-excavation.
2. Where trench widths are exceeded, redesign with a resultant increase in cost of stronger pipe or special installation procedures will be necessary. Cost of this redesign and increased cost of pipe or installation shall be borne by the Contractor without additional cost to the Owner.

C. Removal of Rock

1. Rock in either ledge or boulder formation shall be replaced with suitable materials to provide a compacted earth cushion having a thickness between unremoved rock and the pipe of at least 8 inches or 1/2 inch for each foot of fill over the top of the pipe, whichever is greater, but not more than three-fourths the nominal diameter of the pipe.
2. Where bell-and-spigot pipe is used, the cushion shall be maintained under the bell as well as under the straight portion of the pipe.
3. Rock excavation shall be as specified and defined in Section 312000 – Earth Moving.

D. Removal of Unstable Material

1. Where wet or otherwise unstable soil incapable of properly supporting the pipe, as determined by the Engineer, is unexpectedly encountered in the bottom of a trench, such material shall be removed to the depth required and replaced to the proper grade with select granular material, compacted as provided in paragraph BACKFILLING.
2. When removal of unstable material is due to the fault or neglect of the Contractor while performing shoring and sheeting, water removal, or other specified requirements, such removal and replacement shall be performed at no additional cost to the Owner.

3.2 BEDDING

A. The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe.

B. Concrete Pipe Requirements

1. When no bedding class is specified or detailed on the drawings, concrete pipe shall be bedded in granular material minimum 4 inch in depth in trenches with soil foundation. Depth of granular bedding in trenches with rock foundation shall be 1/2 inch in depth per foot of depth of fill, minimum depth of bedding shall be 8 inch up to maximum depth of 24 inches.
2. The middle third of the granular bedding shall be loosely placed.
3. Bell holes and depressions for joints shall be removed and formed so entire barrel of pipe is uniformly supported. The bell hole and depressions for the joints shall be not more than the length, depth, and width required for properly making the particular type of joint.

C. Corrugated Metal Pipe

1. Bedding for corrugated metal pipe and pipe arch shall be in accordance with ASTM A798. It is not required to shape the bedding to the pipe geometry. However, for pipe arches, either shape the bedding to the relatively flat bottom arc or fine grade the foundation to a shallow v-shape. Bedding for corrugated structural plate pipe shall meet requirements of ASTM A807.

D. Plastic Pipe: Bedding for PVC and PE pipe shall meet the requirements of ASTM D2321. Use Class IB or II material for bedding, haunching, and initial backfill.

3.3 PLACING PIPE

A. Each pipe shall be thoroughly examined before being laid; defective or damaged pipe shall not be used. Plastic pipe shall be protected from exposure to direct sunlight prior to laying, if necessary to maintain adequate pipe stiffness and meet installation deflection requirements.

B. Pipelines shall be laid to the grades and alignment indicated.

C. Proper facilities shall be provided for lowering sections of pipe into trenches. Lifting lugs in vertically elongated metal pipe shall be placed in the same vertical plane as the major axis of the pipe.

D. Pipe shall not be laid in water, and pipe shall not be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary.

E. Deflection of installed flexible pipe shall not exceed the following limits:

TYPE OF PIPE	MAXIMUM ALLOWABLE DEFLECTION (percent)
Corrugated Steel and Aluminum Alloy	5
Concrete-Lined Corrugated Steel	3
Plastic (PVC, HDPE)	5

F. Note post installation requirements of paragraph DEFLECTION TESTING in PART 3 of this specification for all pipe products including deflection testing requirements for flexible pipe.

G. Concrete and PVC Pipe: Laying shall proceed upgrade with spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow.

H. PE Pipe: Laying shall be with the separate sections joined firmly on a bed shaped to line and grade and shall follow manufacturer's guidelines.

I. Corrugated Metal Pipe and Pipe Arch:

1. Laying shall be with the separate sections joined firmly together, with the outside laps of circumferential joints pointing upstream, and with longitudinal laps on the sides.
2. Part paved pipe shall be installed so that the centerline of bituminous pavement in the pipe, indicated by suitable markings on the top at each end of the pipe sections, coincides with the specified alignment of pipe.

3. Fully paved steel pipe or pipe arch shall have a painted or otherwise applied label inside the pipe or pipe arch indicating sheet thickness of pipe or pipe arch.
4. Any unprotected metal in the joints shall be coated with bituminous material as specified in AASHTO M 190 or AASHTO M 243.
5. Interior coating shall be protected against damage from insertion or removal of struts or tie wires.
6. Lifting lugs shall be used to facilitate moving pipe without damage to exterior or interior coatings.
7. During transportation and installation, pipe or pipe arch and coupling bands shall be handled with care to preclude damage to the coating, paving or lining.
8. Damaged coatings, pavings and linings shall be repaired in accordance with the manufacturer's recommendations prior to placing backfill. Pipe on which coating, paving or lining has been damaged to such an extent that satisfactory field repairs cannot be made shall be removed and replaced.
9. Vertical elongation, where indicated, shall be accomplished by factory elongation. Suitable markings or properly placed lifting lugs shall be provided to ensure placement of factory elongated pipe in a vertical plane.

J. Multiple Culverts

1. Where multiple lines of pipe are installed, adjacent sides of pipe shall be at least half the nominal pipe diameter or 1 meter 3 feet apart, whichever is less.

K. Jacking Pipe Through Fills: Methods of operation and installation for jacking pipe through fills shall conform to requirements specified in Volume 1, Chapter 1, Part 4 of AREMA Eng Man.

3.4 JOINTING

A. Concrete Pipe

1. Flexible Watertight Joints: Gaskets and jointing materials shall be as recommended by the particular manufacturer in regard to use of lubricants, cements, adhesives, and other special installation requirements. Surfaces to receive lubricants, cements, or adhesives shall be clean and dry. Gaskets and jointing materials shall be affixed to the pipe not more than 24 hours prior to the installation of the pipe, and shall be protected from the sun, blowing dust, and other deleterious agents at all times. Gaskets and jointing materials shall be inspected before installing the pipe; any loose or improperly affixed gaskets and jointing materials shall be removed and replaced. The pipe shall be aligned with the previously installed pipe, and the joint pushed home. If, while the joint is being made the gasket becomes visibly dislocated the pipe shall be removed and the joint remade.
2. External Sealing Band Joint for Noncircular Pipe: Surfaces to receive sealing bands shall be dry and clean. Bands shall be installed in accordance with manufacturer's recommendations.

B. Corrugated Metal Pipe

1. Flexible Watertight, Gasketed Joints: Installation shall be as recommended by the gasket manufacturer for use of lubricants and cements and other special installation requirements. The gasket shall be placed over one end of a section of pipe for half the width of the gasket. The other half shall be doubled over the end of the same pipe. When the adjoining section of pipe is in place, the doubled-over half of the gasket shall then be rolled over the adjoining section. Any unevenness in overlap shall be corrected so that the gasket covers the end of pipe sections equally.
2. Connecting bands shall be centered over adjoining sections of pipe, and rods or bolts placed in position and nuts tightened.
3. Band Tightening: The band shall be tightened evenly, even tension being kept on the rods or bolts, and the gasket; the gasket shall seat properly in the corrugations.
4. Watertight joints shall remain uncovered for a period of time designated, and before being covered, tightness of the nuts shall be measured with a torque wrench. If the nut has tended to loosen its grip on the bolts or rods, the nut shall be retightened with a torque wrench and remain uncovered until a tight, permanent joint is assured.

3.5 DRAINAGE STRUCTURES

A. Manholes and Inlets

1. Construction shall be of reinforced concrete or precast reinforced concrete, complete with frames and covers or gratings; and with fixed galvanized steel ladders where indicated.
2. Pipe connections to concrete manholes and inlets shall be made with flexible, watertight connectors.

B. Walls and Headwalls: Construction shall be as indicated.

3.6 STEEL LADDER INSTALLATION

A. Ladder shall be adequately anchored to the wall by means of steel inserts spaced not more than 6 feet vertically, and shall be installed to provide at least 6 inches of space between the wall and the rungs. The wall along the line of the ladder shall be vertical for its entire length.

3.7 BACKFILLING

A. Backfilling Pipe in Trenches

1. After the pipe has been properly bedded, selected material from excavation or borrow, at a moisture content that will facilitate compaction, shall be placed along both sides of pipe in layers not exceeding 6 inches in compacted depth.
2. The backfill shall be brought up evenly on both sides of pipe for the full length of pipe. The fill shall be thoroughly compacted under the haunches of the pipe.

3. Each layer shall be thoroughly compacted with mechanical tampers or rammers. This method of filling and compacting shall continue until the fill has reached an elevation equal to the midpoint (spring line) of RCP or has reached an elevation of at least 12 inches above the top of the pipe for flexible pipe.
4. The remainder of the trench shall be backfilled and compacted by spreading and rolling or compacted by mechanical rammers or tampers in layers not exceeding 6 inches.
5. Tests for density shall be made as necessary to ensure conformance to the compaction requirements specified below. Where it is necessary, in the opinion of the Engineer, that sheeting or portions of bracing used be left in place, the contract will be adjusted accordingly.

    a. Untreated sheeting shall not be left in place beneath structures or pavements.

B. Backfilling Pipe in Fill Sections

1. For pipe placed in fill sections, backfill material and the placement and compaction procedures shall be as specified below.
2. The fill material shall be uniformly spread in layers longitudinally on both sides of the pipe, not exceeding 6 inches in compacted depth, and shall be compacted by rolling parallel with pipe or by mechanical tamping or ramming.
3. Prior to commencing normal filling operations, the crown width of the fill at a height of 12 inches above the top of the pipe shall extend a distance of not less than twice the outside pipe diameter on each side of the pipe or 12 feet, whichever is less.
4. After the backfill has reached at least 12 inches above the top of the pipe, the remainder of the fill shall be placed and thoroughly compacted in layers not exceeding 6 inches. Use select granular material for this entire region of backfill for flexible pipe installations.

C. Movement of Construction Machinery: When compacting by rolling or operating heavy equipment parallel with the pipe, displacement of or injury to the pipe shall be avoided. Movement of construction machinery over a culvert or storm drain at any stage of construction shall be at the Contractor's risk. Any damaged pipe shall be repaired or replaced.

D. Compaction

1. Minimum Density

    a. Backfill over and around the pipe and backfill around and adjacent to drainage structures shall be compacted at the approved moisture content to the following applicable minimum density, which will be determined as specified below.
    b. Under paved roads, streets, parking areas, and similar-use pavements including adjacent shoulder areas, the density shall be not less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material, up to the elevation where

requirements for pavement subgrade materials and compaction shall control.

c. Under unpaved or turfed traffic areas, density shall not be less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material.
d. Under nontraffic areas, density shall be not less than that of the surrounding material.

2. Determination of Density:

a. Testing is the responsibility of the Contractor and performed at no additional cost to the Owner. Testing shall be performed by an approved commercial testing laboratory.
b. Tests shall be performed in sufficient number to ensure that specified density is being obtained.
c. Laboratory tests for moisture-density relations shall be made in accordance with ASTM D1557 except that mechanical tampers may be used provided the results are correlated with those obtained with the specified hand tamper.
d. Field density tests shall be determined in accordance with ASTM D2167 or ASTM D6938. When ASTM D6938 is used, the calibration curves shall be checked and adjusted, if necessary, using the sand cone method as described in paragraph Calibration of the referenced publications. ASTM D6938 results in a wet unit weight of soil and ASTM D6938 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D6938.
e. Test results shall be furnished the Engineer. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed.

3.8 PIPELINE TESTING

A. Leakage Tests

1. Lines shall be tested for leakage by low pressure air or water testing or exfiltration tests, as appropriate.

a. Low pressure air testing for concrete pipes shall conform to ASTM C969.
b. Low pressure air testing for plastic pipe shall conform to ASTM F1417.
c. Low pressure air testing procedures for other pipe materials shall use the pressures and testing times prescribed in ASTM C828 or ASTM C969, after consultation with the pipe manufacturer.

2. Testing of individual joints for leakage by low pressure air or water shall conform to ASTM C1103. Prior to exfiltration tests, the trench shall be backfilled up to at least the lower half of the pipe. If required, sufficient additional backfill shall be

placed to prevent pipe movement during testing, leaving the joints uncovered to permit inspection.

3. Visible leaks encountered shall be corrected regardless of leakage test results.
4. When the water table is 2 feet or more above the top of the pipe at the upper end of the pipeline section to be tested, infiltration shall be measured using a suitable weir or other device acceptable to the Engineer.
5. An exfiltration test shall be made by filling the line to be tested with water so that a head of at least 2 feet is provided above both the water table and the top of the pipe at the upper end of the pipeline to be tested.

    a. The filled line shall be allowed to stand until the pipe has reached its maximum absorption, but not less than 4 hours. After absorption, the head shall be reestablished.
    b. The amount of water required to maintain this water level during a 2-hour test period shall be measured.
    c. Leakage as measured by the exfiltration test shall not exceed 250 gallons per inch in diameter per mile of pipeline per day. When leakage exceeds the maximum amount specified, satisfactory correction shall be made and retesting accomplished.

B. Post-Installation Inspection

1. Check each reinforced concrete pipe installation for joint separations, soil migration through the joint, cracks greater than 0.01 inches, settlement and alignment.
2. Check each flexible pipe (HDPE, PVC, CMP, PP) for rips, tears, joint separations, soil migration through the joint, cracks, localized bucking, bulges, settlement and alignment.
3. Replace pipes having cracks greater than 0.1 inches in width or deflection greater than 5 percent deflection.
4. An engineer shall evaluate all pipes with cracks greater than 0.01 inches but less than 0.10 inches to determine if any remediation or repair is required.
5. Repair or replace any pipe with crack exhibiting displacement across the crack, exhibiting bulges, creases, tears, spalls, or delamination.
6. Reports: The final post installation inspection report shall include: a copy of all video taken, pipe location identification, equipment used for inspection, inspector name, deviation from design, grade, deviation from line, deflection and deformation of flexible pipe systems, inspector notes, condition of joints, condition of pipe wall (e.g. distress, cracking, wall damage dents, bulges, creases, tears, holes, etc.).

END OF SECTION 334000

SECTION 334915 - DRAINS, GRATES, AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all equipment and materials, and do all work necessary to furnish and install the drains, grates, and frames as indicated on the Drawings and as specified.

1.2 REFERENCES

A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

1. American Society for Testing and Materials (ASTM):

A 36	Structural Steel
A 123	Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip.

1.3 SUBMITTALS

A. Shop drawings shall be submitted for specified products indicating construction of frame for trench drain grate and methods of installation and connection to grate.

B. Submit manufacturer's product data for specified products.

PART 2 - PRODUCTS

2.1 AREA DRAIN

A. Area drains shall be ADS Nyloplast 12” Locking Bronze Grate Assembly, square grate top with secured heel-proof light duty grate, with ADS Nyloplast Basin Structure, or approved equal.

2.2 TRENCH DRAIN

A. Modular system of precast, polymer-concrete channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling,

shall be manufactured by ABT, Inc., (Phone) 800-438-6057; (Fax) 704-528-5478., or approved equal. Include number of units required to form total lengths indicated.

B. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.

C. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

PART 3 - EXECUTION

3.1 EXCAVATION AND BEDDING FOR TRENCH AND SLOT DRAIN SYSTEM

A. Trenching and excavation, including the removal of rock and unstable material, shall be in accordance with Section 312000, EARTH MOVING. Bedding material shall be placed in the trench as indicated or as required as replacement materials used in those areas where unstable materials were removed. Compaction of the bedding material shall be as specified in Section 312000.

3.2 INSTALLATION AREA DRAIN

A. Area drains shall be installed at required elevation, in accordance with manufacturer's recommendations and approved submittals, and as indicated on the Drawings. Drain shall have concrete collar around drain base where indicated.

3.3 INSTALLATION TRENCH DRAIN

A. Trench drain shall be installed in concrete at required elevation, and as indicated on the Drawings and in strict accordance with manufacturer’s printed instructions.

1. Where there is parallel subsurface drainage in the sand layer, weeps shall be drilled in the side of the trench drain @ 1’ OC and then covered with filter fabric.

END OF SECTION 334915