Texas Parks and Wildlife Department
LAKE CORPUS CHRISTI STATE PARK
RESTROOM REPLACEMENT
TPWD Project No. 1210196

INDEX OF TECHNICAL SPECIFICATIONS
100% CONSTRUCTION DOCUMENTS

DECEMBER 4, 2020

RA PROJECT NO. 20003.00
SECTION 00 01 07 – SEALS PAGE

1.1 DESIGN PROFESSIONALS OF RECORD

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      Corpus Christi, Texas 78412
   2. Texas Architectural Registration No. 20468
   3. Responsible for Divisions 01-33 Sections; except where indicated as prepared by other design professionals of record.

B. Structural Engineer:
   1. Brian J. Robertson, PE
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      Dallas, Texas 75207
   2. Texas Professional Engineer No. 108844
   3. Texas Firm Registration No. 7986
   4. Responsible for Divisions 03, 05, 06 Sections 033000, 051200, 061000, 061600; except where indicated as prepared by other design professionals of record.

C. HVAC/Plumbing Engineer:
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D. Electrical Engineer:
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   3. Texas Firm Registration No. 6328
   4. Responsible for Division 26 Sections; except where indicated as prepared by other design professionals of record.
E. Civil Engineer:
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      JQ Infrastructure, LLC
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      San Antonio, Texas 78216
   2. Texas Professional Engineer No. 89535
   3. Texas Firm Registration No. 1294
   4. Responsible for Divisions 01 Section 01 57 23, Divisions 02 Section 0241 00, Division 03 Section 03 48 15, Division 31; except where indicated as prepared by other design professionals of record.

F. Landscape Architect:
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   d. Responsible for Division 31 & 32 Sections 311211, 320190, 329113, 329303; except where indicated as prepared by other design professionals of record.

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SECTION 01 41 00 -  REGULATORY REQUIREMENTS (WINDSTORM CONSTRUCTION REQUIREMENTS)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections apply to work specified in this Section.

1.2 SUMMARY

A. All components of the building exterior envelope, including, but not limited to, wall screens, cladding, roofing, openings (exterior doors, screened openings) must be designed and installed to comply with the uniform static wind pressure requirements specified in this section.

B. Project Location: This project is located in the Inland II: Risk Category II with design wind speed equaling 131 mph./Inland II area.

C. Contractor shall coordinate with Owner for any required engineering inspections and certifications. Contractor shall coordinate required windstorm inspections with the progress of the work.

1.3 DEFINITIONS

A. Components and Cladding: Elements of the building envelope (exterior wall and roof systems) that are either directly loaded by the wind or receive wind loads originating at relatively close locations, and that transfer those loads to the main wind force resisting system. Examples: curtain walls, exterior glass windows and panels, roof sheathing, studs, soffits, etc.

B. Exterior Wall and Roof Openings: Openings that are likely to be breached during high winds. Examples: Windows, doors, roof hatches, louvers, skylights, etc.

1.4 DESIGN AND PERFORMANCE REQUIREMENTS

A. Wind loads shall be determined from the pressures developed by a 131 mph wind velocity, (3 second gust), Exposure D, Risk Category II, and appropriate coefficients from the document American Society of Civil Engineers (ASCE) 7-16 “Minimum Design Loads for Buildings and Other Structures.”

B. Impact resistance shall be as determined by the Texas Windstorm Code and section 1609.1.2 of the 2018 International Building Code.

C. Corrosion-resistant fasters are required at all exposed locations. Fasteners exposed to the elements shall have a minimum corrosion-resistant inhibitor of Stainless A4. Fasteners for
interior use shall have a minimum corrosion-resistant inhibitor of a phosphate or multilayer coating application.

D. Pre-installation Conference: Conduct conference at Project site to review all necessary submittal requirements, inspections, testing, schedules, and documentation necessary to comply the required Texas Department of Insurance (TDI) Windstorm Certification.

1.5 SUBMITTALS

A. All components and cladding listed in the Texas Windstorm Approved Materials catalog shall have the appropriate product evaluation number indicated on the submittal.

B. For components not pre-certified and listed in the Texas Windstorm Approved Materials catalog, engineering calculations and/or test data must be submitted to the Windstorm Inspector for review. Submit wind uplift pressure and connection calculations in compliance with the design wind loads and criteria on the structural drawings. Calculations shall be sealed by a professional engineer licensed to practice structural engineering in the State of Texas.

These items include but are not limited to the following:

- Exterior envelope components.
- Exterior cladding fastening requirements.
- Stainless steel wire mesh insect screening assemblies.
- All utilized components and materials not pre-certified by the product manufacturer.

C. Installation instruction indicating fasteners, minimum attachment requirements, and other necessary pertinent information for installation shall be submitted.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 COORDINATION

A. The contractor shall provide and have available at the job site all necessary installation instructions during construction.

B. The Engineer responsible for Windstorm inspection and construction certification for the project will provide the Contractor a list of required inspections of the installation of various elements and systems for the project. The contractor shall be responsible for scheduling and providing sufficiently advance notification to the Engineer responsible Windstorm Certification for each required inspection.
3.2 EXECUTION

A. Prior to covering or concealing the fasteners or connectors of the exterior elements, the contractor shall notify the architect and engineer in time to allow for a visual inspection as required for Windstorm Certification by the Architect/Engineer.

B. Contractor shall furnish, upon completion, written confirmation to the structural engineer that the installation and materials used for all components and cladding elements is in conformance with the requirements of this section and the Texas Windstorm Code.

END OF SECTION 01 41 00
SECTION 01 57 23 - TEMPORARY STORM WATER POLLUTION CONTROL

PART 1 - GENERAL

1.1 DEFINITIONS

A. A/E, Architect, Engineer of Record – The licensed design professional applying stamp and signature to the drawings regardless of their contractual relationship to the Owner.

B. BMP – Best Management Practices

C. Contractor – Firm responsible for providing prime construction services for the project under contract with the Owner. Refers to the General Contractor, Prime Contractor, Construction Manager at Risk or Design Build firm under various contract types.

D. CSN – Construction Site Notice

E. NOI & NOT – Notice of Intent and Notice of Termination for TPDES permits.

F. SWPPP – Storm Water Pollution Prevention Plan

G. TCEQ – Texas Commission on Environmental Quality

H. TPDES – Texas Pollutant Discharge Elimination System

I. Large Construction Activities – Construction activities including clearing, grading and excavating that result in land disturbance of equal to or greater than five (5) acres

J. Small Construction Activities - Construction activities including clearing, grading and excavating that result in land disturbance of equal to or greater than one (1) acre and less than five (5) acres of land.

1.2 RELATED DOCUMENTS AND APPLICABLE WORK

A. The TCEQ TPDES General Permit No. TXR150000, March 5, 2018 and the project SWPPP. This specification requires compliance with all provisions of the TCEQ with regards to the TPDES permit. The TCEQ requirements currently pertain to large construction activities of five (5) acres or more and small construction activities which disturb one (1) to less than five (5) acres

B. Information to Respondents, Agreement, Uniform General Conditions, Supplementary General Conditions and Special Conditions shall be carefully read for provisions pertaining to this work. In the event of conflict, the better quality or greater quantity shall prevail.

C. The work described in this section is applicable to any and all sections of the Contract Documents. Any and all work that would disturb the existing site conditions or present the potential for site run-off shall adhere fully to this specification section.

D. Unless specifically notified to the contrary by the Owner, in writing, all aspects of this specification shall apply to this project.

1.3 CONTRACTOR RESPONSIBILITIES

A. This project requires implementation of storm water “Best Management Practices” (BMP) for control devices and monitoring by the Contractor to comply with all provisions of the Storm Water Pollution Prevention Plan (SWPPP) developed for the project by the licensed civil engineer. The Contractor must fulfill all Texas Pollutant Discharge Elimination System (TPDES) regulatory requirements, including the filing of a NOI and NOT or signing and posting of the Construction Site Notice (CSN).

B. The Contractor shall provide signatures of a corporate Officer for the NOI, CSN and NOT and any other forms or applications as required by the TPDES General Permit TXR150000. The Contractor shall also provide delegated authorization to...
sign reports per 30 TAC 305.128. Individuals conducting site inspections shall be qualified to the satisfaction of the Owner. Documented qualifications shall be included in the SWPPP booklet.

C. When the Contractor receives the approved SWPPP from the Owner, the Contractor signs the NOI or CSN (see Sample form in Part 4 of this section) and forwards it to the Owner. A $100 application fee must accompany the NOI. The Owner signs his NOI and sends both NOI’s and application fees to TCEQ. The Contractor shall insert a copy of the signed NOI or CSN into the SWPPP booklet to be kept at the jobsite.

D. The SWPPP booklet kept at the jobsite shall also contain the following:
   1. A letter delegating signature authority to the field personnel for both the Contractor and the Owner.
   2. A copy of TPDES permit when received.
   3. Posting Notice for large construction activities

E. The Contractor shall review SWPPP and verify existing conditions at the site before determining scope of implementation of site controls. Site survey and site plan drawings shall be used for additional reference. The Contractor shall notify the Owner, in advance, of this site review to allow for Owner participation.

F. The Contractor shall construct a Project SWPPP sign and place it at the main entrance to the project site. This sign shall include the NOI and TPDES permit; or the Construction Site Notice for small construction projects. The sign shall be constructed as detailed in the sample SWPPP sign drawing included in Part 4 of this Section.

G. Contractor shall contact Owners Representative for review of initial site controls in place prior to commencing site-disturbing activities, to ensure that any unusual circumstances or unforeseen site conditions with regard to erosion and sedimentation have been addressed.

H. The Contractor shall provide all material, labor, equipment and services required to implement, maintain and monitor all erosion and sedimentation controls in compliance with the Storm Water Pollution Prevention Plan (SWPPP). All controls implemented by the Contractor shall comply with the Texas Pollutant Discharge Elimination System (TPDES) regulations as issued by the Texas Commission on Environmental Quality (TCEQ) on February 19, 2013. These controls shall remain in operation until project completion and reestablishment of the site or longer as directed by the Owners Representative. The work shall include, but not be limited to the following:

I. All earthwork as required to implement swales, dikes, basins and other excavations for temporary routing of utilities, to protect against erosion or sediment-laden (“polluted”) storm water runoff.

J. All structural controls as shown or specified, including silt fences, sediment traps, stabilized construction entrance, subsurface drains, pipe slope drains, inlet/outlet protection, reinforced soil retention, gabions, rock berms, etc.

K. All non-structural controls as shown or specified, including temporary or permanent vegetation, mulching, geotextiles, sod stabilization, preservation of vegetative buffer strips, preservation/protection of existing trees and other mature vegetation.

L. All modifications and revisions to SWPPP necessary to meet changing site conditions, and to address new sources of storm water discharges, as the work progresses.
M. All maintenance and repair of structural and non-structural controls in place shall continue until final stabilization is achieved or as directed by the Owners Representative

N. Weekly site inspections, as required by the SWPPP, of pollutant sources, including hazardous sources, structural and non-structural controls, and all monitoring of SWPPP revisions and maintenance of inspection records.

O. Removal of all structural and non-structural controls as necessary upon completion, and only after final stabilization is achieved.

P. Filing of Notice of Termination (NOT) with the Owners Representative within 30 days of final stabilization being achieved, or of another Operator assuming control of the unstabilized portions of the site.

Q. Refer to the SWPPP for additional requirements to ensure compliance with TPDES regulations.

1.4 QUALITY ASSURANCE

A. QUALITY ASSURANCE in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.10 QUALITY ASSURANCE AND UGC Article 8.

B. In order to minimize the discharge of pollutants to storm water, the Contractor shall implement all permanent and temporary site controls according to Texas Pollutant Discharge Elimination System (TPDES) Guidelines, as set forth by the Texas Commission on Environmental Quality.

C. Implementation of site controls shall be performed by a qualified contractor experienced in the proper installation of such devices in accordance with manufacturers’ specifications, and in keeping with recognized Best Management Practices (BMP’s), and in keeping with TPDES regulations. Qualification of installing Contractor shall be reviewed with the Owner prior to entering into a contract with them for services.

D. The Contractor shall inspect all BMP’s at regular intervals as specified in the Storm Water Pollution Prevention Plan for this project. Record all deficiencies of site controls, and take immediate action to correct any deficiencies recorded. Keep records of inspections current and on file, available for review by EPA, TCEQ, MS4 operator and Owner.

1.5 SUBMITTALS

A. Submit in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.09 SUBMITTALS and UGC Article 8.

B. Submittals of products used in structural and non-structural controls shall be made through established procedures for review and approved by the Engineer of Record prior to installation on the site. The Contractor shall make available physical samples and product literature on any material used in structural or non-structural controls during the course of the project prior to its implementation in the field.

PART 2 - PRODUCTS

2.1 TEMPORARY EROSION CONTROL

A. In all cases, the development of plans and specifications will give first consideration to erosion controls, as it is much easier to maintain soil cover than to trap sediment. The goal of the planned erosion control will be to divert runoff away from unstable areas or to provide a stable surface that will resist the effects of rain and runoff. All projects should utilize one or more of the following practices unless engineer ascertains that there is no chance of runoff entering the project from areas adjoining the site. The preferred erosion controls to be used on the project include:
1. Interceptor swale - use as perimeter control, less than 5 acres only.
2. Diversion dike – use to route runoff away from project site, less than 10 acres only.
3. Pipe slope drain – transport runoff down steep, erodible slopes, less than 5 acres only.
4. Outlet stabilization – prevent erosion at outlet of channel or conduit.
5. Level spreader – outlet device for dikes and diversions.
6. Subsurface drain – use to prevent soils from becoming saturated and prevent seeps.
7. Tree protection – for erosion control and aesthetics.
8. Temporary vegetation – RECOMMENDED - use for temporary stabilization of disturbed areas; for slopes steeper than 3:1 use in conjunction with matting.
10. Mulch – use to stabilize newly seeded areas.
12. Dust Control – use in areas subject to air movement of dust.

2.2 TEMPORARY SEDIMENT CONTROL

A. Activities at most sites will result in soil disturbance. Erosion will occur in the disturbed areas and best management practices must be planned to contain and sediment transported by runoff. The preferred erosion controls to be used on the project include:

1. Construction exit – use at all designated access points
2. Silt fence (interior) – useful in areas of minor sheet flow, use 100 ft. or more of fence for each ¼ acre
3. Silt fence (exterior) – use along down slope borders of site, use 100 ft. or more of fence for each ¼ acre
4. Triangular filter dikes – use for areas within site requiring frequent access (movable)
5. Hay bale dike – use in areas of minor sheet flow, use 100 ft. or more for each ¼ acre – Note: replace every 3 months
6. Rock berm – use for drainage swales and ditches within and below site, less than 5 acres
7. High service rock berm – use around sensitive features and in high flow areas within and below site, less than 5 acres
8. Brush berm – use in small areas of sheet flow, less than 2 acres
9. Sand bag berm – use for construction in streambeds, contributing drainage area 5 – 10 acres
10. Buffer (vegetative) strips – use on floodplains, next to wetlands, along stream banks, and on steep slopes
11. Inlet protection – prevent sediment from entering storm inlet, less than 1 acre
12. Sediment trap – use where flows are concentrated in a swale of channel, 1 - 5 acres
13. Sediment basin – use for larger disturbed areas, 5 – 100 acres

PART 3 - EXECUTION

3.1 EROSION CONTROLS

A. INTERCEPTOR SWALE

1. Interceptor swales are used to shorten the length of exposed slope by intercepting runoff and can also serve as perimeter swales preventing off-site runoff from entering the disturbed area or prevent sediment-laden runoff...
from leaving the construction site or disturbed area. They may have a V-shape or be trapezoidal with a flat bottom and side slopes of 3:1 or flatter. The outflow from a swale should be directed to a stabilized outlet or sediment-trapping device. The swales should remain in place until the disturbed area is permanently stabilized. A schematic of an interceptor swale is shown below.

2. Materials
   a. Stone stabilization should be used when grades exceed 2% or velocities exceed 6 feet per second and should consist of a layer of crushed stone three inches thick, riprap or high velocity erosion control mats.
   b. Stabilization should extend across the bottom of the swale and up both sides of the channel to minimum height of three inches above the design water surface elevation based on a 2-year, 24-hour storm.

3. Installation
   a. An interceptor swale should be installed across exposed slopes during construction and should intercept no more than 5 acres of runoff.
   b. All earth removed and not needed in construction should be disposed of in an approved spoils site so that it will not interfere with the functioning of the swale or contribute to siltation in other areas of the site.
   c. Trees, brush, stumps, obstructions and other material should be removed and disposed of to avoid interference with proper functioning of the swale.
   d. Should have a maximum depth of 1.5 feet with side slopes of 3:1 or flatter. Swale should have positive drainage for its entire length to an outlet.
   e. When the slope exceeds 2 percent, or velocities exceed 6 feet per second (regardless of slope), stabilization is required. Stabilization should be crushed stone placed in a layer of at least 3 inches thick or may be high velocity erosion control matting. Check dams are also recommended to reduce velocities in the swales possibly reducing the amount of stabilization necessary.
   f. Minimum compaction for the swale should be 90% standard proctor density.

4. Inspection and Maintenance Guidelines
   a. Swales should be inspected weekly and after each rain event to locate and repair any damage to the channel or clear debris or other obstructions so as not to diminish flow capacity.
   b. Damage from storms or normal construction activities such as tire ruts or disturbance of swale stabilization should be repaired as soon as practical.
B. DIVERSION DIKES

1. A temporary diversion dike is a barrier created by the placement of an earthen embankment to reroute the flow of runoff to an erosion control device or away from an open, easily erodible area. A diversion dike intercepts runoff from small upland areas and diverts it away from exposed slopes to a stabilized outlet, such as a rock berm, sandbag berm, or stone outlet structure. These controls can be used on the perimeter of the site to prevent runoff from entering the construction area. Dikes are generally used for the duration of construction to intercept and reroute runoff from disturbed areas to prevent excessive erosion until permanent drainage features are installed and/or slopes are stabilized. A schematic of a diversion dike is shown below.

2. Materials:
   a. Stone stabilization (required for velocities in excess of 6 fps) should consist of riprap placed in a layer at least 3 inches thick and should extend a minimum height of 3 inches above the design water surface up the existing slope and the upstream face of the dike.
   b. Geotextile fabric should be a non-woven polypropylene fabric designed specifically for use as a soil filtration media with an approximate weight of 6 oz./yd², a Mullen burst rating of 140 psi, and having an equivalent opening size (EOS) greater than a #50 sieve.
3. Installation
   a. Diversion dikes should be installed prior to and maintained for the
duration of construction and should intercept no more than 10 acres of
runoff.
   b. Dikes should have a minimum top width of 2 feet and a minimum height
of compacted fill of 18 inches measured from the top of the existing
ground at the upslope toe to top of the dike and having side slopes of
3:1 or flatter.
   c. The soil for the dike should be placed in lifts of 8 inches or less and be
compacted to 95 % standard proctor density.
   d. The channel, which is formed by the dike, must have positive drainage
for its entire length to an outlet.
   e. When the slope exceeds 2 percent, or velocities exceed 6 feet per
second (regardless of slope), stabilization is required. Situations in
which velocities do not exceed 6 feet per second, vegetation may be
used to control erosion.

4. Inspection and Maintenance Guidelines
   a. Swales should be inspected weekly and after each rain event to
determine if silt is building up behind the dike or if erosion is occurring
on the face of the dike. Locate and repair any damage to the channel or
clear debris or other obstructions so as not to diminish flow capacity.
   b. Silt should be removed in a timely manner.
   c. If erosion is occurring on the face of the dike, the slopes of the face
should either be stabilized through mulch or seeding or the slopes of
the face should be reduced.
   d. Damage from storms or normal construction activities such as tire ruts
or disturbance of swale stabilization should be repaired as soon as
practical.

   Schematic of a Diversion Dike (NCTCOG, 1993b)
3.2 SEDIMENTATION CONTROLS

A. Temporary Construction Entrance/Exit
   1. The purpose of a temporary construction entrance is to provide a stable entrance/exit condition from the construction site and keep mud and sediment off public roads. A stabilized construction entrance is a stabilized pad of crushed stone located at any point traffic will be entering or leaving the construction site from a public right-of-way, street, alley, sidewalk or parking area. The purpose of a stabilized construction entrance is to reduce or eliminate the tracking or flowing of sediment onto public rights-of-way. This practice should be used at all points of construction ingress and egress. Excessive amounts of mud can also present a safety hazard to roadway users. To minimize the amount of sediment loss to nearby roads, access to the construction site should be limited to as few points as possible and vegetation around the perimeter should be protected where access is not necessary. A rock stabilized construction entrance should be used at all designated access points.
   
   2. Materials:
a. The aggregate should consist of 4 to 8 inch washed stone over a stable foundation as specified in the plan.
b. The aggregate should be placed with a minimum thickness of 8 inches.
c. The geotextile fabric should be designed specifically for use as a soil filtration media with an approximate weight of 6 oz/yd², a mullen burst rating of 140 lb/in², and an equivalent opening size greater than a number 50 sieve.
d. If a washing facility is required, a level area with a minimum of 4 inch washed stone or commercial rack should be included in the plans. Divert wastewater to a sediment trap or basin.

3. Installation
   a. Avoid curves on public roads and steep slopes. Remove vegetation and other objectionable material from the foundation area. Grade crown foundation for positive drainage.
   b. The minimum width of the entrance/exit should be 12 feet or the full width of exit roadway, whichever is greater.
   c. The construction entrance should be at least 50 feet long.
   d. If the slope toward the road exceeds 2%, construct a ridge, 6 to 8 inches high with 3:1 (H:V) side slopes, across the foundation approximately 15 feet from the entrance to divert runoff away from the public road.
   e. Place geotextile fabric and grade foundation to improve stability, especially where wet conditions are anticipated.
   f. Place stone to dimensions and grade shown on plans. Leave surface smooth and slope for drainage.
   g. Divert all surface runoff and drainage from the stone pad to a sediment trap or basin.
   h. Install pipe under pad as needed to maintain proper public road drainage.

4. Common Trouble Points
   a. Inadequate runoff control – sediment washes onto public road.
   b. Stone to small or geotextile fabric absent, results in muddy condition as stone is pressed into soil.
   c. Pad too short for heavy construction traffic – extend pad beyond the minimum 50-foot length as necessary.
   d. Pad not flared sufficiently at road surface, results in mud being tracked on to road and possible damage to road edge.
   e. Unstable foundation – use geotextile fabric under pad and/or improve foundation drainage.

5. Inspection and Maintenance Guidelines
   a. The entrance should be maintained in a condition, which will prevent tracking or flowing of sediment onto public rights-of-way. This may require periodic top dressing with additional stone as conditions demand and repair and/or cleanout of any measures used to trap sediment.
   b. All sediment spilled, dropped, washed or tracked on to public rights-of-way should be removed immediately by contractor.
   c. When necessary, wheels should be cleaned to remove sediment prior to entrance onto public right-of-way.
d. When washing is required, it should be done on an area stabilized with crushed stone that drains into an approved sediment trap or sediment basin.

e. All sediment should be prevented from entering any storm drain, ditch or water course by using approved methods.

Schematic of Temporary Construction Entrance (after NC, 1993)

B. SILT FENCE

1. A silt fence is a barrier consisting of geotextile fabric supported by metal posts to prevent soil and sediment loss from a site. When properly used, silt fences can be highly effective at controlling sediment from disturbed areas. They cause runoff to pond, allowing heavier solids to settle out. If not properly installed, silt fences are not likely to be effective. A schematic illustration of a silt fence is shown below.
2. The purpose of a silt fence is to intercept and detain water-borne sediment from unprotected areas of a limited extent. Silt fence is used during the period of construction near the perimeter of a disturbed area to intercept sediment while allowing water to percolate through. This fence should remain in place until the disturbed area is permanently stabilized. Silt fence should not be used where there is a concentration of water in a channel or drainage way. If concentrated flow occurs after installation, corrective action must be taken such as placing a rock berm in the areas of concentrated flow. Silt fencing within the site may be temporarily moved during the day to allow construction activity provided it is replaced and properly anchored to the ground at the end of the day. Silt fences on the perimeter of the site or around drainage ways should not be moved at any time.

3. Materials
   a. Filter Fabric
      1) General: The filter fabric shall be of non-woven polypropylene, polyethylene or polyamide thermoplastic fibers with non-raveling edges. The fabric shall be non-biodegradable, inert to most soil chemicals, ultraviolet resistant, unaffected by moisture or other weather conditions, and permeable to water while retaining sediment. The filter fabric shall be supplied in rolls a minimum of 36 inches wide.
      2) Physical Requirements: The fabric shall meet the following requirements when sampled and tested in accordance with the methods indicated:

<table>
<thead>
<tr>
<th>Physical Properties</th>
<th>Method</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fabric Weight (oz/sqyd)</td>
<td>ASTM D-3776</td>
<td>4.5 minimum</td>
</tr>
<tr>
<td>Water Flow Rate (gal/sq ft/min)</td>
<td>ASTM D-4491</td>
<td>40 maximum</td>
</tr>
<tr>
<td>Equivalent Opening Size</td>
<td>ASTM D4751</td>
<td>20 - 100</td>
</tr>
<tr>
<td>Grab Tensile (lbs)</td>
<td>ASTM D4632</td>
<td>100 minimum</td>
</tr>
<tr>
<td>Millen Burst Strength (psi)</td>
<td>ASTM D3786</td>
<td>300 minimum</td>
</tr>
<tr>
<td>Ultraviolet Resistance</td>
<td>ASTM D1682</td>
<td>70 minimum</td>
</tr>
<tr>
<td>Trapezoid Tear (lbs)</td>
<td>ASTM D4533</td>
<td>55 minimum</td>
</tr>
<tr>
<td>Elongation (%)</td>
<td>ASTM D4632</td>
<td>30 maximum</td>
</tr>
</tbody>
</table>

   b. Fence Posts
      1) Posts shall be painted or galvanized steel Tee of Y Posts with anchor plates, not less than 5 feet in length with a minimum weight of 1.3 pounds per foot with a minimum Brinell Hardness of 143. Hangers shall be adequate to secure fence and fabric to posts. Posts and anchor plates shall conform to ASTM A702.

   c. Woven Wire shall be welded wire fabric 2x4-W1.0 x W 1.0.

4. Installation
   a. Steel posts, which support the silt fence, should be installed on a slight angle toward the anticipated runoff source. Post must be embedded a minimum of 1 foot deep and spaced not more than 8 feet on center. Where water concentrates, the maximum spacing should be 6 feet.
b. Lay out fencing down-slope of disturbed area, following the contour as closely as possible. The fence should be sited so that the maximum drainage area is $\frac{1}{4}$ acre/100 feet of fence.

c. The toe of the silt fence should be trenched in with a spade or mechanical trencher, so that the down-slope face of the trench is flat and perpendicular to the line of flow. Where fence cannot be trenched in (e.g., pavement or rock outcrop), weight fabric flap with 3 inches of pea gravel on uphill side to prevent flow from seeping under fence.

d. The trench must be a minimum of 6 inches deep and 6 inches wide to allow for the silt fence fabric to be laid in the ground and backfilled with compacted material.

e. Silt fence should be securely fastened to each steel support post or to woven wire, which is in turn attached to the steel fence post. There should be a 3-foot overlap, securely fastened where ends of fabric meet.

f. Silt fence should be removed when the site is completely stabilized so as not to block or impede storm flow or drainage.

5. Common Trouble Points

a. Fence not installed along the contour causing water to concentrate and flow over the fence.

b. Fabric not seated securely to ground (runoff passing under fence)

c. Fence not installed perpendicular to flow line (runoff escaping around sides)

d. Fence treating too large an area, or excessive channel flow (runoff overtops or collapses fence)

6. Inspection and Maintenance Guidelines

a. Inspect all fencing weekly, and after any rainfall.

b. Remove sediment when buildup reaches 6 inches, or install a second line of fencing parallel to the old fence.

c. Replace any torn fabric or install a second line of fencing parallel to the torn section.

d. Replace or repair any sections crushed or collapsed in the course of construction activity. If a section of fence is obstructing vehicular access, consider relocating it to a spot where it will provide equal protection, but will not obstruct vehicles. A triangular filter dike may be preferable to a silt fence at common vehicle access points

C. TRIANGULAR SEDIMENT FILTER DIKES

1. The purpose of a triangular sediment filter dike is to intercept and detain water-borne sediment from unprotected areas of limited extent. The triangular sediment filter dike is used where there is no concentration of water in a channel or other drainage way above the barrier and the contributing drainage area is less than one acre. If the uphill slope above the dike exceeds 10%, the length of the slope above the dike should be less than 50 feet. If concentrated flow occurs after installation, corrective action should be taken such as placing rock berm in the areas of concentrated flow. This measure is effective on paved areas where installation of silt fence is not possible or where vehicle access must be maintained. The advantage of these controls is the ease with which they can be moved to allow vehicle traffic, then reinstalled to maintain sediment control.

2. Materials
a. Silt fence material should be polypropylene, polyethylene or polyamide woven or non-woven fabric. The fabric width should be 36 inches, with a minimum unit weight of 4.5 oz/yd, mullen burst strength exceeding 190 lb/in², ultraviolet stability exceeding 70%, and minimum apparent opening size of U.S. Sieve No. 30.

b. The dike structure should be 6-gauge 6” x 6” wire mesh folded into triangular form being eighteen (18) inches on each side.

3. Installation

a. As shown in the schematic below, the frame should be constructed of 6” x 6”, 6-gauge welded wire mesh, 18 inches per side, and wrapped with geotextile fabric the same composition as that used for silt fences.

b. Filter material should lap over ends six (6) inches to cover dike to dike junction; each junction should be secured by shoat rings.

c. Position dike parallel to the contours, with the end of each section closely abutting the adjacent sections.

d. There are several options for fastening the filter dike to the ground as shown in schematic below. The fabric skirt may be toed-in with 6 inches of compacted material, or 12 inches of the fabric skirt should extend uphill and be secured with a minimum of 3 inches of open graded rock, or with staples or nails. If these two options are not feasible the dike structure may be trenched in 4 inches.

e. Triangular sediment filter dikes should be installed across exposed slopes during construction with ends of the dike tied into existing grades to prevent failure and should intercept no more than one acre of runoff.

f. When moved to allow vehicular access, the dikes should be reinstalled as soon as possible, but always at the end of the workday.

Schematic of Triangular Sediment Filter Dike
D. HIGH SERVICE BERM

1. Materials
   a. Silt fence material should be polypropylene, polyethylene or polyamide woven or nonwoven fabric. The fabric width should be 36 inches, with a minimum unit weight of 4.5 oz/yd², mullen burst strength exceeding 190 lb/in², ultraviolet stability exceeding 70%, and minimum apparent opening size of U.S. Sieve No. 30.
   b. Fence posts should be made of hot rolled steel, at least 4 feet long with Tee or Y-bar cross section, surface painted or galvanized, minimum nominal weight 1.25 lb/ft², and Brindell hardness exceeding 140. Rebar (either #5 or #6) may also be used to anchor the berm.
   c. Woven wire backing to support the fabric should be galvanized 2" x 4" welded wire, 12-gauge minimum.
   d. The berm structure should be secured with a woven wire sheathing having maximum opening of 1 inch and a minimum wire diameter of 20 gauge galvanized and should be secured with shoat rings.
   e. Clean, open graded 3-to 5-inch diameter rock should be used, except in areas where high velocities or large volumes of flow are expected, where 5-to 8-inch diameter rocks may be used.

2. Installation
   a. Lay out the woven wire sheathing perpendicular to the flow line. The sheathing should be 20-gauge woven wire mesh with 1-inch openings.
b. Install the silt fence along the center of the proposed berm placement, as with a normal silt fence described in Section 2.4.3.

c. Place the rock along the sheathing on both sides of the silt fence as shown in the diagram (Figure 1.30), to a height not less than 24 inches. Clean, open graded 3-5” diameter rock should be used, except in areas where high velocities or large volumes of flow are expected, where 5-to 8-inch diameter rock may be used.

d. Wrap the wire sheathing around the rock and secure the tie wire so that the ends of the sheathing overlap at least 2 inches, and the berm retains its shape when walked upon.

e. The high service rock berm should be removed when the site is revegetated or otherwise stabilized or it may remain in place as a permanent BMP if drainage is adequate.

3. Common Trouble Points
   a. Insufficient berm height or length (runoff quickly escapes over top or around sides of berm).
   b. Berm not installed perpendicular to flow line (runoff escaping around one side).
   c. Internal silt fence not anchored securely to ground (high flows displacing berm).
   d. When installed in streambeds, they often result in diversion scour, so their use in this setting is not recommended.

4. Inspection and Maintenance Guidelines
   a. Inspection should be made weekly and after each rainfall by the responsible party. For installations in streambeds, additional daily inspections should be made on rock berm.
   b. Remove sediment and other debris when buildup reaches 6 inches and dispose of the accumulated silt of in an approved manner.
   c. Repair any loose wire sheathing.
   d. The berm should be reshaped as needed during inspection.
   e. The berm should be replaced when the structure ceases to function as intended due to silt accumulation among the rocks, washout, construction traffic damage, etc.
   f. The rock berm should be left in place until all upstream areas are stabilized and accumulated silt removed.
Schematic of High Service Rock Berm (LCRS, 1998)

END OF SECTION 01 57 23
SECTION 02 41 00 - SITE DEMOLITION

PART 1 - GENERAL
1.1 GENERAL DOCUMENTS
A. The Terms and Conditions of the Contract, including Supplementary and Special Conditions of the Contract, and the Drawings apply to this Section.

1.2 SUMMARY
A. Furnish all material, equipment and labor necessary to demolish and remove from the site those items noted on the drawings.

1.3 RELATED SECTIONS:
A. Section 31 00 00 – Site Earthwork
B. Section 31 11 00 – Clearing and Grubbing

1.4 REFERENCES:
A. OSHA Regulations.
B. American National Standards Institute (ANSI)
   1. ANSI A10.6-2006 – Safety and Health Program Requirements for Demolition Operations.
C. Texas Department of Transportation Standards and Specifications

1.5 GENERAL REQUIREMENTS:
A. Remove rubbish and debris from the site on a daily basis unless otherwise directed.
B. In the interest of occupational safety and health, perform work in accordance with OSHA and ANSI requirements.

1.6 REGULATORY AND SAFETY REQUIREMENTS
A. Comply with federal, state and local regulations regarding demolition activities, hauling and disposal of materials.

1.7 DUST AND DEBRIS CONTROL
A. Prevent the spread of dust and debris and avoid creation of a nuisance in the surrounding area.
B. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, ice, flooding, or pollution.
C. Sweep pavements as often as necessary to control the spread of debris.

1.8 PROTECTION
A. Traffic Control Signs
   1. Where pedestrian and driver safety is endangered in the area of removal work, use traffic barricades with flashing lights.
B. Existing Work
   1. Before beginning any demolition work, survey the site and examine the drawings and specifications to determine the extent of the work.
C. Items to Remain in Place
   1. Take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Owner. Repair or replace damaged items as approved by the Owners Representative. Coordinate the work of this section with all other work indicated. Construct and maintain shoring, bracing, and supports as required. Ensure that structural elements are not overloaded. Increase structural supports or add new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract. Do not overload pavements to
remain. Provide new supports and reinforcement for existing construction weakened by demolition or removal work.

D. Existing Construction
   1. Do not disturb existing construction, vegetation or natural features beyond the extent indicated or necessary for installation of new construction.

E. Trees
   1. Protect trees within the project site which might be damaged during demolition, and which are indicated to be left in place. Reference Landscape Plans and Specifications for tree protection and removal.

F. Utility Service
   1. Maintain existing utilities indicated to stay in service and protect against damage during demolition operations. Prior to start of work, the Contractor will contact owners of utility lines to be disconnected, and coordinate sealing of utilities serving each area of alteration or removal.

G. Facilities
   1. Protect electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities.

1.9 SPECIAL REQUIREMENTS
   A. Existing utilities are to remain in place and operational until all utility relocations as shown on the plans have been constructed, inspected and approved by the Owners Representative.

1.10 BURNING
   A. The use of burning at the site for the disposal of materials, or as a method of demolition, will not be permitted.
   B. The accumulation of combustible debris in large quantities in one location will not be permitted. Remove combustible material from the site on a daily basis.
   C. Do not allow combustible materials to accumulate which could result in an accidental fire.

1.11 EXPLOSIVES
   A. The use of explosives in any form for any purpose on this site is prohibited.

1.12 HAZARDOUS CONDITIONS
   A. Exercise care to avoid leaving hazardous conditions on the site at the end of a work day. If unavoidable, erect appropriate barricades, signs and take other necessary precautions to protect the public and passersby from these hazardous areas.
   B. Large accumulations of rubble which may shift shall be avoided.

PART 2 - PRODUCTS
2.1 FILL MATERIAL
   A. Backfill material for depressions or excavations resulting from demolition operations shall meet the requirements of Section 31 00 00.

PART 3 - EXECUTION
3.1 SURFACE FEATURES
   A. The Contractor is to install all erosion and sedimentation control features including tree protection per the plans prior to any demolition activities.
   B. All existing surface features shown or not shown on the plans that exist and are in conflict with proposed new improvements shall be demolished prior to any other demolition activities. Demolition shall be coordinated with the Owner’s Designated Representative.
   C. Existing trees
      1. Reference Landscape plans and specifications.
3.2 UTILITIES AND RELATED EQUIPMENT
   A. General Requirements
      1. Do not interrupt existing utilities serving occupied or used facilities, except when
         authorized in writing by the Owner’s Designated Representative. Do not interrupt
         existing utilities except when approved in writing and then only after temporary utility
         services have been approved and provided. Do not begin demolition or deconstruction
         work until all utility disconnections have been made. Shut off and cap utilities for
         future use, as indicated.
      2. Refer to Section 31 11 00 – Clearing and Grubbing for coordination and protection
         requirements of existing utilities that are to remain active during construction.
      3. Notify Utility Owners’ Representative to turn off affected utility services that are to be
         abandoned no less than 48 hours prior to starting demolition.
   B. Disconnecting Existing Utilities
      1. Remove existing utilities as indicated and terminate in a manner conforming to the
         nationally recognized code covering the specific utility and approved by the Owner’s
         Designated Representative. When utility lines are encountered that are not indicated
         on the drawings, the Owner’s Designated Representative shall be notified prior to
         further work in that area. Remove meters and related equipment and deliver to a
         location [on the station] in accordance with instructions of the Owner.

3.3 PAVING AND SLABS
   A. Remove concrete and asphaltic concrete paving and slabs, including aggregate base. Provide
      neat sawcuts at limits of pavement removal as indicated. Pavement and slabs designated to
      be recycled and utilized in this project shall be moved, ground and stored as directed by the
      Owner’s Designated Representative. Pavement and slabs not to be used in this project shall
      be removed from the Owner’s property at Contractor’s expense.

3.4 CONCURRENT EARTH-MOVING OPERATIONS
   A. Do not begin excavation, filling, and other earth-moving operations that are sequential to
      demolition or deconstruction work in areas occupied by structures to be demolished or
      deconstructed until all demolition and deconstruction in the area has been completed and
      debris removed. Fill holes, open basements and other hazardous openings.

3.5 DUST CONTROL
   A. Sprinkle debris, and use temporary enclosures as necessary to limit dust to the lowest
      practicable level.
   B. Do not use water to an extent that may cause flooding, contaminated runoff, or icing.

3.6 DISPOSAL
   A. All materials noted to be removed and disposed of become the property of the Contractor.
      All material shall be disposed of off-site in a legal manner. The Contractor shall include in his
      work the careful transporting of debris so that no mud, dirt, gravel, lumber, nails, concrete or
      any other material is allowed to fall on public property or any other property other than the
      destination to which the removed materials are legally being transported. In the event some
      materials fall on public property or other property the Contractor shall be responsible for
      damage caused and clean-up costs.

3.7 BACKFILLING
   A. Backfill to existing ground level, foundation level of new construction, finish grades as shown
      on the drawings of subgrade elevation of new improvements.
   B. Backfill material and compaction shall conform to Sections 31 00 00.
   C. Demolition debris shall not be used as backfill material.

3.8 SALVAGE
A. Equipment and materials, including piping within the limits of demolition, unless otherwise specified, will become the property of the Contractor.

END OF SECTION 02 41 00
SECTION 02 41 19 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. 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.

B. Related Requirements:

1. Section 01 10 00 "Summary of Work" for restrictions on use of the premises, Owner-occupancy requirements, phasing requirements, and "Safety Plan" for maintaining emergency egress from the existing building.
2. Section 01 50 00 “Construction Facilities and Temporary Controls” for temporary construction and environmental protection measures for selective demolition operations.
3. Section 01 73 00 "Execution" for cutting and patching procedures.

1.3 DEFINITIONS

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

B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and store item indicated for reuse and deliver to Owner indicated for salvage.

C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.
E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be encountered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at the Project site.

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.
6. Review contractor’s construction sequencing and demolition plans to determine impact on facility operations.
7. Review contractor’s "safety plan" and procedures to maintain emergency paths of egress from the existing facility during construction.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For refrigerant recovery technician.


C. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for dust control, and for noise control. Indicate proposed locations and construction of barriers.

D. 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. Means of protection for items to remain and items in path of waste removal from building.

5. Locations of proposed dust- and noise-control temporary partitions and means of egress.

6. Coordination of Owner’s continuing occupancy of portions of existing building and of Owner’s partial occupancy of completed Work.

E. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by demolition operations. Comply with Section 013233 "Photographic Documentation." Submit before Work begins.

F. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

G. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

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

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

1.7 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.8 FIELD CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner’s operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose shall be completely investigated by the Contractor and coordinated with the Construction Documents.

1. Before selective demolition, Owner will remove the following items:

   a. Furniture and equipment.
   b. Office and janitor Supplies.
C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

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

F. 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.

1.9 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Verify warrantors with owner and notify warrantor before proceeding. Existing warranties include the following:

1.10 COORDINATION

A. Arrange selective demolition schedule so as not to interfere with Owner’s operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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

B. Standards: Comply with ASSE A10.6 and NFPA 241.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

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

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

E. 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.

F. Engage a professional engineer to perform an engineering survey of 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 building demolition operations.

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

G. Survey of Existing Conditions: Record existing conditions by use of measured drawings and preconstruction photographs or video.

1. Comply with requirements specified in Section 01 32 33 "Photographic Documentation."
2. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.
3. 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.

3.2 PREPARATION

A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.
3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

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

1. Comply with requirements for existing services/systems interruptions specified in Division 1, Section 01 01 00 “Summary of Work.”

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off 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 utilities with utility companies.
3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
   a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
   b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
   c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
   d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
   e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
   f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
   g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.
   h. Where entire wall is to be removed, existing services/systems may be removed with removal of the wall.

3.4 PROTECTION

A. Temporary Protection: 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.

5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 01 50 00 "Temporary Facilities and Controls."

B. Temporary Shoring: Design, 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.

C. Remove temporary barricades and protections where hazards no longer exist.

3.5 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. 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 portable fire-suppression devices during flame-cutting operations.

5. Maintain fire watch during and for at least one hour after flame-cutting operations.


7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.

8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.

9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

10. Dispose of demolished items and materials promptly.
B. 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.

C. 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 on-site.
   5. Protect items from damage during transport and storage.

D. Removed and Reinstalled Items:
   1. Clean and repair items to functional condition adequate for intended reuse.
   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.

E. 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 cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete full depth at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.

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

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

D. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings," and its Addendum.

E. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight. See Section 07 52 16 - "SBS Modified Bituminous Membrane Roofing" for new roofing requirements.
1. Remove existing roof membrane, flashings, copings, and roof accessories.
2. Remove existing roofing system down to substrate.

F. Air-Conditioning Equipment: Remove equipment without releasing refrigerants.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner’s property, remove demolition waste materials from Project site and legally dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn demolished materials.

3.8 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.

3.9 SELECTIVE DEMOLITION SCHEDULE

A. Remove: As indicated on the Drawings.

B. Remove and Salvage: As indicated on the Drawings.

C. Remove and Reinstall: As indicated on the Drawings.

D. Existing to Remain: As indicated on the Drawings.

E. Dismantle: As indicated on the Drawings.

END OF SECTION 02 41 19
SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 2 - GENERAL

2.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

2.2 SUMMARY

A. This Section specifies cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:

1. Footings.
2. Foundation walls.
3. Slabs-on-grade.

B. WORK INCLUDED

1. Design, fabrication, erection, and stripping of formwork for cast-in-place concrete including shoring, reshoring, falsework, bracing, proprietary forming systems, prefabricated forms, void forms, permanent metal forms, bulkheads, keys, blockouts, sleeves, pockets, and accessories. Erection shall include installation in formwork of items furnished by other trades.
2. Furnish all labor and materials required to fabricate, deliver and install reinforcement and embedded metal assemblies for cast-in-place concrete, including steel bars, welded steel wire fabric, ties and supports.
3. Furnish all labor and materials required to perform the following:
   a. Cast-in-place concrete
   b. Concrete mix designs
   c. Grouting structural steel baseplates

2.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, Slag Cement, and silica fume; subject to compliance with requirements.

2.4 SUBMITTALS

A. Submit in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.09 SUBMITTALS and UGC Article 8.
B. Product Data: For each type of product indicated.

C. Design Mixtures: For each concrete mixture, submit proposed mix designs in accordance with ACI 318 requirements. Each proposed mix design shall be accompanied by a record of past performance.
   1. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
   2. Indicate amounts of mixing water to be withheld for later addition at Project site.

D. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
   1. Do not reproduce the structural drawings for use as shop drawings.
   2. Embedded metal assemblies: Submit shop drawings for fabrication and placement. Use standard AWS welding symbols.

E. Steel Reinforcement Submittals for Information: Mill test certificates of supplied concrete reinforcing, indicating physical and chemical analysis.

F. Welding certificates.

G. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
   1. Aggregates.

H. Material Certificates: For each of the following, signed by manufacturers:
   1. Cementitious materials
   2. Admixtures
   3. Form materials and form-release agents
   4. Steel reinforcement and accessories
   5. Curing compounds
   6. Floor and slab treatments
   7. Bonding agents
   8. Adhesives
   9. Vapor retarders
   10. Joint-filler strips
   11. Repair materials

I. Submit manufacturer's certification of maximum chloride ion content in admixtures.

J. Fly ash: Submit certification attesting to carbon content and compliance with ASTM C618.

K. Construction Joint Layout: Submit a diagram of proposed construction joint locations for horizontal framing that exceed the limits of a single placement as stated in the structural notes, other than those indicated on the Drawings.
L. Floor surface flatness and levelness measurements to determine compliance with specified tolerances.

M. Field quality-control test and inspection reports.

N. Minutes of preinstallation conference.

2.5 QUALITY ASSURANCE

A. QUALITY ASSURANCE in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.10 QUALITY ASSURANCE AND UGC Article 8.

B. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

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.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

D. Testing Agency Qualifications: An independent agency, 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 I, according to ACI CP-01 or an equivalent certification program.

2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

E. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.

F. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code-Reinforcing Steel."

G. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specification for Structural Concrete,"

2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
H. Concrete Testing Service: Owner may engage a qualified independent testing agency to perform material evaluation tests.

I. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete 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 subcontractor.

2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

2.6 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

C. Store all proprietary materials in accordance with manufacturer’s recommendations.

PART 3 - PRODUCTS

3.1 CONCRETE, GENERAL

A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

   1. ACI 301 (ACI 301M).
   2. ACI 117 (ACI 117M).
3.2 FORM-FACING MATERIALS

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

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

3. Steel Forms

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


D. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

E. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.


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

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

3.3 STEEL REINFORCEMENT

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

B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.

C. Deformed-Bar Anchor: ASTM A1064/ A1064M.

D. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.
3.4 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut bars true to length with ends square and free of burrs.

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

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
2. For slabs on grade and slabs on void forms, provide sand plates, horizontal runners, or precast concrete blocks on bottom where base material will not support chair legs or where vapor barrier has been specified.

3.5 MECHANICAL SPLICES

A. Provide mechanical splices designed to develop, in tension and compression, 125 percent of the minimum ASTM specified yield strength of the smaller bar being spliced. The following splicing systems are acceptable (equal or better):

1. Erico "Cadweld T-Series"
2. Erico "Lenton"
3. Dayton Barsplice "Bar-Grip"
4. Dayton Barsplice "Grip-Twist"

3.6 DOWEL BAR ANCHORS

A. Provide dowel bar anchors and threaded dowels designed to develop, in tension and compression, 125 percent of the minimum ASTM specified yield strength of the dowel bars. Unless otherwise indicated, anchors shall be furnished with ACI standard 90 degree hooks. Dowels shall be furnished by the anchor supplier. The following dowel splicing systems are acceptable (equal or better):

1. Richmond Screw Anchor "Dowel Bar Splicer"
2. Erico "Lenton Form Saver"
3. Dayton Barsplice "Grip-Twist"

3.7 EMBEDDED METAL ASSEMBLIES

A. Steel Shapes and Plates: ASTM A36

C. Reinforcing Bars to be Welded: ASTM A706.

D. Coatings
   1. Epoxy coating for metal assemblies shall be "Hi-Build Epoxoline," as manufactured by the Tnemec Company, Kansas City, Missouri, applied in accordance with manufacturer's recommendations.

3.8 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
   1. Portland Cement: ASTM C 150, Type I/II, gray. Supplement with the following:
      a. Fly Ash: ASTM C 618, Class F or C.
      b. Slag Cement: ASTM C 989, Grade 100 or 120.

B. Normal-Weight Aggregates: ASTM C 33, Class 3M coarse aggregate or better, graded. Provide aggregates from a single source.
   1. Maximum Coarse-Aggregate Size: As indicated on drawings.
   2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.


3.9 ADMIXTURES


B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
   1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
   2. Retarding Admixture: ASTM C 494/C 494M, Type B.
   3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
   4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
   5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
   6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

3.10 VAPOR RETARDERS

A. Plastic Vapor Retarder: ASTM E 1745, Class A.
1. Membrane shall have the following properties:
   a. Minimum 15 mils thickness.
   b. Permeance Rating: ASTM E96, 0.01 Perms [grains/(ft² * hr *- in Hg)] or lower as tested after mandatory conditioning (ASTM E 154 sections 8, 11, 12, 13)
   c. Installation shall be in accordance with ASTM E1643 and manufacturer’s instructions.

2. Products (equal or better):
   a. Carlisle Coatings & Waterproofing, Inc.: Blackline 400.
   b. Epro; Ecoshield-E 15 mil.
   c. Inteplast Group; Barrier Bac VBC-350 Composite Vapor Retarder
   d. Reef Industries; Vaporguard.
   e. Stego Wrap 15 mil, by Stego.

3. Accessories
   a. Perimeter/seam sealing tape for use with membranes that are not self-adhering to the underside of concrete slabs on void forms:
      1) Crete Claw detail tape by Stego Industries, LLC, for adhering vapor retarder membrane to the underside of concrete surface at slabs on carton void forms, 3-inch and 6-inch widths as noted in Part 3.
      2) StegoTack double-sided adhesive tape by Stego Industries, LLC, for adhering membrane to concrete at gradebeams.
   b. Manufacturer’s recommended standard adhesive or pressure sensitive tape for general use.

3.11 CURING MATERIALS

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

1. Products (equal or better):
   a. Axim Concrete Technologies; CATEXOL Cimfilm.
   b. BASF Construction Chemicals – Building Systems; 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.; Vapor Aid.
   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 Envio Set.

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

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

D. Water: Potable.

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

1. Products (equal or better):

   a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.

   b. BASF Construction Chemicals – Building Systems; Kure 200.

   c. ChemMasters; Safe-Cure Clear.

   d. Conspec by Dayton Superior; W.B. Resin Cure.

   e. Dayton Superior Corporation; Day Chem Rez Cure (J-11-W).

   f. Edoco by Dayton Superior; Res X Cure WB.

   g. Euclid Chemical Company (The), an RPM company; Kurez W VOX; TAMMSCURE WB 30C.


   i. Lambert Corporation; Aqua Kure-Clear.

   j. L&M Construction Chemicals, Inc.; L&M Cure R.


   l. Nox-Crete Products Group; Resin Cure E.

   m. Right Pointe; Clear Water Resin.

   n. SpecChem, LLC; Spec Rez Clear.

   o. Symons by Dayton Superior; Resi-Chem Clear.

   p. TK Products, Division of Sierra Corporation; TK-2519 DC WB.

   q. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.

F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

1. Products (equal or better):

   a. Anti-Hydro International, Inc.; AH Clear Cure WB.

   b. BASF Construction Chemicals – Building Systems; Kure-N-Seal WB.

   c. ChemMasters; Safe-Cure & Seal 20.
d. Conspec by Dayton Superior; Cure and Seal WB.
e. Cresset Chemical Company; Crete-Trete 309-VOC Cure & Seal.
f. Dayton Superior Corporation; Safe Cure and Seal (J-18).
g. Edoco by Dayton Superior; Spartan Cote WB II.
h. Euclid Chemical Company (The), an RPM company; Aqua Cure VOX; Clearseal WB 150.
j. Lambert Corporation; Glazecote Sealer-20.
k. L&M Construction Chemicals, Inc.; Dress & Seal WB.
m. Metalcrete Industries; Metcure.
n. Nox-Crete Products Group; Cure & Seal 150E.
o. Symons by Dayton Superior; Cure & Seal 18 Percent E.
p. TK Products, Division of Sierra Corporation; TK-2519 WB.
q. Vexcon Chemicals, Inc.; Starseal 309.

G. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, 18 to 25 percent solids, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

1. Products (equal or better):
   a. BASF Construction Chemicals – Building Systems; Kure-N-Seal W.
   b. ChemMasters; Safe-Cure Clear.
   c. Conspec by Dayton Superior; High Seal.
   d. Dayton Superior Corporation; Safe Cure and Seal (J-19).
   e. Edoco by Dayton Superior; Spartan Cote WB II 20 Percent.
   f. Euclid Chemical Company (The), an RPM Company; Diamond Clear VOX; Clearseal WB STD.
   g. Kaufman Products, Inc.; SureCure Emulsion.
   h. Lambert Corporation; Glazecote Sealer-20.
   i. L&M Construction Chemicals, Inc.; Dress & Seal WB.
   k. Metalcrete Industries; Metcure 0800.
   l. Nox-Crete Products Group; Cure & Seal 200E.
   m. Symons by Dayton Superior; Cure & Seal 18 Percent E.
   n. Vexcon Chemicals, Inc.; Starseal 0800.

3.12 RELATED MATERIALS


B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

C. Sleeves and Blockouts: Formed with galvanized metal, galvanized pipe, polyvinyl chloride pipe, fiber tubes, or wood.
D. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required; of strength and character to maintain formwork in place while placing concrete.

3.13 REPAIR MATERIALS

   1. Compressive Strength: 1200 psi minimum at 1 day; 6000 psi minimum at 28 days when tested according to ASTM C 109.
   2. Bond Strength: 1800 psi minimum at 28 days when tested according to ASTM C 882 (Modified).
   3. Product / Manufacturer: SikaTop 122 Plus or SikaTop 123 Plus, Sika Corporation, or approved equal.

B. Repair Mortar – Form and Pour or Pump: Pre-packaged, cement-based, single-component, polymer-modified, silica-fume-enhanced, cementitious mortar.
   1. Compressive Strength: 3000 psi minimum at 1 day; 6500 psi at 28 days when tested according to ASTM C 109.
   2. Bond Strength: 2200 psi at 28 days when tested according to ASTM C 882 (modified).
   3. Product / Manufacturer: Sika MonoTop 611, Sika Corporation, or approved equal.

3.14 CONCRETE MIXTURES, GENERAL

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.
   1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
   2. Required average strength above specified strength:
      a. Based on a record of past performance: Determination of required average strength above specified strength shall be based on the standard deviation record of the results of at least 30 consecutive strength tests in accordance with ACI 318, Chapter 5.3 by the larger amount defined by formulas 5-1 and 5-2.
      b. Based on laboratory trial mixtures: Proportions shall be selected on the basis of laboratory trial batches prepared in accordance with ACI 318, Chapter 5.3.3.2 to produce an average strength greater than the specified strength f'c by the amount defined in table 5.3.2.2.

   1) Proportions of ingredients for concrete mixes shall be determined by an independent testing laboratory or qualified concrete supplier.
   2) For each proposed mixture, at least three compressive test cylinders shall be made and tested for strength at the specified age. Additional cylinders may be made for testing for information at earlier ages.
B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash: 20 percent.
4. Combined Fly Ash or Pozzolan and Slag Cement: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.

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

1. Do not use admixtures which have not been incorporated and tested in accepted mixes.
2. Use water-reducing admixture in concrete, as required, for placement and workability.
3. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
4. Use water-reducing admixture in pumped concrete, and concrete with a water-cementitious materials ratio below 0.50.

3.15 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Proportion normal-weight concrete mixture as indicated on drawings.

3.16 FABRICATING REINFORCEMENT

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

3.17 FABRICATION OF EMBEDDED METAL ASSEMBLIES

A. Fabricate metal assemblies in the shop. Holes shall be made by drilling or punching. Holes shall not be made by or enlarged by burning. Welding shall be in accordance with AWS D1.1.

B. Welding of deformed bar anchors and headed stud anchors shall be done by full fusion process equal to that of TRW Nelson Stud Welding Division. A minimum of two headed studs shall be tested at the start of each production period for proper quality control. The studs shall be capable of being bent 45 degrees without failure.

C. Welding of reinforcement shall be done in accordance with AWS D1.4, using the recommended preheat temperature and electrode for the type of reinforcement being welded. Bars larger than no. 9 shall not be welded. Welding shall be subject to the observance and testing of the Testing Laboratory.
D. Metal assemblies exposed to earth, weather or moisture shall be hot dip galvanized. All other metal assemblies shall be either hot dip galvanized or painted with an epoxy paint. Repair galvanizing after welding with a Cold Galvanizing compound installed in accordance with the manufacturer's instructions. Repair painted assemblies after welding with same type of paint.

3.18 CONCRETE MIXING

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

1. When air temperature is between 85 and 95 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 95 deg F, reduce mixing and delivery time to 60 minutes.

PART 4 - EXECUTION

4.1 FORMWORK

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

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

1. Vertical alignment:
   a. Lines, surfaces and arises less than 100 feet in height - 1 inch.
   b. Outside corner of exposed corner columns and control joints in concrete exposed to view less than 100 feet in height - 1/2 inch.

2. Lateral alignment:
   a. Members - 1 inch.
   b. Centerline of openings 12 inches or smaller and edge location of larger openings in slabs - 1/2 inch.

3. Level alignment:
   a. Elevation of slabs-on-grade - 3/4 inch.
   d. Lintels, sills, parapets, horizontal grooves, and other lines exposed to view - 1/2 inch.
   a. 12 inch dimension or less - plus 3/8 inch to minus 1/4 inch.
   b. Greater than 12 inch to 3 foot dimension - plus 1/2 inch to minus 3/8 inch.
   c. Greater than 3 foot dimension - plus 1 inch to minus 3/4 inch.

5. Relative alignment:
   a. Stairs:
      1) Difference in height between adjacent risers - 1/8 inch.
      2) Difference in width between adjacent treads - 1/4 inch.
      3) Maximum difference in height between risers in a flight of stairs - 3/8 inch.
      4) Maximum difference in width between treads in a flight of stairs - 3/8 inch.
   b. Grooves:
      1) Specified width 2 inches or less - 1/8 inch.
      2) Specified width between 2 inches and 12 inches - 1/4 inch.
   c. Vertical alignment of outside corner of exposed corner columns and control joint grooves in concrete exposed to view - 1/4 inch in 10 feet.
   d. All other conditions - 3/8 inch in 10 feet.

C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
   2. Class B, 1/4 inch for rough-formed finished surfaces.

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

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
   1. Install keyways, reglets, recesses, and the like, for easy removal.
   2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide elevation or camber in formwork as required for anticipated formwork deflections due to weight and pressures of concrete and construction loads.

H. Foundation Elements: The sides of all below grade portions of beams, pier caps, walls, and columns shall be formed straight and to the lines and grades specified. Foundation elements shall not be earth formed unless specifically indicated on the Drawings.
I. 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.

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

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

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

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

N. Coat contact surfaces of forms with form-release agent, according to manufacturer’s written instructions, before placing reinforcement, anchoring devices, and embedded items.

1. Do not apply form release agent where concrete surfaces are scheduled to receive subsequent finishes which may be affected by agent. Soak contact surfaces of untreated forms with clean water. Keep surfaces wet prior to placing concrete.

4.2 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.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC’s "Code of Standard Practice for Steel Buildings and Bridges."
   a. Spacing within a bolt group: 1/8"  
   b. Location of bolt group (center): 1/2"  
   c. Rotation of bolt group: 5 degrees  
   d. Angle off vertical: 5 degrees  
   e. Bolt projection: ± 3/8"


4.3 REMOVING AND REUSING FORMS

A. General: 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 for 24 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.
1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.

2. Formwork supporting conventionally reinforced concrete shall not be removed until concrete has attained 85 percent of its specified 28-day compressive strength as established by tests of field cured cylinders. In the absence of cylinder tests, supporting formwork shall remain in place until the concrete has cured at a temperature of at least 50 degrees Fahrenheit (10 degrees Celsius) for the minimum cumulative time periods given in ACI 347, Section 3.7.2.3. When the surrounding air temperature is below 50 degrees Fahrenheit (10 degrees Celsius), that time period shall be added to the minimum listed time period. Formwork for two-way conventionally reinforced slabs shall remain in place for at least the minimum cumulative time periods specified for one-way slabs of the same maximum span.

3. Minimum cumulative curing times may be reduced by the use of high-early strength cement or forming systems which allow form removal without disturbing shores, but only after the Contractor has demonstrated to the satisfaction of the Architect that the early removal of forms will not cause excessive sag, distortion or damage to the concrete elements.

4. Wood forms shall be completely removed. Provide temporary openings if required.

5. Provide adequate methods of curing and thermal protection of exposed concrete if forms are removed prior to completion of specified curing time.

6. Areas required to support construction loads in excess of 20 psf shall be reshored to properly distribute construction loading. Construction loads up to the rated live load capacity may be placed on unshored construction provided the concrete has attained the specified 28-day compressive strength.

7. Obtaining concrete compressive strength tests for the purposes of form removal shall be the responsibility of the Contractor.

8. 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. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

4.4 SHORES AND RESHORES

A. The Contractor shall be solely responsible for proper shoring and reshoring.

B. 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.
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.

4.5 VAPOR RETARDERS

A. Plastic Vapor Retarders: Place, protect, and repair vapor retarders according to ASTM E 1643 and manufacturer’s written instructions.

B. Lap joints 6 inches and seal with tape as noted below.

1. Vapor retarder membrane seal at slabs on void forms for use with membranes that are not self-adhering to the underside of concrete slabs: Seal vapor retarder membrane to underside of slab using perimeter/seam seal tape applied continuously to perimeter of vapor retarder membrane at grade beams (3in. tape) and at the seams at interior conditions (6in. tape).
   a. Apply double-sided adhesive tape top surface of grade beam and adhere membrane to tape. Refer to the drawings for detail.
   b. Remove any dirt or debris from membrane prior to application of sealing tape.

2. General sealing and at slabs on grade: Use manufacturer’s standard adhesive or pressure sensitive tape for sealing membrane at seams, pipe penetrations, tears, etc.

4.6 STEEL REINFORCEMENT

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

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Weld reinforcing bars according to AWS D1.4, where indicated. Only steel conforming to ASTM A706 may be welded.

D. Installation tolerances:

1. Top and bottom bars in slabs, girders, beams and joists:
   a. Members 8" deep or less: ±3/8"
   b. Members more than 8" deep: ±1/2"
2. Concrete Cover to Formed or Finished Surfaces: ±3/8" for members 8" deep or less; ±1/2" for members over 8" deep, except that tolerance for cover shall not exceed 1/3 of the specified cover.

E. Concrete Cover: Refer to the Structural Notes.

F. Splices: Provide standard reinforcement splices by lapping and tying ends. Comply with ACI 318 for minimum lap of spliced bars where not specified on the documents.

G. Mechanical Splices: Use for splicing of bars larger than no. 11 or where no. 11 bars are spliced to larger size bars and where indicated on the drawings. Comply with manufacturer's instructions for preparation of bars and installation procedures.

H. Field Welding of Embedded Metal Assemblies: All paint and galvanizing shall be removed in areas to receive field welds. All areas where paint or galvanizing has been removed shall be field repaired with the specified paint or cold galvanizing compound, respectively.

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

J. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

4.7 JOINTS

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

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

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated.
D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

   1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
   2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 7 Section “Joint Sealants,” are indicated.
   3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

4.8 WATERSTOPS

A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.

4.9 CONCRETE PLACEMENT

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

B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301, and only if specifically noted as withheld on the batch ticket.

   1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
   2. Water content shall not exceed the maximum specified water/cement ratio for the mix.

C. 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. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
   2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
   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.

4. Do not permit concrete to drop freely any distance greater than 20'-0" for concrete containing a high range water reducing admixture (superplasticizer) or 5'-0" for other concrete. Provide chute or tremie to place concrete where longer drops are necessary. Do not place concrete into excavations with standing water. If place of deposit cannot be pumped dry, pour concrete through a tremie with its outlet near the bottom of the place of deposit.

5. Pump priming grout shall be discarded and not used in the structure.

D. 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.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.


3. Screed slab surfaces with a straightedge and strike off to correct elevations.

4. Slope surfaces uniformly to drains where required.

5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

E. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.

2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

F. Hot-Weather Placement: Comply with ACI 305.1 and as follows:

1. Maintain concrete temperature below 95 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 to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor’s option.

2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.
4.10 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view.

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

1. Apply to concrete surfaces exposed to public view.

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

4.11 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

1. Housekeeping pads: Concrete fill shall be normal weight concrete (3000 psi), reinforced with 4x4-W2.1xW2.1 welded wire mesh set at middepth of pad. Trowel concrete to a dense, smooth finish. Set anchor bolts for securing mechanical or electrical equipment during pouring of concrete fill.

D. Protective slabs ("Mud slabs"): Concrete fill shall be normal weight concrete (2500 psi minimum) with a minimum thickness of 3 1/2". Reinforce protective slabs with 6x6-W2.9xW2.9 welded wire mesh reinforcing. Finish slab to a wood float finish.
4.12 INSTALLATION OF NON-SHRINK GROUT UNDER BASEPLATES

A. Grout under all bearing and baseplates. Comply with manufacturer’s instructions. Do not dry pack.

B. Mixing: Use a mechanical mixer. Add only enough water to make grout placeable. Do not mix more grout than can be used in 20 minutes. Under no circumstances shall grout be retempered.

4.13 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 305.1 for hot-weather protection during curing.

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

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. 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 with the following materials:
   a. Water.
   b. Continuous water-fog spray.
   c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
   a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.

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

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

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

4.14 CONCRETE SURFACE REPAIRS

A. Surface Defects in Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Owner’s approval.

B. Contractor shall submit a detailed, descriptive procedure listing proposed pre-packaged repair materials and methods for the repair of surface defects prior to the start of repair work.

C. Patching Mortar: Mix, place and finish pre-packaged repair mortar in accordance with manufacturer’s instructions.

D. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, minor honeycombs and rock pockets with no exposed reinforcement, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

   1. Immediately after form removal, cut out minor honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete, but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface, 1/4 inch deep minimum. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

   2. Repair defects on surfaces exposed to view using pre-packaged repair mortar so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
E. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include minor spalls, pop outs, honeycombs and rock pockets with no exposed reinforcement, crazing and cracks in excess of 0.01 inch wide that do not penetrate to reinforcement, and other objectionable conditions.

2. After concrete has cured at least 14 days, correct high areas by grinding.

3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.

4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.

5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with patching mortar. Remove defective areas with clean, square cuts, ¼” deep minimum. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Place, compact, and finish patching mortar to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

8. Unapproved and defective repairs shall be removed and replaced in accordance with requirements provided by the Engineer at no additional cost to the Owner.

4.15 STRUCTURAL REPAIRS

A. Structurally Defective Concrete: Structural defects include spalls, honeycombs or rock pockets with exposed reinforcement, hollow-sounding concrete, cracks that penetrate to the reinforcement or completely through concrete elements, inadequate cover over reinforcement, and other conditions that affect the structural performance or durability of the concrete as determined by the Engineer.

B. Repair structural defects in concrete in accordance with plans, specifications, details, etc. provided by the Engineer.

1. The cost of the additional services provided by the Engineer to prepare the repair documents, and to oversee the repair work shall be borne by the Contractor.
C. Unapproved and defective repairs shall be removed and replaced in accordance with requirements provided by the Engineer at no additional cost to the Owner.

4.16 CLEANUP

A. Imperfect or damaged work or any material damaged or determined to be defective before final completion and acceptance of the entire job shall be satisfactorily replaced at the Contractor's expense, and in conformity with all of the requirements of the Drawings and Specifications. Removal and replacement of concrete work shall be done in such manner as not to impair the appearance or strength of the structure in any way.

B. Cleaning: Upon completion of the work all forms, equipment, protective coverings and any rubbish resulting therefrom shall be removed from the site. After sweeping floors, wash floors with clean water. Finished concrete surfaces shall be left in a clean condition, satisfactory to the Owner.

4.17 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner may engage a special inspector and/or a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Inspections may include:

1. Steel reinforcement placement.
2. Steel reinforcement welding.
3. Headed bolts and studs.
4. Verification of use of required design mixture.
5. Concrete placement, including conveying and depositing.
6. Curing procedures and maintenance of curing temperature.
7. Verification of concrete strength before removal of shores and forms from beams and slabs.

C. Concrete Tests: 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 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.
2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.

   a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
3. 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.

4. Air Content: ASTM C 231, pressure method, for normal-weight concrete; 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 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.

6. Compression Test Specimens: ASTM C 31/C 31M.
   a. Cast and laboratory cure four cylinders for each composite sample.
      1) Do not transport field-cast cylinders until they have cured for a minimum of 24 hours.

   a. Test one cylinder at 7 days
   b. Test two cylinders at 28 days
   c. Test one cylinder at 56 days
   d. If 4” by 8” cylinders are used, provide 1 additional cylinder at each stage

8. Strength of each concrete mixture will be satisfactory if every 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.

9. 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.

10. 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.

11. 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. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
   a. When the strength level of the concrete for any portion of the structure, as indicated by cylinder tests, falls below the specified requirements, the Contractor shall provide improved curing conditions and/or adjustments to the mix design as required to obtain the required strength. If the average strength of the laboratory control cylinders falls so low as to be deemed unacceptable, the Contractor shall follow the core test procedure set forth in ACI 301, Section 1.6. Locations of core
tests shall be approved by the Architect. Core sampling and testing shall be at Contractors expense.

b. If the results of the core tests indicate that the strength of the structure is inadequate, any replacement, load testing, or strengthening as may be ordered by the Architect shall be provided by the Contractor without cost to the Owner.

12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

13. Correct deficiencies in the Work that test reports and inspections indicate does not comply with the Contract Documents.

END OF SECTION 03 30 00
SECTION 03 48 15 - PRECAST CONCRETE SITE UTILITY STRUCTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. The Terms and Conditions of the Contract, including Supplementary and Special Conditions of the Contract, and the Drawings apply to this Section.

1.2 SUMMARY
A. Section includes precast concrete site utility structures.

1.3 RELATED WORK
A. Related work of other Sections includes:
1. Section 31 00 00 – Site Earthwork
2. Section 31 50 00 – Excavation Support and Protection

1.4 REFERENCES
A. American Society for Testing and Materials (ASTM), 1916 Race Street, Philadelphia, Pennsylvania 19103, U.S.A. All references are to current active standard
1. ASTM A615 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
2. ASTM A706 – Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement
B. American Concrete Institute (ACI), 38800 Country Club Drive, Farmington Hills, Michigan 48331-3439:
1. ACI 318 – Building Code Requirements for Structural Concrete.
C. American Association of State Highway and Transportation Officials (AASHTO), 444 N Capitol St. NW, Suite 249, Washington, DC 20001

1.5 SUBMITTALS
A. Submit in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.09 SUBMITTALS and UGC Article 8.
B. Shop Drawings:
1. Standard Units
   a. Submit cut sheets for standard precast concrete units, showing conformance to project requirements, and to applicable industry design standards listed in this publication. Cut sheets must include:
      1) Sufficient dimensions to verify that the unit meets the dimensional requirements, including any precast openings, of the unit specified in the plans and specifications.
      2) Design loading.
      3) 28 day concrete compressive strength.
      4) Grade of reinforcement.
   2. Texas Department of Transportation (TxDOT) Units
      a. Submit standard TxDOT detail sheet with any proposed variations clearly indicated.
   3. Construction details of structure frames, covers, and grates.
C. Quality Assurance
   1. QUALITY ASSURANCE in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.10 QUALITY ASSURANCE AND UGC Article 8.
   2. The precaster shall be certified by the National Precast Association (NPCA) or the American Concrete Pipe Association’s Plant Certification Program prior to and during production of products for this project.

1.6 DELIVERY, STORAGE AND HANDLING
A. Delivery
1. Deliver precast units to the site in accordance with the delivery schedule to avoid excessive build-up of units in storage at the site. Upon delivery to the jobsite, all precast units shall be inspected by the Owner’s Designated Representative for quality and final acceptance.

B. Storage
1. Store units off the ground or in a manner that will minimize potential damage.

C. Handling
1. Handle, transport, and store products in a manner to minimize damage. Lifting devices or holes shall be consistent with industry standards. Perform lifting with methods or devices intended for this purpose.

PART 2 - PRODUCTS
2.1 SYSTEM DESCRIPTION
A. Furnish precast concrete units designed and fabricated by an experienced and acceptable precast concrete manufacturer who has, for at least three years, regularly and continuously engaged in the manufacture of precast concrete work similar to that indicated on the drawings. Coordinate precast work with the work of other trades.

B. Standard Precast Units
1. Design standard concrete units to withstand AASHTO H-20 or HS-20 loading conditions, unless otherwise indicated on the drawings.

2.2 CONCRETE MATERIALS
A. Fine and coarse aggregates shall conform to the requirements of ASTM C33 and ACI 318. Aggregates shall be free of deleterious substances causing reactivity with oxidized hydrogen sulfide. Aggregates shall be graded to produce a concrete mix that is homogenous.

B. Cement shall be Portland cement meeting the requirements of ASTM C150.

C. Unless specified on the plans, concrete mixes shall be designed for a 5,000 psi 28-day compressive strength.

2.3 REINFORCING STEEL
A. All bars shall be ASTM A615 of ASTM A706, Grade 60.

PART 3 - EXECUTION
3.1 FABRICATION AND PLACEMENT
A. Perform fabrication in accordance with NPCA QC Manual.

B. Forms
1. Use forms for manufacturing precast concrete products, of the type and design consistent with industry standards and practices. They should be capable of consistently providing uniform products and dimensions. Construct forms so that the forces and vibrations to which the forms will be subjected can cause no product damage. Clean forms of concrete build-up after each use. Apply form release agents according to the manufacturers recommendations and do not allow to build up on the form casting surfaces.

C. Reinforcement
1. Follow applicable ASTM Standard or ACI 318 for placement and splicing. Fabricate cages of reinforcement either by tying the bars, wires or welded wire fabric into rigid assemblies. Position reinforcing as specified by the design and so that the concrete cover conforms to requirements. The tolerance on concrete cover shall be one-third of that specified but not more than 1/2 inch. Provide concrete cover not less than 1/2 inch. Take positive means to assure that the reinforcement does not move significantly during the casting operations.

D. Embedded Items
1. Position embedded items at locations specified in the design documents. Perform welding in accordance with AWS D1.1/D1.1M when necessary. Hold rigidly in place inserts, plates, weldments, lifting devices and other items to be imbedded in precast concrete products so that they do not move significantly during casting operations. Submit product data sheets and proper installation instruction for anchors, lifting inserts and other devices. Clearly indicate the products dimensions and safe working load.

3.2 CONCRETE
A. Concrete Mixing
   1. Mixing operations shall produce batch-to-batch uniformity of strength, consistency and appearance.

B. Concrete Placing
   1. Deposit concrete into forms as near to its final location as practical. Keep the free fall of the concrete to a minimum. Consolidate concrete in such a manner that segregation of the concrete is minimized and honeycombed areas are kept to a minimum. Use vibrators to consolidate concrete with frequencies and amplitudes sufficient to produce well consolidated concrete
   2. Cold Weather Concreting
      a. Perform cold weather concreting in accordance with the requirements of ACI 306.1.
   3. Hot Weather Concreting
      a. Perform hot weather concreting in accordance with the requirements of ACI 305R.

C. Surface Finish
   1. Finish unformed surfaces of wet-cast precast concrete products as specified. If no finishing procedure is specified, finish such surfaces using a strike-off to level the concrete with the top of the form.

D. Stripping Products from Forms
   1. Do not remove products from the forms until the concrete reaches the compressive strength for stripping required by the design. If no such requirement exists, products may be removed from the forms after the final set of concrete provided that stripping damage is minimal.

E. Patching and Repair
   1. No repair is required to formed surfaces that are relatively free of air voids and honeycombed areas, unless the surfaces are required by the design to be finished.
   2. Repairing Minor Defects
      a. Defects that will not impair the functional use or expected life of a precast concrete product may be repaired by any method that does not impair the product.
   3. Repairing Honeycombed Areas
      a. When honeycombed areas are to be repaired, remove all loose material and cut back the areas into essentially horizontal or vertical planes to a depth at which coarse aggregate particles break under chipping rather than being dislodged. Use proprietary repair materials in accordance with the manufacturer's instructions. If a proprietary repair material is not used, saturate the area with water. Immediately prior to repair, the area should be damp, but free of excess water. Apply a cement-sand grout or an approved bonding agent to the chipped surfaces, followed immediately by consolidating an appropriate repair material into the cavity.
   4. Repairing Major Defects
      a. Evaluate, by qualified personnel, defects in precast concrete products which impair the functional use or the expected life of products to determine if repairs are feasible and, if so, to establish the repair procedure.

F. Shipping Products
   1. Do not ship products until they are at least 5 days old, unless it can be shown that the concrete strength has reached at least 75 percent of the specified 28-day strength, or that damage will not result, impairing the performance of the product.

3.3 INSTALLATION
A. Site Access
   1. It is the Contractor's responsibility to provide adequate access to the site to facilitate hauling, storage and proper handling of the precast concrete product.

B. General Requirements
   1. Install precast concrete products to the lines and grades shown in the contract documents or otherwise specified.
2. Lift products by suitable lifting devices at points provided by the precast concrete producer.

3. Install products in accordance with the precast concrete producer’s instructions. In the absence of such instructions, install underground utility structures in accordance with ASTM C891. Install pipe and manhole sections in accordance with the procedures outlined by the American Concrete Pipe Association.

4. Field modifications to the product will relieve the precast producer of liability even if such modifications result in the failure of the product.

C. Water Tightness

1. Where water tightness is a necessary performance characteristic of the precast concrete product’s end use, watertight joints, connectors and inserts should be used to ensure the integrity of the entire system.

END OF SECTION 03 48 15
SECTION 04 22 00 – CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Mortar and grout.
3. Steel reinforcing bars.
5. Miscellaneous masonry accessories.

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for installing anchor sections of adjustable masonry anchors for connecting to structural steel frame.
2. Section 09 30 13 "Ceramic Tiling" for tile finishes applied to unit masonry.
3. Section 09 91 00 "Painting" for paint finishes applied to unit masonry.

1.3 DESCRIPTION OF WORK

A. Extent of each type of reinforced unit masonry work is indicated on drawings and in schedules.

B. Furnish and construct masonry in accordance with the requirements of the Contract Documents including, but not limited to, the following:

1. Furnishing and placing masonry units, grout, mortar, masonry lintels and connectors.
2. Furnishing, erecting and maintaining of bracing, framing, scaffolding, rigging and shoring.
3. Furnishing and installing other equipment for constructing masonry.
4. Cleaning masonry and removing surplus material and waste.
5. Installing lintels, nailing blocks, inserts, windows, door frames, connectors, and construction items to be built into the masonry, and building in items furnished and located by other trades.

1.4 REFERENCES
Standards of the American Concrete Institute, the American Society for Testing and Materials, and the American Welding Society referred to in this Specification are listed below with their serial designations and the latest adoption and revision of each are declared to be part of this Specification as if fully set forth in this document except as modified herein.

A. ACI 117 Standard Specifications for Tolerances for Concrete Construction and Materials
B. ACI 315 Details and Detailing of Concrete Reinforcement
C. ASTM A 36 Specification for Structural Steel
D. ASTM A 82 Specifications for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
E. ASTM A 123 Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
G. ASTM A 185 Specification for Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement
H. ASTM A 615 Specification for A 615M-93 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
I. ASTM A 641 Specification for Zinc-coated (Galvanized) Carbon Steel Wire
J. ASTM A 775 Specification for Epoxy-Coated Reinforcing Steel Bars
K. ASTM C 90 Specification for Load-Bearing Concrete Masonry Units
L. ASTM C 140 Methods of Sampling and Testing concrete Masonry Units
M. ASTM C 143 Test Method for Slump of Hydraulic Cement Concrete
N. ASTM C 270 Specification for Mortar for Unit Masonry
O. ASTM C 476 Specification for Grout for Masonry
P. ASTM C 1019 Test Method for Sampling and Testing Grout
Q. ASTM E 447 Test Methods for Compressive Strength of Masonry Prisms
R. ANSI/AWS D1.4 Structural Welding Code-Reinforcing Steel

1.5 SYSTEM DESCRIPTION

A. Compressive strength requirements - Compressive strength of masonry in each masonry wythe and grouted collar joint shall equal or exceed the applicable f'm.

B. Compressive Strength determination

1. Alternatives for determination of compressive strength - Determine the compressive strength for each wythe by the unit strength method or by the prism test method as specified herein.
2. Unit strength method:
   a. Concrete masonry - Determine the compressive strength of masonry, based on the strength of the unit and the type of mortar specified. The following Articles must be met:
      1. Units conform to ASTM C 55 or ASTM C 90 and are sampled and tested in accordance with ASTM C 140.
      2. Thickness of bed joints does not exceed 5/8 in. (16 mm).
      3. For grouted masonry, the grout meets one of the following requirements:
a. Grout conforms to ASTM C 476.
   b. Grout compressive strength equals f’m but compressive strength is not less than 2000 psi. Determine compressive strength of grout in accordance with ASTM C 1019.

3. Prism test method
   a. Determine the compressive strength of masonry by the prism test method for the following conditions:
      1. When required.
      2. When masonry does not meet the requirements for application of the unit strength method.
   b. A prism test consists of testing three prisms in accordance with ASTM E 447 Method B modified as follows:
      1. Construct prisms in stack bond, one unit long and thick with a full mortar bed.
      2. Construct clay masonry prisms with height to thickness ratios in the range from 2.0 to 5.0.
      3. Construct concrete masonry prisms with height to thickness ratios in the range from 1.33 to 5.0.
      4. Provide a minimum of one joint in hollow unit masonry prisms.
   c. The compressive strength of masonry is the average strength of three prisms, but not more than the strength of the masonry units used in prism construction.
   d. For clay masonry, multiply the compressive strength of masonry by the height to thickness correction factor.

1.6 SUBMITTALS

A. General
   1. Submit the material samples, shop drawings, and documentation as required by this Specification.
   2. Obtain written acceptance of submittals prior to the use of the materials or methods requiring acceptance.
   3. Type and proportions of the ingredients composing the grout mixture(s) to be used in construction.
   4. Test results:
      a. Results of mortar tests performed in accordance with the property specification of ASTM C 270.
      b. Results of tests of masonry units and materials attesting compliance with the specified requirements.
   5. Construction procedures:
      a. Cold weather construction procedures for meeting the requirements of the Project Specifications.
      b. Hot weather construction procedures for meeting the requirements of the Project Specifications.
   6. Manufacturer’s literature.
   7. Shop drawings showing:
a. Fabrication dimensions and locations for placement of the reinforcing steel and accessories.

b. Details of steel reinforcement.

8. Certification of compliance for:
   a. Each type and size of reinforcement to be used in construction, demonstrating compliance with this Specification.
   b. Each type and size of anchors, ties, and metal accessories, demonstrating compliance with this Specification and when required, samples of these items.
   c. Letter certifying that cement conforms to the requirements of the Contract Documents.

9. Weight slips for grout materials at time of delivery.

1.7 QUALITY ASSURANCE

A. Testing laboratory services.

1. General:
   a. Employ an acceptable independent testing laboratory to perform tests to document submittals, certify product compliance prior to use in construction, establish mortar and grout mix designs, provide supporting data for changes requested by the Contractor, or appeal rejection of material found defective by Owner’s tests.
   b. The Work will be inspected and evaluated for compliance with the Contract Documents. Unless otherwise required, these services will be paid for by the Owner.
   c. Permit and facilitate access of the Owner’s representatives to the construction sites and the performance of all activities for quality assurance by these representatives, including inspection and testing required in this Specification.
   d. Failure to detect any defective work or material does not in any way prevent later rejection when a defect is discovered and it does not obligate the Architect/Engineer for final acceptance.

2. Duties and authorities of testing agency designated by the Owner
   a. Representatives of the agency shall inspect, sample, and test the material and shall inspect the construction of masonry in accordance with the Contract Documents. When there is reason to believe that any material furnished or work performed by the Contractor fails to fulfill the requirements of the Contract Documents, report such deficiency to the Architect/Engineer and to the Contractor.
   b. The agency shall report all test and inspection results to the Architect/Engineer and Contractor immediately after they are performed. Include in test reports a summary of conditions under which test specimens were stored prior to testing and state what portion of the construction is represented by each test.
   c. The testing agency and its representatives are neither authorized to revoke, alter, relax, enlarge, or release any requirement of the Contract Documents, nor authorized to approve or accept, reject or disapprove, any portion of the Work.

3. Responsibilities and duties of Contractor
   a. The use of testing services does not relieve the Contractor of the responsibility to furnish materials and construction in full compliance with the Contract Documents.
   b. Include in the submittals the results of all testing performed to qualify the materials and to establish mix designs.
   c. To facilitate testing and inspection, comply with the following:
1. Furnish any necessary labor to assist the designated testing agency in obtaining and handling samples at the project or other sources of material.
2. Advise the designated testing agency sufficiently in advance of operations to allow for completion of quality tests and for the assignment of personnel.
   d. Provide and maintain for the sole use of the testing agency adequate facilities for safe storage and proper curing of test specimens on the project site in accordance with the Contract Documents.

4. Inspection and testing:
   a. Secure production samples of materials at plants or stock piles and test for conformance to the Contract Documents.
   b. Conduct strength tests of masonry units, prisms, and materials for conformance to the Contract Documents.
   c. When required, perform other testing or inspection services.

1.8 DELIVERY, STORAGE AND HANDLING

A. Do not use damaged masonry units, damaged components of structure, or damaged packaged material.

B. Protect moisture controlled, concrete masonry units and cementitious materials from precipitation or ground water.

C. Do not use masonry materials that are contaminated.

D. Store different aggregates separately.

E. Protect reinforcement, ties, and metal accessories from permanent distortions and store them off the ground.

1.9 PROJECT CONDITIONS

A. Construction loads - Do not apply construction loads that exceed the safe superimposed load carrying capacity of the masonry and shores, if used.

B. Masonry protection - Cover top of unfinished masonry work to protect it from the weather.

C. Cold weather construction: No masonry shall be placed when the ambient temperature falls below 40° F.

D. Hot weather construction
   1. Implement the following when the ambient air temperature exceeds the following:
      a. 100° F (38° C), or;
      b. 90° F (32° C) with a wind velocity greater than 8 mph (13 km/h).
   2. Do not spread mortar beds more than 4 ft (1.2 m) ahead of masonry.
   3. Set masonry units within one min. of spreading mortar.
2.1 MORTAR MATERIALS

A. Provide mortar of the type and color specified that conforms to ASTM C 270.

2.2 GROUT MATERIALS

A. Unless otherwise required, provide grout that conforms to the requirements of ASTM C 476. Do not use admixtures unless acceptable.

2.3 MASONRY MATERIALS

A. Provide concrete masonry units that conform to ASTM C 55, C 73, C 90, C 129, or C 744 as specified, Grade N, Type I.

1. Provide units of the dimensions shown on the Drawings.
2. Where dimensions are not shown on the Drawings, provide units having nominal face dimensions of 16” long by 8” high by the depth shown or otherwise required.

2.4 REINFORCEMENT AND METAL ACCESSORIES

A. Reinforcing steel - Provide deformed reinforcing bars that conform to one of the following as specified.

1. ASTM A 615, Grade 60.
2. ASTM A 775.

B. Joint Reinforcement

1. Except as otherwise specified, provide joint reinforcement manufactured with wire conforming to ASTM A 82 and with deformed longitudinal wires. One set of deformations shall occur around the perimeter of the wire at a maximum spacing of 0.7 times the diameter of the wire, but there shall not be less than eight sets per inch of length. The overall length of each deformation within the set shall be such that the sum of gaps between the ends of the deformations shall not exceed 25 percent of the perimeter of the wire. The height or depth of the deformations shall be 0.012 in. (0.30 mm) for wire size W2.8 or larger, 0.011 in. (0.28 mm) for wire size W2.1, and 0.009 in. (0.23 mm) for wire size W1.7. Cross wires are permitted to be plain.
2. Anchors, ties and accessories - Provide anchors, ties, and accessories that conform with the following specifications, except as otherwise specified:
   a. Plate and bent bar anchors       ASTM A 36
   b. Sheet metal anchors and ties     ASTM A 366
   c. Wire mesh ties                   ASTM A 185
   d. Wire ties and anchors           ASTM A 82
   e. Anchor ties                      ASTM A 307, Grade A
3. Coatings for corrosion protection - Unless otherwise required, protect carbon steel joint reinforcement, ties, and anchors from corrosion by hot dip galvanizing in conformance with the following minimum.
   a. Joint reinforcement, interior walls.
      1. ASTM A 641 (0.1 oz/ft²)(0.031 kg/m²)
   b. Joint reinforcement, wire ties, or wire anchors in exterior walls or interior walls exposed to a mean relative humidity exceeding 75 percent.
      1. ASTM A 153 (1.50 oz/ft²)(0.46 kg/m²)
   c. Sheet metal ties or anchors in exterior walls or interior walls exposed to a mean relative humidity exceeding 75 percent.
      1. ASTM A 153, Class B
   d. Sheet metal ties or anchors in interior walls.
      1. ASTM A 525, Class G60
   e. Steel plates and bars (as applicable to size and form indicated).
      1. ASTM A 123 or ASTM A 153, Class B

2.5 ACCESSORIES

A. Unless otherwise required, provide contraction joint material that conforms to one of the following standards:
   2. ASTM D 2287, Type PVC 654-4 PVC shear keys with a minimum durometer hardness of 85.
   3. ASTM C 920.

B. Unless otherwise required, provide expansion joint material that conforms to one of the following standards:
   1. ASTM C 920.
   2. ASTM D 994.

C. Masonry cleaner:
   1. Use potable water and detergents to clean masonry unless otherwise acceptable.
   2. Unless otherwise required, do not use acid or caustic solutions.

D. Joint fillers - Use the size and shape of joint fillers specified.

2.6 MORTAR

A. Ingredients:
1. Portland cement: Comply with ASTM C150, Type I. **White**

2. Limit:
   a. Provide hydrated lime complying with ASTM C207, or quicklime complying with ASTM C5.
   b. When quicklime is used, slake and then screen through a 16 mesh sieve. After slaking and screening, but before using, store and protect for not less than ten days.

3. Aggregate: Provide clean, sharp, well graded aggregate free from injurious amounts of dust, lumps, shale, alkali, surface coatings, and organic matter, and complying with ASTM C144.

4. Admixtures: Do not use admixtures unless specifically approved in advance by the Architect.


B. Mixing:

1. Provide mortar Type “S” and in accordance with ASTM C270.

2. Proportions:
   a. For Type “S” mortar, provide one part Portland cement to 1/2 part hydrated lime and 4-1/2 parts sand by volume.

3. Mix all cementitious materials and aggregates between 3 and 5 min. in a mechanical batch mixer with a sufficient amount of water to produce a workable consistency. Unless acceptable, do not hand mix mortar. Maintain workability of mortar by remixing or re-tempering. Discard all mortar which has begun to stiffen or is not used within 2 1/2 hours after initial mixing.

4. Do not use admixtures containing more than 0.2 percent chloride ions.

2.7 GROUT

A. Ingredients:

1. Portland cement: Comply with ASTM C150, Type I.

2. Aggregate: Provide clean, sharp, well graded aggregate free from injurious amounts of dust, lumps, shale, alkali, surface coatings, and organic matter.

3. Admixtures: Do not use admixtures unless specifically approved in advance by the Architect.


B. Mixing:

1. Unless otherwise required, proportion and mix grout in accordance with the requirements of ASTM C 476.

2. Unless otherwise required, mix grout to a consistency that has a slump between 8 and 11 in. (203 and 279 mm). When tests are required, test grout slump in accordance with ASTM C 143.

3. Provide “fine grout” or “coarse grout” as designated on the Drawings or otherwise directed by the Architect, and in accordance with ASTM C476.
4. Proportions:
   a. For “fine grout,” provide one part Portland cement to 2-1/4 parts minimum to 3 parts maximum of damp loose sand, with sufficient water to achieve fluid consistency.
   b. For “coarse grout,” provide one part Portland cement to 3 parts maximum of damp loose sand to two parts coarse aggregate, with sufficient water to achieve fluid consistency.
   c. “Fluid consistency” is interpreted as meaning as fluid as possible for pouring intimately in place without segregation.

2.8 FABRICATION

A. Reinforcement

1. Fabricate bars used in masonry reinforcement in accordance with the fabricating tolerances of ACI 315.
2. Unless otherwise required, bend bars cold and do not heat bars.
3. The minimum inside diameter of bend for stirrups shall be five bar diameters.
4. The minimum inside bend diameter for other bars is as follows:
   a. No. 3 through No. 8 6 bar diameters
   b. No. 9 through No. 11 8 bar diameters
5. Provide standard hooks that conform to the following:
   a. standard 180 deg hook: 180 deg bend plus a minimum extension of 4 bar diameters or 2 1/2 in. (64 mm), whichever is greater.
   b. A standard 135 deg hook: a 135 deg bend plus a minimum extension of 6 bar diameters or 4 in. (102 mm), whichever is greater.
   c. A standard 90 deg hook: 90 deg bend plus a minimum extension of 12 bar diameters.
   d. For stirrups: a 90 or 135 deg bend plus a minimum of 6 bar diameters or 2 1/2 in. (64 mm), whichever is greater.
6. Fabricate joint reinforcement, anchors, and ties in accordance with the Contract Documents and with the published specifications of the accepted manufacturer.

2.9 SOURCE QUALITY

A. When tests are required, perform tests of masonry units in accordance with the following standards:

1. Concrete masonry ASTM C 140
1. That foundations are constructed with tolerances conforming to the requirements of ACI 117.
2. That reinforcing dowels are positioned in accordance with the Project Drawings.
3. If stated conditions are not met, notify the Architect/Engineer.

3.2 PREPARATION

A. Do not use reinforcement bars with kinks or bends not shown on drawings or final shop drawings, or bars with reduced cross-section due to excessive rusting or other causes.

B. Prior to placing masonry, remove laitance, loose aggregate, and anything else that would prevent mortar from bonding to the foundation.

C. Wetting masonry units: Do not wet concrete masonry units before laying.

D. Debris - Construct grout spaces free of mortar dropping, debris, loose aggregates, and any material deleterious to masonry grout.

E. Reinforcement - Place reinforcement and ties in grout spaces prior to grouting.

F. Cleanouts - Provide cleanouts in the bottom course of masonry for each grout pour, when the grout pour height exceeds 5 ft (1.5 m).

   1. Where required, construct cleanouts adjacent to each vertical bar. In solid grouted masonry, space cleanouts horizontally a maximum of 32 in. (813 mm) on center.
   2. Construct cleanouts with an opening of sufficient size to permit removal of debris. The minimum opening dimension shall be 3 in. (76 mm).
   3. After cleaning, close cleanouts with closures braced to resist grout pressure.

3.3 INSTALLATION, GENERAL

A. Temporary Formwork: Provide formwork and shores as required for temporary support of reinforced masonry elements. Design, erect, support, brace and maintain formwork.

B. Construct formwork to conform to shape, line and dimensions shown. Make sufficiently tight to prevent leakage of mortar grout, or concrete (if any). Brace, tie and support as required to maintain portion and shape during construction and curing of reinforced masonry.

C. Do not remove forms and shores until reinforced masonry member has hardened sufficiently to carry its own weight and all other reasonable temporary loads that may be placed on it during construction.

   1. Allow not less than the following minimum time to elapse after completion of the member before removing shores or forms, provided suitable curing conditions have been obtained during the curing period.
      a. 10 days for girder and beams.
b. 7 days for slabs.
c. 7 days for reinforced masonry soffits.

3.4 INSTALLATION OF REINFORCED CONCRETE UNIT MASONRY

A. General:

1. Do not wet concrete masonry units (CMU).
2. Lay CMU units with full-face shell mortar beds. Fill vertical head joints (end joints between units) solidly with mortar from face of unit to a distance behind face equal to not less than the thickness of longitudinal face shells. Solidly bed cross-webs of starting courses in mortar. Maintain head and bed joint widths shown, or is not shown, provide 3/8" joints.
   a. Where solid CMU units are shown, lay with full mortar head and bed joints.

B. Pattern Bond: Lay CMU wall units in 1/2 running bond with vertical joints in each course centered on units in courses above and below, unless otherwise indicated. Bond and interlock each course at corners and intersections. Use special-shaped units where shown, and as required for corners, jambs, sash, control joints, lintels, bond beams and other special conditions.

C. Maintain vertical continuity of core or cell cavities, which are to be reinforced and grouted, to provide minimum clear dimensions indicated and to provide minimum clearance and grout coverage for vertical reinforcement bars. Keep cavities free of mortar. Solidly bed webs in mortar where adjacent to reinforced cores or cells.

D. Where horizontal reinforced beams (bond beams) are shown, use special units or modify regular units to allow for placement of continuous horizontal reinforcement bars. Place small mesh expanded metal lath or wire screening in mortar joints under bond beam courses over cores or cells of non-reinforced vertical cells, or provide units with solid bottoms.

   1. Option: Where all vertical cores are not shown to be grouted, Contractor may elect to fill all vertical cores with grout. In which case, requirements for mortar bedding of cross-webs and closing of core spaces below bond beams do not apply.

3.5 GROUTING

A. Use "Fine Grout" for filling spaces less than 4" in both horizontal directions.

B. Use "Course Grout" for filling 4" spaces or larger in both horizontal directions.

C. Grouting Technique: At the Contractor's option, use either low-lift or high-lift grouting techniques subject to the requirements which follow.

3.6 LOW-LIFT GROUTING

A. Provide minimum clear dimension of 2" and clear area of 8 sq. in. in vertical cores to be grouted.
B. Place vertical reinforcement prior to laying of CMU. Extend above elevation of maximum pour height as required to allow for splicing. Support in position at vertical intervals not exceeding 192 bar diameters nor 10 ft.

C. Lay CMU to maximum pour height. Do not exceed 4' height, or if bond beam occurs below 4' height stop pour at course below bond beam.

D. Pour grout using container with spout or by chute. Rod or vibrate grout during placing. Place grout continuously; do not interrupt pouring of grout for more than one hour. Terminate grout pours 1-1/2" below top course of pour.

E. Bond Beams: Stop grout in vertical cells 1-1/2" below bond beam course. Place horizontal reinforcement in bond beams; lap at corners and intersections as shown. Place grout in bond beam course before filling vertical cores above bond beam.

3.7 HIGH-LIFT GROUTING

A. Do not use high-lift grouting technique for grouting of CMU unless minimum cavity dimension and area is 3" and 10 sq. in., respectively.

B. Provide cleanout holes in first course at all vertical cells which are to be filled with grout.

C. Use units with one face shell removed and provide temporary supports for units above, or use header units with concrete brick supports, or cut openings in one face shell.

D. Construct masonry to full height of maximum grout pour specified, prior to placing grout.

1. Limit grout lifts to a maximum height of 4' and grout pour to a maximum height of 24', for single wythe hollow concrete masonry walls, unless otherwise indicated.

E. Place vertical reinforcement before grouting. Place before or after laying masonry units, as required by job conditions. Tie vertical reinforcement to dowels at base of masonry where shown and thread CMU over or around reinforcement. Support vertical reinforcement at intervals not exceeding 192 bar diameters nor 10'.

1. Where individual bars are placed after laying masonry, place wire loops extending into cells as masonry is laid and loosen before mortar sets. After insertion of reinforcement bar, pull loops and bar to proper position and tie free ends.

F. Place horizontal beam reinforcement as the masonry units are laid.

G. Embed lateral tie reinforcement in mortar joints where shown. Place as masonry units are laid, at the vertical spacing shown.

H. Preparation of Grout Spaces: Prior to grouting, inspect and clean grout spaces. Remove dust, dirt, mortar drippings, loose pieces of masonry and other foreign materials from grout spaces. Clean reinforcement and adjust to proper position. Clean top surface of structural members supporting masonry to ensure bond. After final cleaning and inspection, close cleanout holes and brace closures to resist grout pressures.
I. Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist displacement of masonry units and breaking or mortar bond. Install shores and bracing, if required, before starting grouting operations.

J. Place grout by pumping into grout spaces unless alternate methods are acceptable to the Architect.

K. Limit group pours to sections which can be completed in one working day with not more than one hour interruption of pouring operation. Place grout in lifts which do not exceed 5'. Allow not less than 30 minutes, nor more than one hour between lifts of a given pour. Rod or vibrate each grout lift during pouring operation.

1. Place grout in lintels or beams over openings in one continuous pour.

L. Where bond beam occurs more than one course below top of pour, fill bond beam course to within 1" of vertically reinforced cavities, during construction of masonry.

M. When more than one pour is required to complete a given section of masonry, extend reinforcement beyond masonry as required for splicing. Pour grout to within 1-1/2" of top course of first pour. After grouted masonry is cured, lay masonry units and place reinforcement for second pour section before grouting. Repeat sequence if more pours are required.

3.8 REINFORCEMENT INSTALLATION

A. Basic requirements - Place reinforcement and accessories in accordance with the sizes, types, and locations indicated on the Project Drawings, and as specified. Do not place dissimilar metals in contact with each other.

B. Securing reinforcement - Support and fasten reinforcement together to prevent displacement by construction loads or by placement of grout or mortar beyond the tolerances allowed.

C. Details of reinforcement:

1. Maintain clear distance between reinforcing bars and any face of masonry unit or formed surface, as indicated on the project drawings, but not less than 1/4 in. (6.4 mm) for fine grout or 1/2 in. (13 mm) for coarse grout.

2. Splice only where indicated on the Project Drawings, unless otherwise acceptable.

3. Unless accepted by the Architect/Engineer, do not bend reinforcement after it is embedded in grout or mortar.

4. Place joint reinforcement so that longitudinal wires are embedded in mortar with a minimum cover of 1/2 in. (13 mm) when not exposed to weather or earth and 5/8 in. (16 mm) when exposed to weather or earth.

D. Wall ties:

1. Embed the ends of wall ties in mortar joints. Embed wall tie ends at least 1/2 in. (13 mm) into the outer face shell of hollow units. Embed wire wall ties at least 1 1/2 in. (38 mm) into the mortar bed of solid masonry units or solid grouted hollow units.
2. Unless otherwise required, bond wythes not bonded by headers with wall ties as follows:

<table>
<thead>
<tr>
<th>Wire Size</th>
<th>Minimum number of ties required</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1.7</td>
<td>One wall tie wire per 2.67 ft² (0.25 m²)</td>
</tr>
<tr>
<td>W2.8</td>
<td>One wall tie wire per 4.50 ft² (0.42 m²)</td>
</tr>
</tbody>
</table>

The maximum spacing between ties in 36 in. (914 mm) horizontally and 24 in. (610 mm) vertically.

3. Unless accepted by the Architect/Engineer, do not bend wall ties after being embedded in grout or mortar.

4. Unless otherwise required, install adjustable ties in accordance with the following requirements.
   a. One tie for each 1.77 ft² (0.16 m²) of wall area.
   b. Do not exceed 16 in. (406 mm) horizontal or vertical spacing.
   c. The maximum misalignment of bed joints from one wythe to the other is 1 1/4 in. (32 mm).
   d. The maximum clearance between connecting parts of the ties is 1/16 in. (1.6 mm).
   e. When pintle legs are used, provide ties with at least two legs made of wire size W2.8.

5. Install wire ties perpendicular to a vertical line on the face of the wythe from which they protrude. Where one-piece ties or joint reinforcement are used, the bed joints of adjacent wythes shall align.

6. Unless otherwise required, provide additional unit ties around all openings larger than 16 inches (406 mm) in either dimension. Space ties around perimeter of opening at a maximum of 3 ft (0.9 m) on center. Place ties within 12 inches (305 mm) of opening.

E. Site tolerances:

1. Tolerances for the placement of steel in walls and flexural elements shall be ±1/2 in. (13 mm) when the distance from the centerline of steel to the opposite face of masonry, d, is equal to 8 in. (203 mm) or less, ±1 in. (25 mm) for d equal to 24 in. (610 mm) or less but greater than 8 in. (203 mm), and ±1 1/4 in. (32 mm) for d greater than 24 in. (610 mm).

2. In walls, for vertical bars, 2 in. (51 mm) from the location along the length of the wall indicated on the Project Drawings.

3. If it is necessary to move bars more than one bar diameter or a distance exceeding the tolerance stated above to avoid interference with other reinforcing steel, conduits, or embedded items, notify the Architect/Engineer for acceptance of the resulting arrangement of bars.

3.9 GROUT PLACEMENT

A. Placing time - Place grout within 1 1/2 hr from introducing water in the mixture and prior to initial set.

B. Confinement - Confine grout to the areas indicated on the Project Drawings. Use material to confine grout that permits bond between masonry units and mortar.
C. Grout pour height - Do not exceed the maximum grout pour height given in Table 5.

D. Grout lift height - Place grout in lifts not exceeding 5 ft (1.5 m).

E. Consolidation - Consolidate grout at the time of placement.

F. Consolidate grout pours 12 in. (305 mm) or less in heights by mechanical vibration or by puddling.

G. Consolidate pours exceeding 12 in. (305 mm) in height by mechanical vibration and reconsolidate by mechanical vibration after initial water loss and settlement has occurred.

3.10 FIELD QUALITY CONTROL

A. When the testing of prisms is required, perform one test prior to construction and perform at least one test during construction of each 5000 ft² (465 m²) of wall area or portion thereof.

B. When required, test mortar in accordance with the property specifications of ASTM C 270 or evaluate in accordance with ASTM C 780.

C. When required, the designated testing agency will sample and test grout in accordance with ASTM C 1019 for each 5000 ft² (465 m²) of masonry wall surface.

3.11 CLEANING

A. Clean exposed masonry surfaces of all stains, efflorescence, mortar or grout droppings, and debris.

END OF SECTION 04 22 00
SECTION 05 12 00 - STRUCTURAL STEEL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Structural steel framing members and connections.
2. Shop prime painting and touch up painting in the field.
3. Temporary construction bracing.
4. Fabrication and erection inspection and testing.

B. Related Sections include the following:

1. Division 1 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.
2. Division 1 Section “Submittals” for administrative requirements for the submission of shop drawings and other submittals.
3. Division 5 Section "Metal Fabrications" for steel lintels or shelf angles not attached to structural-steel frame, miscellaneous steel fabrications and other metal items not defined as structural steel.

1.3 DEFINITIONS

A. Structural Steel: Elements of structural-steel frame, as classified by AISC's "Code of Standard Practice for Steel Buildings and Bridges," that support design loads.

1.4 PERFORMANCE REQUIREMENTS

A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand ASD-service loads indicated and comply with other information and restrictions indicated.

2. Engineering Responsibility: Fabricator's responsibilities include using a qualified professional engineer to prepare structural analysis data for structural-steel connections.
B. Construction: Type PR, partially restrained.

1.5 SUBMITTALS

A. Submit in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.09 SUBMITTALS and UGC Article 8.

B. Submittals for Review

1. Provide complete details and schedules for fabrication and shop assembly of members, erection plans, details, procedures, and diagrams showing sequence of erection of structural steel components.

   a. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
   b. Include embedment drawings.
   c. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
   d. Indicate type, size, and length of bolts, distinguishing between shop and field bolts.

2. Shop drawings and erection drawings shall not be made by using reproductions of Contract Drawings.

3. Structural steel members for which shop drawings have not been reviewed shall not be fabricated. Engineer's review shall cover general locations, spacings, and details of design. Omission from shop drawings of any materials required by the Contract Documents shall not relieve the Contractor of the responsibility of furnishing and installing such materials, even though such shop drawings may have been reviewed and returned.

C. Submittals for Information:

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

2. For structural-steel connections indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

3. Connection Calculations: Contractor shall design all connections not specifically detailed on the Drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State of Texas. Submit design calculations for the connections designed by the contractor, prior to or with the steel shop drawings. Shop drawings containing connections for which calculations have not been received shall be returned unchecked as an incomplete submittal. Calculations shall be retained for the Engineer's file and will not be approved or returned.

   a. Connections shall be designed in accordance with the requirements specified in the Structural Drawings and Specifications.
b. Beam connections: Submit a complete calculation for each different beam connection used and detailed on the shop drawings. Conditions which are similar may be grouped together so as to utilize a single connection design.

c. Submit complete connection calculations for wind brace connections, truss connections, moment connections and other connections where specified on the Contract Drawings. Each calculation shall identify the location or locations for which the connection applies, the member mark(s) from the Contract Documents, the piece mark(s) from the shop drawings, the member size, the design loading(s), member size, and the end of the member to which the connection applies.

d. The unit of measurement for the connection calculations must follow the United States customary system (USCS).

5. Qualification Data: For Installer, fabricator, and testing agency.
6. Mill Test Reports: Signed by manufacturers certifying that the following products comply with requirements:
   a. Structural steel including chemical and physical properties.
   b. Bolts, nuts, and washers including mechanical properties and chemical analysis.
   c. Shop primers.
   d. Nonshrink grout.

7. Source quality-control test reports.

1.6 QUALITY ASSURANCE

A. QUALITY ASSURANCE in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.10 QUALITY ASSURANCE AND UGC Article 8.

B. Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years documented experience.

C. Fabricator Qualifications: Company specializing in performing the work of this section with minimum 10 years of documented experience.

D. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code-Steel."

E. The latest adopted edition of all standards referenced in this Section shall apply unless noted otherwise. In case of conflict between these Contract Documents and the referenced standard, the Contract Documents shall govern. In case of conflict between these Contract Documents and the Building Code, the more stringent shall govern.

F. The Contractor shall furnish fabrication and erection inspection and testing of all welds in accordance with AWS D1.1, Chapter 6. Submit records of inspections and tests to the Owner's testing laboratory for their review. The fabrication and erection inspectors shall be AWS certified welding inspectors.
G. All materials, fabrication procedures and field erection are subject to verification inspection and testing by the Owner's testing laboratory in both the shop and field. Such inspections and tests will not relieve the Contractor of the responsibility for providing materials and fabrication procedures in compliance with specified requirements.

H. Qualifications for Welding Work: Contractor shall be responsible for qualifying welding operators in accordance with the AWS "Standard Qualification Procedure." Provide certification to Owner's testing laboratory that welders to be employed in the work have satisfactorily passed AWS qualification tests. Recertification of welders shall be Contractor's responsibility.

I. Qualification of Welding Procedures: Contractor shall provide the testing laboratory with welding procedures which are to be used. Welding procedures shall be qualified prior to use in accordance with AWS D1.1, Part B.

J. Comply with applicable provisions of the following specifications and documents:

1. AISC's "Code of Standard Practice for Steel Buildings and Bridges"
2. AISC's "Specification for Structural Steel Buildings."
3. ASTM A6 "Specifications for General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use."
4. AISC's "Specification for the Design of Steel Hollow Structural Sections."
5. RCSC's "Specification for Structural Joints Using High Strength Bolts."
6. AWS D1.1 "Structural Welding Code"
7. SSPC (Society for Protective Coatings), standards as noted.

K. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from erosion and deterioration.

1. Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use.
2. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.8 COORDINATION

A. Furnish anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.
PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A 992.

B. Channels, Angles: ASTM A 36.

C. Plate and Bar: ASTM A 36.

D. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.

E. Steel Pipe: ASTM A 53, Type E, Grade B.
   1. Weight Class: As indicated.
   2. Finish: Black, except where indicated to be galvanized.

F. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM F3125, grade A 325, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.
   1. Finish: Plain.

B. High-Strength Bolts, Nuts, and Washers: ASTM A 490, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers, plain.

C. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.

D. Unheaded Anchor Rods: ASTM F 1554, Grade 36.
   5. Finish: Plain.

   3. Finish: Plain.
2.3 PRIMER


B. Galvanizing Repair Paint: ASTM A 780.

C. Cold Galvanizing Compound shall be "ZRC" cold galvanizing compound as manufactured by ZRC Worldwide, Marshfield, Massachusetts.

2.4 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, Grade B, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time, capable of developing a minimum compressive strength of 5,000 psi at 28 days.

2.5 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Comply with fabrication requirements, including tolerance limits, of AISC's "Code of Standard Practice for Steel Buildings and Bridges", AISC's "Specification for Structural Steel Buildings", and as indicated on accepted shop drawings.

1. Camber structural-steel members where indicated.
2. Mill tolerances shall conform to ASTM A6. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
3. Mark and match-mark materials for field assembly.
4. Plates shall be free of gross discontinuities such as ruptures and delaminations. Plates shall comply with ASTM A578, Level 1.
5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.

C. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads. Members in compression joints which depend on contact bearing shall have the bearing surfaces milled to a common plane. Members to be milled shall be completely assembled before milling.
E. Base Plates: Oversize anchor bolt holes in base plates to facilitate erection as specified in Table 14-2 in AISC 360-10.

F. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 1, "Solvent Cleaning, SSPC-SP 2, "Hand Tool Cleaning, or SSPC-SP 3, "Power Tool Cleaning."

G. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

H. Holes: Provide holes required for securing other work to structural steel and for passage of other work through steel framing members.
   1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
   2. Base-Plate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
   3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.6 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM F3125, grade A 325 or grade A 490 Bolts" for type of bolt and type of joint specified.
   1. Joint Type: Snug tightened.
   2. Provide washers over all slotted holes in an outer ply.

B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work. Welds not specified shall be continuous fillet welds designed to develop the full strength of the member. A combination of welds and bolts shall not be used to transmit stress at the same face of any connections. Clean completed welds prior to inspection. Slag shall be removed from all completed welds.

2.7 SHOP PRIMING

A. Shop prime steel surfaces except the following:
   1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
   2. Surfaces to be field welded.
   3. Surfaces to be high-strength bolted with slip-critical connections.
   5. Top surfaces of beams which support composite metal floor deck.
   6. Headed shear studs, although overspray is acceptable.
B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:

1. SSPC-SP 2, "Hand Tool Cleaning."
2. SSPC-SP 3, "Power Tool Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer’s written instructions and at rate recommended by SSPC to provide a dry film thickness of not less than 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.8 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/ A 123M.

1. Fill vent holes and grind smooth after galvanizing.

B. Galvanizing: The following steel shall be hot-dip galvanized (including any associated fasteners):

1. Lintels and shelf angles attached to structural-steel frame and located in exterior walls.
2. Railing exposed to weather.

2.9 SOURCE QUALITY CONTROL

A. Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.

1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

C. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC’s "Specification for Structural Joints Using ASTM F3125, grade A 325 or grade A 490 Bolts."

D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1 and the following inspection procedures, at testing agency’s option:

1. Liquid Penetrant Inspection: ASTM E 165.
2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
4. Radiographic Inspection: ASTM E 94.
E. In addition to visual inspection, shop-welded shear connectors will be tested and inspected according to requirements in AWS D1.1 for stud welding and as follows:

1. Bend tests will be performed if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
2. Tests will be conducted on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments, with steel erector present, for compliance with requirements.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Design of temporary bracing and supports shall be the responsibility of the Contractor. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design," unless closer tolerances are required for proper fitting of adjoining or enclosing materials, in which case the more stringent shall apply.


1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of base plate.
3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate before packing with grout.
4. Promptly pack grout solidly between bearing surfaces and base or bearing plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

5. Grout under baseplates in accordance with Section 033000.


D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated. Any member having a splice not shown and detailed on the accepted shop drawings shall be rejected.

F. Do not field cut or alter structural members without approval of Architect/Engineer. Do not use thermal cutting during erection unless approved by Architect/Engineer. Finish thermally cut sections within smoothness limits in AWS D1.1.

G. Gas Cutting: Do not use gas cutting torches in the field to correct fabrication errors in structural framing.

H. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

I. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM F3125, grade A 325 or grade A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.
2. A307 bolts and high-strength (ASTM F3125, grade A325 and grade A490) bolts noted to be "snug-tight" shall be tightened using a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench, bringing the plies into contact.
3. High-strength bolts which are not specifically designated to be "snug-tight" shall be tightened to provide at least the minimum tension shown in Table 4 of the "Specification
for Structural Joints using ASTM F3125, grade A325 and grade A490 Bolts." Tightening shall be done by the turn-of-the-nut method, with direct tension indicators, or by properly calibrated wrenches.

4. Bolts tightened with a calibrated wrench or by torque control shall have a hardened washer under the element (nut or bolt head) turned in tightening.

5. Hardened washers shall be placed over slotted holes in an outer ply. Hardened beveled washers shall be used where the outer face of the bolted parts has a slope greater than 1:20 with respect to the bolt axis.

B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work. Welds not specified shall be continuous fillet welds designed to develop the full strength of the member. A combination of welds and bolts shall not be used to transmit stress at the same face of any connections. Clean completed welds prior to inspection. Slag shall be removed from all completed welds.


3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.

B. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM F3125, grade A 325 or grade A 490 Bolts."

C. Welded Connections: Field welds will be visually inspected according to AWS D1.1.

1. In addition to visual inspection, field welds will be tested according to AWS D1.1 and the following inspection procedures, at testing agency's option:
   
   a. Liquid Penetrant Inspection: ASTM E 165.
   b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
   c. Ultrasonic Inspection: ASTM E 164.
   d. Radiographic Inspection: ASTM E 94.

D. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1 for stud welding and as follows:

1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1.
E. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.6 REPAIRS AND PROTECTION

A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Touch-up Cold Galvanizing: Touch up areas of hot dip galvanized members where galvanizing has been abraded during shipping and erection and areas where galvanizing has been removed or damaged due to welding. Apply cold galvanizing compound in accordance with the manufacturer's instructions to a minimum dry film thickness of 2.0 mils.

END OF SECTION 05 12 00
SECTION 061000 - ROUGH CARPENTRY

PART 2 - GENERAL

2.1 RELATED DOCUMENTS

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

2.2 SUMMARY

A. Section Includes:

1. Framing with dimension lumber.
2. Wood blocking canters and nailers.
3. Wood sleepers.
4. Plywood backing panels.

B. Related Requirements:

1. Section 061600 "Sheathing" for sheathing, subflooring, and underlayment.

2.3 DEFINITIONS

A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.

B. Dimension Lumber: Lumber of 2 inches nominal size or greater but less than 5 inches nominal size in least dimension.

C. Exposed Framing: Framing not concealed by other construction.

D. OSB: Oriented strand board.

2.4 ACTION SUBMITTALS

A. Submit in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.09 SUBMITTALS and UGC Article 8.

B. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.

3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5664.

4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

C. Fastener Patterns: Full-size templates for fasteners in exposed framing.

2.5 INFORMATIONAL SUBMITTALS

A. Submit in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.09 SUBMITTALS and UGC Article 8.

B. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

C. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated wood.
2. Fire-retardant-treated wood.
3. Engineered wood products.
5. Post-installed anchors.
6. Metal framing anchors.

2.6 QUALITY ASSURANCE

A. QUALITY ASSURANCE in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.10 QUALITY ASSURANCE AND UGC Article 8.

B. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

2.7 DELIVERY, STORAGE, AND HANDLING

A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.
PART 3 - PRODUCTS

3.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.
3. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 15 percent unless otherwise indicated.

C. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.

1. Allowable design stresses, as published by manufacturer, shall meet or exceed those indicated. Manufacturer’s published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

3.2 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
2. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.

D. Application: Treat items indicated on Drawings, and the following:
1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.
5. Wood floor plates that are installed over concrete slabs-on-grade.

3.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.

1. Treatment shall not promote corrosion of metal fasteners.
2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D2898. Use for exterior locations and where indicated.
3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D3201 at 92 percent relative humidity. Use where exterior type is not indicated.
4. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D5664 and design value adjustment factors shall be calculated according to ASTM D6841.

C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent. Kiln-dry plywood after treatment to maximum moisture content of 15 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.

1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.

E. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not bleed through, contain colorants, or otherwise adversely affect finishes.
F. Application: Treat items indicated on Drawings.

3.4 DIMENSION LUMBER FRAMING

A. Joists and Rafters: As indicated on drawings.

3.5 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Rooftop equipment bases and support curbs.
5. Furring.

B. Dimension Lumber Items: match grade and species of joist and rafter framing.

C. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

D. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

E. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

3.6 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: As indicated on drawings.

3.7 FASTENERS

A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture.

1. All fasteners shall be Type 316 Stainless Steel.

B. Nails, Brads, and Staples: ASTM F1667.
C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities
having jurisdiction, based on ICC-ES AC70.

3.8 METAL FRAMING ANCHORS

A. Allowable design loads, as published by manufacturer, shall meet or exceed those indicated
Manufacturer's published values shall be determined from empirical data or by rational
engineering analysis and demonstrated by comprehensive testing performed by a qualified
independent testing agency. Framing anchors shall be punched for fasteners adequate to
withstanding same loads as framing anchors.

B. Stainless Steel Sheet: ASTM A666, Type 316

C. Joist Ties: Flat straps, with holes for fasteners, for tying joists together over supports.

1. Width: As indicated.
2. Thickness: As indicated.
3. Length: As indicated.

D. Rafter Tie-Downs: Bent strap tie for fastening rafters or roof trusses to wall studs below, 1-1/2
inches wide by 0.050 inch thick.

PART 4 - EXECUTION

4.1 INSTALLATION, GENERAL

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame
Construction," unless otherwise indicated.

B. Framing with Engineered Wood Products: Install engineered wood products to comply with
manufacturer's written instructions.

C. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and
fitted. Fit rough carpentry accurately to other construction. Locate nailers, blocking and similar
supports to comply with requirements for attaching other construction.

D. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring
backing panels.

E. Install metal framing anchors to comply with manufacturer's written instructions. Install
fasteners through each fastener hole.

F. Install sill sealer gasket to form continuous seal between sill plates and foundation walls.

G. Do not splice structural members between supports unless otherwise indicated.
H. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.

I. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

J. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

K. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

L. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
3. ICC-ES evaluation report for fastener.

M. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

N. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.

1. Comply with indicated fastener patterns where applicable.
2. Use finishing nails unless otherwise indicated. Countersink nail heads and fill holes with wood filler.
3. Use common nails unless otherwise indicated. Drive nails snug but do not countersink nail heads.
4.2 WOOD BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

4.3 CEILING JOIST AND RAFTER FRAMING INSTALLATION

A. Rafters: Notch to fit exterior wall plates and use metal framing anchors. Double rafters to form headers and trimmers at openings in roof framing, if any, and support with metal hangers. Where rafters abut at ridge, place directly opposite each other and nail to ridge member or use metal ridge hangers.

1. At valleys, provide double-valley rafters of size indicated or, if not indicated, of same thickness as regular rafters and 2 inches deeper. Bevel ends of jack rafters for full bearing against valley rafters.

2. At hips, provide hip rafter of size indicated or, if not indicated, of same thickness as regular rafters and 2 inches deeper. Bevel ends of jack rafters for full bearing against hip rafter.

B. Provide collar beams (ties) as indicated or, if not indicated, provide 1-by-6-inch nominal size boards between every third pair of rafters, but not more than 48 inches o.c. Locate below ridge member, at third point of rafter span. Cut ends to fit roof slope and nail to rafters.

C. Provide special framing as indicated for eaves, overhangs, dormers, and similar conditions if any.

4.4 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000
SECTION 061600 - SHEATHING

PART 2 - GENERAL

2.1 RELATED DOCUMENTS

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

2.2 SUMMARY

A. Section Includes:
   1. Roof sheathing.

B. Related Requirements:
   1. Section 061000 "Rough Carpentry" for plywood backing panels.
   2. Section 072500 "Weather Barriers" for water-resistant barrier applied over wall sheathing.

2.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Review air-barrier and water-resistant glass-mat gypsum sheathing requirements and installation, special details, transitions, mockups, air-leakage testing, protection, and work scheduling that covers air-barrier and water-resistant glass-mat gypsum sheathing.

2.4 ACTION SUBMITTALS

A. Submit in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.09 SUBMITTALS and UGC Article 8.

B. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
   1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
   2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
3. For fire-retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5516.

4. For products receiving waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

5. For air-barrier and water-resistant glass-mat gypsum sheathing, include manufacturer's technical data and tested physical and performance properties of products.

C. Shop Drawings: For air-barrier and water-resistant glass-mat gypsum sheathing assemblies.

1. Show locations and extent of sheathing, accessories, and assemblies specific to Project conditions.

2. Include details for sheathing joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.

3. Include details of interfaces with other materials that form part of air barrier.

2.5 INFORMATIONAL SUBMITTALS

A. Submit in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.09 SUBMITTALS and UGC Article 8.

B. Qualification Data: For Installer.

C. Product Certificates: From air-barrier and water-resistant glass-mat gypsum sheathing manufacturer, certifying compatibility of sheathing accessory materials with Project materials that connect to or that come in contact with the sheathing.

D. Product Test Reports: For each air-barrier and water-resistant glass-mat gypsum sheathing assembly, indicating compliance with specified requirements, for tests performed by a qualified testing agency.

E. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated plywood.

2. Fire-retardant-treated plywood.

F. Field quality-control reports.

2.6 QUALITY ASSURANCE

A. QUALITY ASSURANCE in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.10 QUALITY ASSURANCE AND UGC Article 8.

B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer of air-barrier and water-resistant glass-mat gypsum sheathing.
1. Installer shall be licensed by ABAA according to ABAA's Quality Assurance Program and shall employ ABAA-certified installers and supervisors on Project.

C. Testing Agency Qualifications:

1. For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

2. For testing and inspecting agency providing tests and inspections related to air-barrier and water-resistant glass-mat gypsum sheathing: an independent agency, qualified according to ASTM E329 for testing indicated, and certified by Air Barrier Association of America, Inc.

2.7 HANDLING

A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 3 - PRODUCTS

3.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: As tested according to ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

B. Air-Barrier and Water-Resistant Glass-Mat Gypsum Sheathing Performance: Air-barrier and water-resistant glass-mat gypsum sheathing assembly, and seals with adjacent construction, shall be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

3.2 WOOD PANEL PRODUCTS

A. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.

B. Factory mark panels to indicate compliance with applicable standard.
3.3 PRESERVATIVE-TREATED PLYWOOD

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.

C. Application: Treat all plywood unless otherwise indicated.

3.4 ROOF SHEATHING

A. Plywood Sheathing: As indicated on drawings.

B. Oriented-Strand-Board Sheathing: As indicated on drawings.

3.5 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. For roof sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A153.

B. Nails, Brads, and Staples: ASTM F1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Screws for Fastening Sheathing to Wood Framing: ASTM C1002.

E. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

F. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.

1. For steel framing less than 0.0329-inch-thick, use screws that comply with ASTM C1002.
2. For steel framing from 0.033 to 0.112-inch-thick, use screws that comply with ASTM C954.

G. Screws for Fastening Composite Nail Base Insulated Roof Sheathing to Metal Roof Deck: Steel drill screws, in type and length recommended by sheathing manufacturer for thickness of...
sheathing to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B117. Provide washers or plates if recommended by sheathing manufacturer.

### 3.6 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

#### A. Sealant for Paper-Surfaced Gypsum Sheathing: Elastomeric, medium-modulus, neutral-curing silicone joint sealant compatible with joint substrates formed by gypsum sheathing and other materials, recommended by sheathing manufacturer for application indicated and complying with requirements for elastomeric sealants specified in Section 079200 "Joint Sealants."

#### B. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.

1. **Sheathing Tape: Self-adhering glass-fiber tape**, minimum 2 inches wide, 10 by 10 or 10 by 20 threads/inch, of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.

#### C. Sheathing Tape for Foam-Plastic Sheathing: Pressure-sensitive plastic tape recommended by sheathing manufacturer for sealing joints and penetrations in sheathing.

### PART 4 - EXECUTION

#### 4.1 INSTALLATION, GENERAL

#### A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

#### B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

#### C. Securely attach to substrate by fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in the ICC's International Building Code.
2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in the ICC's International Residential Code for One- and Two-Family Dwellings.
3. ICC-ES evaluation report for fastener.

#### D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.
E. Coordinate roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

4.2 WOOD STRUCTURAL PANEL INSTALLATION


B. Fastening Methods: Fasten panels as indicated below:
   1. Wall and Roof Sheathing:
      a. Nail to wood framing.
      b. Space panels 1/8 inch apart at edges and ends.

4.3 FIELD QUALITY CONTROL

A. ABAA Quality Assurance Program: Perform examinations, preparation, installation, testing, and inspections under ABAA's Quality Assurance Program.

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

C. Inspections: Air-barrier and water-resistant glass-mat gypsum sheathing, accessories, and installation are subject to inspection for compliance with requirements.

D. Air barriers will be considered defective if they do not pass tests and inspections.

E. Repair damage to air barriers caused by testing; follow manufacturer’s written instructions.

F. Prepare test and inspection reports.

END OF SECTION 061600
SECTION 06 20 00 - FINISH CARPENTRY

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Exterior wood trim.
2. Wood soffits.
3. Interior wood ceilings.
4. Insect screenings.
5. Acrylic panels.
6. Interior wood trim, including non-fire-rated interior door frames.

B. Related Requirements:

1. Section 06 10 00 "Rough Carpentry" for furring, blocking, and other carpentry work not exposed to view and for framing exposed to view.

1.3 ACTION SUBMITTALS

A. Submit in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.09 SUBMITTALS and UGC Article 8.

B. Product Data: For each type of process and factory-fabricated product. Indicate component materials, dimensions, profiles, textures, and colors and include construction and application details.

1. Include data for wood-preservative treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained. Include chemical-treatment manufacturer's written instructions for finishing treated material.
2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced before shipment to Project site to levels specified.

C. Samples: For each exposed product and for each color and texture specified.

D. Samples for Initial Selection: For each type of product involving selection of colors, profiles, or textures.
E. Samples for Verification:

1. For each species and cut of lumber and panel products, with half of exposed surface finished; 50 sq. in. for lumber and 8 by 10 inches for panels.

1.4 INFORMATIONAL SUBMITTALS

A. Submit in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.09 SUBMITTALS and UGC Article 8.

B. Compliance Certificates:

1. For lumber that is not marked with grade stamp.
2. For preservative-treated wood that is not marked with treatment-quality mark.

C. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated wood.

D. Sample Warranties: For manufacturer’s warranties.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber, plywood, and other panels flat with spacers between each bundle to provide air circulation.

1. Protect materials from weather by covering with waterproof sheeting, securely anchored.
2. Provide for air circulation around stacks and under coverings.

B. Deliver interior finish carpentry materials only when environmental conditions comply with requirements specified for installation areas. If interior finish carpentry materials must be stored in other than installation areas, store only where environmental conditions comply with requirements specified for installation areas.

1.6 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecast weather conditions permit work to be performed and at least one coat of specified finish can be applied without exposure to rain, snow, or dampness.

B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.

1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.
PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with applicable rules of any rules-writing agency certified by the American Lumber Standard Committee's (ALSC) Board of Review. Grade lumber by an agency certified by the ALSC's Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of inspection agency, indicating grade, species, moisture content at time of surfacing, and mill.
2. For exposed lumber, mark grade stamp on end or back of each piece, or omit grade stamp and provide certificates of grade compliance issued by inspection agency.

B. Softwood Plywood: DOC PS 1.

C. Hardboard: ANSI A135.4.

2.2 INSECT SCREENING

A. Products:

1. McNICHOLS Wire Mesh, Square, Stainless Steel, Type 304, Mill Finish, Woven - Plain Weave, 12 x 12 Mesh (Square), 0.0603” x 0.0603” Opening (Square), 0.023” Thick (24 Gauge) Wire Diameter, 52% Open Area, or equal.

B. Mock-up

1. Establish standards by which work will be judged. Install at project site a job mock-up using acceptable products and manufacturer approved installation methods. Obtain Owner’s and Architect’s acceptance and workmanship standard. Provide mock-up of one complete window screen comprising of jambs, head and sill.

2.3 EXTERIOR TRIM

A. Lumber Trim for Clear Finish:

1. Species and Grade: Western red cedar; NLGA, WCLIB, or WWPA Grade A.
2. Maximum Moisture Content: 19 percent
3. Finger Jointing: Not allowed
4. Face Surface: Surfaced (smooth).

2.4 LUMBER SOFFITS/INTERIOR CEILINGS

A. Provide kiln-dried lumber siding complying with DOC PS 20.
B. Species and Grade: Western red cedar; NLGA, WCLIB, or WWPA Grade A

C. Pattern: Tongue & Grove, 1” x 6”.

2.5 WOOD PANELING AT FOYER RECESS

A. Provide kiln-dried lumber siding complying with DOC PS 20.

B. Species and Grade: Western red cedar; NLGA, WCLIB, or WWPA Grade A

C. Pattern: Tongue & Grove, 1” x 6”, Clear Finish.

2.6 INTERIOR DOOR FRAMES AND JAMBS

A. Architectural Woodwork Standards Grade: Premium.

B. Wood Species and Cut: Match species and cut indicated for other types of transparent-finished architectural woodwork located in same area of building unless otherwise indicated.

1. Species: Select Cypress; Grade A.
2. Cut: Plain sliced/plain sawn.
3. Wood Moisture Content: 8 to 13 percent.

2.7 INTERIOR WOOD WINDOW ACRYLIC PANEL/ WIRE MESH SCREEN FRAMES AND JAMBS

A. Architectural Woodwork Standards Grade: Premium.

B. Wood Species and Cut: Match species and cut indicated for other types of transparent-finished architectural woodwork located in same area of building unless otherwise indicated.

1. Species: WESTERN RED CEDAR; NLGA, WCLIB, or WWPA Grade A.
2. Cut: Plain sliced/plain sawn.
3. Wood Moisture Content: 8 to 13 percent.

C. Mock-up

1. Establish standards by which work will be judged. Install at project site a job mock-up using acceptable products and manufacturer approved installation methods. Obtain Owner’s and Architect’s acceptance and workmanship standard. Provide mock-up of one complete window screen comprising of jambs, head and sill.

2.8 UTILITY SHELVING

B. Utility Shelving Framing: Lumber with 19 percent maximum moisture content of any of the following species and grades:

1. Eastern white pine, Idaho white, lodgepole, ponderosa, or sugar pine; No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
2. Mixed southern pine or southern pine; No. 1 grade; SPIB.
3. Hem-fir or hem-fir (north); No. 1 Common grade; NLGA, WCLIB, or WWPA.
4. Spruce-pine-fir (south) or spruce-pine-fir; Select or No. 1 Common grade; NeLMA, NLGA, WCLIB, or WWPA.

C. Standards for Adjustable Shelf Supports: BHMA A156.9, B04071; zinc-plated steel.

D. Adjustable Shelf Supports: BHMA A156.9, B04081 or B04091; zinc-plated steel.

2.9 ACRYLIC PANELS

A. Basis of Design: Regal Plastics clear textured acrylic sheeting, Clear DP-30, 1/4” thickness; 1/16” radius edges.

B. Mock-up

1. Establish standards by which work will be judged. Install at project site a job mock-up using acceptable products and manufacturer approved installation methods. Obtain Owner’s and Architect’s acceptance and workmanship standard. Provide mock-up of one complete window screen comprising of jambs, head and sill.

2.10 MISCELLANEOUS MATERIALS

A. Fasteners for Exterior Finish Carpentry: Provide nails or screws, in sufficient length to penetrate not less than 1-1/2 inches into wood substrate.

1. For face-fastening siding, provide hot-dip galvanized-steel siding nails.
2. For applications not otherwise indicated, provide hot-dip galvanized-steel fasteners.

B. Wood Glue: Waterproof resorcinol glue recommended by manufacturer for exterior carpentry use.

C. Flashing: Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim" for flashing materials installed in exterior finish carpentry.

D. Sealants: Latex, complying with ASTM C834 Type OP, Grade NF and applicable requirements in Section 079200 "Joint Sealants," and recommended by sealant and substrate manufacturers for intended application.
E. Fasteners for Interior Finish Carpentry: Nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.


G. Multipurpose Construction Adhesive: Formulation, complying with ASTM D3498, that is recommended for indicated use by adhesive manufacturer.

2.11 FABRICATION

A. Back out or kerf backs of standing and running trim wider than 5 inches, except members with ends exposed in finished work.
   1. Interior standing and running trim, except shoe and crown molds.
   2. Wood-board paneling.

B. Ease edges of lumber less than 1 inch in nominal thickness to 1/16-inch radius and edges of lumber 1 inch or more in nominal thickness to 1/8-inch radius.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of projections and substances detrimental to application.

B. Prime lumber and moldings to be painted, including both faces and edges, unless factory primed.
   1. Cut to required lengths and prime ends.
   2. Comply with requirements in Section 099113 "Exterior Painting."
3.3 INSTALLATION, GENERAL

A. Do not use materials that are unsound, warped, improperly treated or finished, inadequately seasoned, or too small to fabricate with proper jointing arrangements.

1. Do not use manufactured units with defective surfaces, sizes, or patterns.

B. Install finish carpentry level, plumb, true, and aligned with adjacent materials.

1. Use concealed shims where necessary for alignment.
2. Scribe and cut exterior finish carpentry to fit adjoining work.
3. Refinish and seal cuts as recommended by manufacturer.
4. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining exterior finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.
5. Coordinate finish carpentry with materials and systems in or adjacent to it.
6. Provide cutouts for mechanical and electrical items that penetrate finish carpentry.

3.4 INSTALLATION OF STANDING AND RUNNING TRIM

A. Install flat-grain lumber with bark side exposed to weather.

B. Install trim with minimum number of joints as is practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches long, except where necessary.

1. Use scarf joints for end-to-end joints.
2. Stagger end joints in adjacent and related members.
3. Do not use pieces less than 24 inches long, except where necessary.
4. Miter at returns, miter at outside corners, and cope at inside corners to produce tight-fitting joints with full-surface contact throughout length of joint.
5. Plane backs of casings to provide uniform thickness across joints where necessary for alignment.
6. Match color and grain pattern of trim for transparent finish (stain or clear finish) across joints.
7. Install trim after gypsum-board joint finishing operations are completed.
8. Install without splitting; drill pilot holes before fastening where necessary to prevent splitting.
9. Fasten to prevent movement or warping.
10. Countersink fastener heads on exposed carpentry work and fill holes.

C. Fit exterior joints to exclude water.

1. Cope at returns and miter at corners to produce tight-fitting joints, with full-surface contact throughout length of joint.
2. Plane backs of casings to provide uniform thickness across joints, where necessary for alignment.
D. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.

3.5 SHELVING INSTALLATION

A. Cut shelf cleats at ends of shelves about 1/2 inch less than width of shelves and sand exposed ends smooth.
   1. Install shelf cleats by fastening to framing or backing with finish nails or trim screws, set below face and filled.
   2. Space fasteners not more than 16 inches o.c. Use two fasteners at each framing member or fastener location for cleats 4 inches nominal (89 mm actual) in width and wider.
   3. Apply a bead of multipurpose construction adhesive to back of shelf cleats before installing.
   4. Remove adhesive that is squeezed out after fastening shelf cleats in place.

B. Install shelf brackets according to manufacturer's written instructions, spaced not more than 32 inches o.c. Fasten to framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors.

C. Install standards for adjustable shelf supports according to manufacturer's written instructions. Fasten to framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors. Space fasteners not more than 12 inches o.c.

D. Install standards for adjustable shelf brackets according to manufacturer's written instructions, spaced not more than 36 inches o.c. and within 6 inches of ends of shelves. Fasten to framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors.

E. Cut shelves to neatly fit openings with only enough gap to allow shelves to be removed and reinstalled.
   1. Install shelves, fully seated on cleats, brackets, and supports.
   2. Fasten shelves to cleats with finish nails or trim screws, set flush.
   3. Fasten shelves to brackets to comply with bracket manufacturer's written instructions.

3.6 ADJUSTING

A. Replace exterior finish carpentry that is damaged or does not comply with requirements.
   1. Exterior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

B. Adjust joinery for uniform appearance.
3.7 CLEANING

A. Clean exterior finish carpentry on exposed and semi-exposed surfaces.

B. Touch up factory-applied finishes to restore damaged or soiled areas.

3.8 PROTECTION

A. Protect installed products from damage from weather and other causes during construction.

B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.

1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 06 20 13
SECTION 06 61 00 - SOLID SURFACING COUNTERTOPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Solid surface material countertops.
   2. Solid surface material backsplashes.
   3. Solid surface material apron fronts.

B. Related Requirements:
   1. Section 22 40 00 "Plumbing Fixtures" for sinks and plumbing fittings.
   2. Section 05 00 00 "Metal Fabrications" for steel countertop support brackets.

1.3 SUBMITTALS

A. Submit in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.09 SUBMITTALS and UGC Article 8.

B. Product Data: Manufacturer's technical literature for each product indicated, specified, or required for countertop materials. Include manufacturer's written fabrication and instructions.

C. Shop Drawings: Dimensioned and detailed plans, elevations, and large-scale details. For countertops.
   1. Show locations of each component.
   2. Show materials, finishes, edge and splash profiles, and locations, methods, and details of joints.
   3. Show locations and sizes of cutouts and holes for plumbing fixtures, accessories and other items installed in counter tops.
   4. Show direction of directional pattern, if any.
   5. Show attachment devices and other components to be incorporated into work.

D. Samples for Initial Selection: For each type of material exposed to view submittal sample showing manufacturer's full range of colors and patterns.
E. Samples for Verification: 6 inch square sample of selected material, in specified gloss, cut into 2 pieces and then joined together to represent an inconspicuous seam.

F. MAINTENANCE DATA:
   1. Information for inclusion in maintenance manual required in Division 01.
   2. Include manufacturer's instructions for maintenance of installed work, including methods and frequency recommended for maintaining optimum condition under anticipated use.
   3. Include precautions against cleaning products and methods which may be detrimental to finishes and performance.

G. WARRANTY:
   1. Warranty per UGC Article 13 and Special Conditions 1.14.
   2. Provide sample copy of manufacturer's written warranty.

1.4 QUALITY ASSURANCE

A. Quality Assurance in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.10 QUALITY ASSURANCE and UGC.

B. Fabricator Qualifications:
   1. Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project.
   2. Record of successful in-service performance.
   3. Sufficient production capability, facilities, and personnel to produce required work.

C. Installer Qualifications:
   1. Experienced in installation of specified work similar to scope of this Project.
   2. Record of successful in-service performance.
   3. Sufficient installation capability, facilities, and personnel to produce required work.

D. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and execution.
   1. Build mockup of typical countertop as shown on Drawings.
   2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 FIELD CONDITIONS

A. Field Measurements:
1. Where components are indicated to fit other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings.

2. Locate concealed framing, blocking, and reinforcements that support components by field measurements before enclosed, and indicate measurements on Shop Drawings.

3. Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabrication without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.6 COORDINATION

A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

1.7 DELIVERY, STORAGE AND HANDLING

A. Delivery: Do not deliver components until painting and similar activities have completed in installation areas.

B. Storage: Prior to installation, store in areas in which material will be installed.

C. Handling: Handle components to prevent damage to finished surfaces.

1.8 WARRANTY

A. Manufacturer's Warranty: Provide manufacturer's warranty against defects in materials. Warranty shall provide material and labor to repair or replace defective materials. Damage caused by physical or chemical abuse or damage from excessive heat will not be warranted. Failures caused improper fabrication or installation will not be warranted.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements of Contract Documents, manufacturers offering products that may be incorporated into work include, but are not limited to, those indicated below:

1. Avonite, Inc.; Avonite Surfaces.
4. LG Chemical, Ltd. Hi-Macs.
5. US Surface Warehouse; LivingStone.
2.2 SOLID SURFACING MATERIAL

A. Sheet Material:
   1. Description: Continuously cast, non-porous, homogeneous solid sheets composed of acrylic polymer, aluminum trihydrate filler, and pigments that yield through-body color; not coated, laminated or of composite construction.
   3. Basis-of-Design Product:
      b. Color & Patterns: Terra Nova.
      c. Finish: Satin or semi-glass.

B. Integral Sink/Bowls:
   1. Description: Cast, non-porous, homogeneous solid sheets of filled plastic resin with through-body colors; not coated, laminated, or of composite construction.
   2. Integral Sink Bowls: Comply with CSA B45.5/IAPMO Z124.
   3. Basis-of-Design Product:
      b. Type: Oval Vanity Bowl, V-130.

2.3 ACCESSORIES

A. Joint Adhesives: Description: No-added uera-formaldehyde, 1 or 2 part adhesive capable of creating inconspicuous, non-porous seams; acceptable to material manufacturer.

B. Fasteners and Mounting Hardware: Hot-dipped, galvanized steel angles as indicated on the Drawings, and specified in Section 05 00 00 "Metal Fabrications."

C. Protective Tape: Heat-reflective aluminum foil or insulating felt tape of thickness necessary to protect edges from heat sources.

2.4 FABRICATION

A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."
   1. Grade: Premium.

B. Shop Assembly:
   1. Fabricate shapes in sizes and profiles indicated according to approved shop drawings and manufacturer's instructions.
   2. To the greatest extent practical assemble countertops and supports in shop.
3. Where necessary for fitting at Project, provide ample allowance for scribing, trimming, and fitting.

C. Seams:
   1. Form inconspicuous joints between components.
   2. Reinforced on concealed side with strip of solid surfacing material not less than 1 inch on either side of joint by same thickness as components being joined.
   3. Locate more than 3 inches cutouts.

D. Cutouts:
   1. Use router to make openings according to templates and finish with clean and smooth edges.
   2. Provide not less than 1/8 inch clearance between cutout edges and appliance or plumbing fixture.
   3. Remove nicks and scratches.

E. Overhangs: Support overhangs that are more than 6 inches.

F. Thermoforming:
   1. Heat component and maintain between 275 and 325 degrees Fahrenheit during forming.
   2. Form pieces to shape prior to seaming and joining.
   3. Cut pieces to finished dimensions.
   4. Sand edges and remove nicks and scratches.

G. Integral Sink/Bowls: Secure sinks/bowls to countertops using manufacturer's recommended sealant, adhesive, or mounting hardware.

H. Configuration:
   1. General Provisions:
      a. Fabricate with loose backsplashes for field assembly.
      b. Accurately cut holes and drill countertop panels to receive plumbing, fixtures, soap dispensers, and other accessories.
      c. Install integral sink bowls in countertops in shop.
   2. Front: Straight, slightly eased at top with separate apron, 6 inches (150 mm) high, recessed 1/4-inch (6.4-mm) behind front edge.
   4. End Splash: None.

I. Countertops: 1/2-inch- (12.7-mm-) thick, solid surface material with front edge built up with same material.

J. Backsplashes: 1/2-inch- (12.7-mm-) thick, solid surface material.
K. Joints: Fabricate countertops without joints.

2.5 INSTALLATION MATERIALS

A. Adhesive: Product recommended by solid surface material manufacturer.

B. Sealant for Countertops: Comply with applicable requirements in Section 07 92 00 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to receive solid surface material countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Starting work within a particular area will be construed as acceptance of surface conditions.

3.2 INSTALLATION

A. General: Install countertop plumb, level, and scribed to adjacent substrates. Install countertops level to a tolerance of 1/8 inch in 10 feet (3 mm in 3.048 m). Do not exceed 1/64-inch (0.4-mm) difference between planes of adjacent units.

B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

C. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.

D. Secure countertops to subtops with adhesive according to solid surface material manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

E. Bond seams with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.

1. Clean surfaces to be seamed to remove oil, dirt, and dust.
2. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's instructions.

3. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width. Retain clamps until fully cured.

4. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

5. Buff and sand to produce a smooth uniform seamless surface.

6. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.

7. Install aprons to backing and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears. Fasten by screwing through backing. Predrill holes for screws as recommended by manufacturer.

8. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.

9. Apply sealant to gaps at walls; comply with Section 07 92 00 "Joint Sealants."

### 3.3 CLEANING

A. Surface Finish:

1. Remove stains according to manufacturer's instructions.
2. Sand and polish to remove nicks, scratches, and other imperfections.

### 3.4 PROTECTION

A. Coverings: Cover installed components to prevent physical damage or staining until substantial completion.

END OF SECTION 06 61 00
SECTION 07 13 10 – CEMENTITIOUS WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Flexible cementitous protective & waterproofing coating / membrane to be applied to exterior face of CMU wall surfaces.

1.3 PERFORMANCE REQUIREMENTS

A. Provide waterproofing that prevents the passage of water but is vapor permeable and can be color tinted.

1.4 SUBMITTALS

A. Submit in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.09 SUBMITTALS and UGC Article 8.

B. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data and tested physical and performance properties of waterproofing.

C. Shop Drawings: Show locations and extent of waterproofing. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing and other termination conditions.

D. Samples: For the following products:
   1. 12-by-12-inch square of waterproofing and flashing sheet.

E. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.
F. Product Test Reports: From a qualified independent testing agency indicating and interpreting test results of waterproofing for compliance with requirements, based on comprehensive testing of current waterproofing formulations.

G. Sample Warranty: Copy of special waterproofing manufacturer's and Installer's warranty stating obligations, remedies, limitations and exclusions before starting waterproofing.

1.5 QUALITY ASSURANCE

A. Quality Assurance in accordance with TPWD Division 1 – Section 01000 – Special Conditions, Section 1.10 Quality Assurance and UGC.

B. Installer Qualifications: A qualified installer who is authorized or licensed by and acceptable to waterproofing manufacturer to install manufacturer's products.

C. Source Limitations: Obtain waterproofing materials through one source from a single manufacturer.

D. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination". Review requirements for waterproofing, including surface preparation specified under other Sections, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures, testing and inspection procedures, and protection and repairs.

1.6 DELIVERY, STORAGE AND HANDLING

A. Store rolls according to manufacturer's written instructions.

B. Protect stored materials from direct sunlight.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.

1. Do not apply waterproofing in snow, rain, fog, or mist.

B. Maintain adequate ventilation during preparation and application of waterproofing materials.

1.8 WARRANTY
A. Warranty per UGC Article 13 and Special Conditions 1.14.

B. Special Manufacturer's Warranty: Written warranty, signed by waterproofing manufacturer agreeing to replace waterproofing material that does not comply with requirements or that does not remain watertight during specified warranty period.

   1. Warranty Period: Five (5) years after date of Substantial Completion.

C. Special Installer's Warranty: Written waterproofing Installer's warranty, signed by Installer, covering Work of this Section, for warranty period of two years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the following products:

   1. Flexible Cementitous Waterproofing:
      a. Basis-Of-Design Product: ARDEX 8+9, or pre-approved equivalent.

         1) Provide and install as per manufacturers written recommendations. Provide all manufacturer required products, admixtures (including coloring admixtures) & accessories.

2.2 MOLDED-SHEET DRAINAGE PANELS

A. Cetco “Aqua Drain” drainage and protection course. Install as per manufacturers written recommendations. Provide all auxiliary materials required and/or recommended by manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas and conditions, with Installer and manufacturers representative present, for compliance with requirements and other conditions affecting performance, prior to installation of waterproofing membranes.

3.2 SURFACE PREPARATION

A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide dry substrates for waterproofing application.
3.3 PROTECTION AND CLEANING

A. Protect waterproofing from damage and wear during remainder of construction period.

B. Protect installed membrane from damage due to ultraviolet light, harmful weather exposures, physical abuse and other causes.

C. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 07 13 10
SECTION 07 19 16 - SILANE WATER REPELLENTS

PART 1 - GENERAL

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

1.2 SUMMARY
A. This Section includes penetrating, non film-forming water-repellent coatings for the following vertical and horizontal surfaces:
   1. Interior & exterior exposed concrete, concrete masonry units, and clay tile masonry.
B. Related Sections include the following:
   1. Division 07, Section "Joint Sealants" for compatibility with specified joint sealants.
   2. Division 09, Section "Painting" for paints and coatings.
C. Products and manufacturers submitted as equivalents must be approved, in writing, by Architect prior to project bidding.

1.3 SUBMITTALS
A. Submit in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.09 SUBMITTALS and UGC Article 8.
B. Comply with Section 01 30 00.
C. Product Data: For each type of product indicated.
D. Samples: For each type of water repellent and substrate indicated, in size, with specified water-repellent treatment applied to half of each Sample.
E. Manufacturer Certificates: Signed by manufacturers certifying that water repellents comply with requirements.
F. Qualification Data: For Applicator.
G. Pre-construction Testing Reports: For water-repellent-treated substrates.
H. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for assemblies.

I. Warranty:
   1. Warranty per UGC Article 13 and Special Conditions 1.14.
   2. Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

A. Quality assurance per UGC Article 8 and Special Conditions 1.10.

B. Applicator Qualifications: Company with minimum of 5 years experience in application of specified products on projects of similar size and scope, and is acceptable to product manufacturer

   1. Successful completion of a minimum of 5 projects of similar size and complexity to specified Work.

C. Test Application: Apply a finish sample for each type of water repellent and substrate required. Duplicate finish of approved sample.

   1. Locate each test application as directed by Architect.
   2. Size: 96 inches x 96 inches.
   3. Final approval by Architect of water-repellent application will be from test applications.
   4. Test application will be standard for judging workmanship on remainder of Project.
   5. Maintain test application during construction for workmanship comparison.
   6. Do not alter, move, or destroy test application until Work is completed and approved by Architect.
   7. Obtain Architect’s written approval of test application before start of material application, including approval of aesthetics, color, texture, and appearance.

1.5 PROJECT CONDITIONS

A. Limitations: Proceed with application only when the following existing and forecasted weather and substrate conditions permit water repellents to be applied according to manufacturers' written instructions and warranty requirements:

   1. Apply sealer with surface, air, and material temperatures between 40 and 110 degrees F (4 and 43 degrees C) during application.
   2. Do not apply in rain or when rain is expected within 12 hours. Do not apply below 40 degrees F (4 degrees C) or when temperatures are expected to fall below 40 degrees F (4 degrees C) within 12 hours.
1.6 DELIVERY, STORAGE AND HANDLING
   A. Comply with manufacturer’s ordering instructions and lead-time requirements to avoid construction delays.
   B. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
   C. Store in unopened containers in a clean, dry area between 35 degrees F (2 degrees C) and 110 degrees F (43 degrees C).

1.7 WARRANTY
   A. Special Warranty: Manufacturer's standard form in which manufacturer and Applicator agree(s) to repair or replace materials that fail to maintain water repellency specified in Part 1 "Performance Requirements" Article within specified warranty period.
      1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
   A. Available Products: Subject to compliance with requirements, provide products from the following manufacturer:
      1. BASF Corporation, Construction Chemicals

2.2 MATERIALS
   A. Penetrating Water Repellent: Clear, water-based, 40 percent alkylalkoxysilane penetrating sealer providing protection against moisture intrusion, freeze/thaw cycles, and chloride intrusion.
      1. Basis-of-Design Product: MasterProtect H 400 (formerly Enviroseal 40) by BASF.
   B. Water-repellent sealer shall have the following minimum performance:
      1. Composition: Alkylalkoxysilane in water.
      2. Compliance: Alberta DOT, Type 1b.
      3. Flash Point, ASTM D3278: Greater than 200 degrees F (93 degrees C).
         a. 48 Hours: 0.42 percent.
         b. 50 Days: 1.2 percent.
5. Scaling Resistance Rating, ASTM C672, non-air-entrained concrete, 100 cycles treated concrete: 0; no scaling.
7. Resistance to Chloride-Ion Penetration, AASHTO T259 and T260 Water Weight Gain, NCHRP 244 Series II Cube Test: 85 percent reduction, exceeds criteria.
8. Absorbed Chloride, NCHRP 244 Series II Cube Test: 87 percent reduction, exceeds criteria.
9. Absorbed Chloride, NCHRP 244 Series IV Southern Climate: 99 percent reduction, exceeds criteria.
10. Water Repellent Performance, Alberta Transportation and Utilities Procedures Type 1b:
    a. Initial Performance: 89 percent.
    b. Post-Abrasion Performance: 89.4 percent.
11. Solids and Active Ingredients: 40 percent by weight.
12. Specific Gravity, 77 degrees F (25 degrees C): 0.95.
13. Density: 7.9 lbs per gal.
14. Penetration, average depth, depending upon substrate: 0.24 inches (6.1 mm).
15. VOC Content (EPA method 24): Less than 2.93 lbs per gal (350 g/L), less water and exempt solvents.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrate of substances that might interfere with penetration or performance of water repellents. Test for moisture content, according to water-repellent manufacturer's written instructions, to ensure that surface is dry enough.

B. Test for pH level, according to water-repellent manufacturer's written instructions, to ensure chemical bond to silicate minerals.

C. Protect adjoining work, including sealant bond surfaces, from spillage or blow-over of water repellent. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of water repellent being deposited on surfaces. Cover live plants and grass.

D. Coordination with Sealants: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.
   1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those used in the work.
3.2 APPLICATION

A. Apply a heavy-saturation spray coating of water repellent on surfaces indicated for treatment using low-pressure spray equipment. Comply with manufacturer's written instructions for using airless spraying procedure, unless otherwise indicated.

B. Apply a second saturation spray coating, repeating first application. Comply with manufacturer's written instructions for limitations on drying time between coats and after rainstorm wetting of surfaces between coats. Consult manufacturer's technical representative if written instructions are not applicable to Project conditions.

3.3 CLEANING

A. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Repair damage caused by water-repellent application. Comply with manufacturer's written cleaning instructions.

3.4 PROTECTION

A. Protect sealer from damage during construction.

END OF SECTION 07 19 16
SECTION 07 21 00 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Mineral-wool blanket, wall insulation in sloped roof sections.

1.3 REFERENCES

A. Test Method for Breaking Load and Flexural Properties of Block-Type Thermal Insulation ASTM C203
B. Test Method for Compressive Properties of Rigid Cellular Plastics ASTM D1621
C. Test Method for Apparent Density of Rigid Cellular Plastics ASTM D1622
D. Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging ASTM D2126
E. Test Method for Water Vapor Transmission of Materials ASTM E96/E96M

1.4 SUBMITTALS

A. Submit in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.09 SUBMITTALS and UGC Article 8.
B. Product Data: For each type of product indicated.
C. Samples for Verification: Full-size units for each type of exposed insulation indicated.
D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product verifying qualities of insulation components meet or exceed specified requirements.
E. Manufacturers printed installation instructions for each type of material to be used.

F. Samples: Submit the following material samples:
   1. 12” square insulation panels of each type and thickness of insulation specified.
   2. Thru-wall flashing minimum of 12” long and of width specified.

G. Research/Evaluation Reports: For foam-plastic insulation, from ICC-ES.

1.5 QUALITY ASSURANCE

A. Quality Assurance per UGC Article 8 and Special Conditions 1.10.

B. Source Limitations: Provide each type of building insulation and related accessories from one single manufacturer.

C. Installer Qualifications:
   1. Contractor shall provide evidence of having completed 3 projects of similar size and scope in the past 3 years.
   2. Contractor shall provide evidence of certification by the rigid insulation manufacturer as having been properly trained in the proper installation of the submitted products.

D. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer’s written instructions for handling, storing, and protecting during installation.

B. Protect foam-plastic board insulation as follows:
   1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
   2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
   3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.
PART 2 - PRODUCTS

2.1 MINERAL-WOOL BLANKETS

A. Mineral-Wool Blanket, Unfaced: ASTM C665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 0 and 0, respectively, per ASTM E84; passing ASTM E136 for combustion characteristics.
   1. Thickness: Nominal 6-inches.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. Rockwool, Comfortbatt™.
   2. Owens Corning, Thermafiber.
   4. Or other equivalent insulation.

2.2 MISCELLANEOUS INSULATION

A. Insulation for Miscellaneous Voids:
   1. Mineral-Wool Board, Types IVA, Unfaced, Safing Insulation: ASTM C612, Types IVA; with maximum flame-spread and smoke-developed indexes of zero and zero, respectively, per ASTM E84; Non-Combustible at 750° per ASTM E136 for combustion characteristics. Nominal density of 4.4 lb/cu. ft. (70 kg/cu. m) per ASTM C303. Moisture Sorption ≥ 0.03% per ASTM C1104.
      a. Rockwool; Roxul Safe™45.
      b. Owens Corning; Thermafiber® Safing.
      c. Or approved equal.
   2. Spray Polyurethane Foam Insulation: ASTM C 1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.
3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Abut wall insulation tightly together both horizontally and vertically, and at all openings.

D. Extend insulation to envelop entire area to be insulated. Fit tightly between masonry wall ties and around obstructions. Fill all voids with insulation. Remove projections that interfere with placement.

E. Provide sizes to fit applications and selected from manufacturer’s standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

A. Mineral-Wool Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.

2. Install batt insulation without visible voids, gaps or separations. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members. Cut and trim insulation neatly to fit spaces without laps, bulges or folds. Use batts free of rips and tears.

3. Fit insulation tight within spaces and tight to and behind mechanical and electrical wiring.

4. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.

5. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

3.4 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 07 21 00
SECTION 07 54 19 - POLYVINYL-CHLORIDE (PVC) ROOFING

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Mechanically fastened, polyvinyl chloride (PVC) roofing system.
   2. Roof insulation.
   3. Cover board.
   4. Walkways.
   5. 24 ga PVC coated galvalume drip edge
B. Section includes installation of sound-absorbing insulation strips in ribs of roof deck. Sound-absorbing insulation strips are furnished under Section 05 31 00 "Steel Decking."
C. Related Requirements:
   1. Section 06 10 00 "Rough Carpentry" for wood nailers, curbs, and blocking; and for wood-based, structural-use roof deck panels.
   2. Section 07 62 00 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
   3. Section 07 72 00 "Roof Accessories" for roof install equipment.
   4. Section 07 92 00 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.
   5. Section 22 14 23 "Storm Drainage Piping Specialties" for roof drains.

1.3 DEFINITIONS
A. Roofing Terminology: Definitions in ASTM D1079 and glossary in NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to work of this Section.

1.4 PREINSTALLATION MEETINGS
A. Pre-installation Roofing Conference: Conduct conference at Project Site.
   1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer’s representative, deck...
Installer, air barrier Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.

2. Review methods and procedures related to roofing installation, including manufacturer’s written instructions.

3. Review and finalize construction schedule, and verify availability of materials, Installer’s personnel, equipment, and facilities needed to make progress and avoid delays.

4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.

5. Review structural loading limitations of roof deck during and after roofing.

6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.

7. Review governing regulations and requirements for insurance and certificates if applicable.

8. Review temporary protection requirements for roofing system during and after installation.

9. Review roof observation and repair procedures after roofing installation.

1.5 ACTION SUBMITTALS

A. Submit in accordance with TPWD Division 1 – Section 01000 – Special Conditions Section 1.09 Submittals and UGC Article 8.

B. Product Data: For each type of product.

1. For roofing system assembly, including cover board, insulation, and roof system component fasteners, include copy of Texas Department of Insurance (TDI) listing.

C. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:

1. Layout and thickness of insulation.
2. Base flashings and membrane terminations.
3. Flashing details at penetrations.
4. Tapered insulation thickness and slopes.
5. Roof plan showing orientation of steel roof deck and orientation of roof membrane, fastener spacing, and patterns for mechanically fastened roofing system. Submittal shall include calculations and drawings from Engineer, Registered in the State of Texas, indicating size, spacing, fastening patterns, and other installation details verifying compliance with performance requirements for the roofing assembly as indicated herein.
6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
7. Tie-in with air barrier.

D. Samples for Verification: For the following products:

1. Roof membrane and flashing, of color required.
2. Walkway pads or rolls, of color required.
E. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

1.6 INFORMATIONAL SUBMITTALS

A. Submit in accordance with TPWD Division 1 – Section 01000 – Special Conditions Section 1.09 Submittals and UGC Article 8.

B. Qualification Data: For Installer and manufacturer.

C. Manufacturer Certificates:
      a. Submit evidence of compliance with performance requirements.
   2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

D. Product Test Reports: For roof membrane and insulation, tests performed by independent qualified testing agency indicating compliance with specified requirements.

E. Evaluation Reports: For components of roofing system, from ICC-ES.

F. Field Test Reports:
   1. Concrete internal relative humidity test reports.
   2. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.

G. Field quality-control reports.

H. Sample Warranties: For manufacturer's special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Closeout per UGC 12 and Special Conditions 1.13. Warranty per UGC Article 13 and Special Conditions 1.14.

B. Inspection Report: Copy of roofing system manufacturer's inspection report of completed roofing installation.

C. Windstorm Inspection Forms: Copies of Texas Department of Insurance (TDI) Inspection Verification (WPI-2-BC-5) and Application of Certification of Compliance (WPI-1) Forms
indicating completed roofing installation meet TDI requirements for Texas Windstorm Insurance Association.

D. Maintenance Data: For roofing system to include in maintenance manuals.

E. Project Record Documents: Accurately record exact location of all roof membrane.

F. Warranties: Executed Warranties.

1.8 QUALITY ASSURANCE

A. Quality Assurance per UGC Article 8 and Special Conditions 1.10.

B. Manufacturer Qualifications: A qualified manufacturer that is listed in FM Approvals' RoofNav for roofing system identical to that used for this Project.

C. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.10 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.
1.11 WARRANTY

A. Warranty per UGC Article 13 and Special 1.14.

B. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Special warranty includes roof membrane, base flashings, roof insulation, fasteners, cover boards, substrate board, and other components of roofing system.
2. Warranty Period: Fifteen (15) years from date of Substantial Completion.

C. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of roofing system such as roof membrane, base flashing, roof insulation, fasteners, cover boards, and walkway products, for the following warranty period:

1. Warranty Period: Two (2) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Installed roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roof system and flashings shall remain watertight.

1. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.
2. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D3746, ASTM D4272/D4272M, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.

B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.

C. Roofing System Design: Provide membrane roofing system that is identical to system that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE/SEI 7:

2. Perimeter Uplift Pressure: -71.3 lbf/ sq.ft.
3. Field-of-Roof Uplift Pressure: -46.0 lbf/ sq.ft.
5. Internal Pressure Coefficient, Gcpi: +/- 0.55.
6. Exposure Category: C.
7. Risk Category: II.

D. Energy Performance: Roofing system shall have an initial solar reflectance of not less than 0.70 and an emissivity of not less than 0.75 when tested according to CRRC-1.

E. Exterior Fire-Test Exposure: ASTM E108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

2.2 POLYVINYL CHLORIDE (PVC) ROOFING

   1. Basis-of-Design Product: Subject to compliance with requirements, provide Duro-Last Roofing, Inc; Duro-Last 40 Mil Membrane. or a comparable product by one of the following:
      a. Johns Manville; a Berkshire Hathaway company.
      b. Sarnafil, Inc.
      c. Siplast
   2. Thickness: 40 mils (1.0 mm).

B. Source Limitations: Obtain components for roofing system from roof membrane manufacturer.

2.3 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.
   1. Adhesives and Sealants: Comply with VOC limits of authorities having jurisdiction.

B. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as PVC sheet.

C. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.

D. Roof Vents: As recommended by roof membrane manufacturer.
   1. Size: Not less than 4-inch (100-mm) diameter.

E. Bonding Adhesive: Manufacturer's standard low VOC solvent-based adhesive.

F. Slip Sheet: Manufacturer's standard, of thickness as required for application.
G. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.

H. Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05 inch thick (25 mm wide by 1.3 mm thick), pre-punched.

I. Fasteners: 1716.1.2.1 Non-Conditioned Spaces (ASTM A167, A123, A153, A653, A641, B695, or B633) 1716.1.2.2. Conditioned spaces (ASTM A899) Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance, designed for fastening roofing components to substrate, as acceptable to roofing system manufacturer, and as tested to meet performance requirements.

J. Distribution Plates: 3" round, plates formed from a minimum 24 gauge G-90 C.Q. steel with a galvalume coating.

K. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.4 ROOF INSULATION

A. General: Preformed roof insulation boards manufactured, or approved, by PVC roof membrane manufacturer, and approved for use in TDI listed roof assemblies.

B. Polysocyanurate Board Insulation: ASTM C1289, Type II, Class 2, Grade 2, felt or glass-fiber mat facer on both major surfaces.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Firestone Building Products; "Resista" board insulation, or a comparable product by one of the following:
   a. Carlisle SynTec Incorporated.
   b. Dyplast Products.
   c. GAF.
   d. Johns Manville; a Berkshire Hathaway company.
   e. Or approved equal.

2. Compressive Strength: 24 psi (172kPa).

3. Size: 48 by 48 inches (1219 by 1219 mm).

4. Board Thickness:
   a. Base Layer: 2.3 inches (58.42 mm), w/ R = 14.0.
   b. Upper Layers: 2.3 inches (58.42 mm), w/ R = 14.0.


C. Tapered Insulation: Provide factory-tapered insulation boards where indicated.
1. Material: Match roof insulation.
3. Slope:
   a. Roof Field: 1/4 inch per foot (1:48) where indicated on Drawings.
   b. Saddles and Crickets: 1/2 inch per foot (1:24) where indicated on Drawings.

### 2.5 INSULATION ACCESSORIES

A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with other roofing system components.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.

C. Insulation Adhesive: Insulation manufacturer’s recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:
   1. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.

D. Cover Board: ASTM C1177/C1177M, glass-mat, water-resistant gypsum board or ASTM C1278/C1278M fiber-reinforced gypsum board.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Georgia-Pacific Gypsum LLC; Dens Deck or a comparable product by one of the following:
      b. USG Corporation.
   2. Thickness: 1/2 inch (13 mm).

### 2.6 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads, approximately 3/16 inch (5 mm) thick and acceptable to roofing system manufacturer.
   1. Size: Approximately 36 by 60 inches (914 by 1524 mm).

### 2.7 PVC COATED GAVALUME DROP EDGE

A. 24 gauge galvalume prefabricated drip edge with factory welded skirt that is compatible with the PVC roof membrane.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 05 31 00 "Steel Decking."

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing system installation according to roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

C. Perform fastener-pullout tests according to roof system manufacturer's written instructions.

1. Submit test result within 24 hours of performing tests.
   a. Include manufacturer's requirements for any revision to previously submitted fastener patterns required to achieve specified wind uplift requirements.

3.3 INSTALLATION OF ROOFING, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions, and Texas Department of Insurance (TDI) listed roof assembly requirements.

B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

C. Install roof membrane and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition and to not void warranty for existing roofing system.
D. Coordinate installation and transition of roofing system component serving as an air barrier with air barrier specified under Section 07 27 26 "Fluid-Applied Membrane Air Barriers."

3.4 INSTALLATION OF INSULATION

A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at end of workday.

B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.

C. Installation Over Metal Decking:

1. Install base layer of insulation with joints staggered not less than 24 inches (610 mm) in adjacent rows, end joints staggered not less than 12 inches (305 mm) in adjacent rows, and with long joints continuous at right angle to flutes of decking.
   a. Locate end joints over crests of decking.
   b. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
   c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
   d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
   e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).
      1) Trim insulation so that water flow is unrestricted.
   f. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
   g. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
   h. Loosely lay base layer of insulation units over substrate.

2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches (305 mm) from previous layer of insulation.
   a. Staggered end joints within each layer not less than 24 inches (610 mm) in adjacent rows.
   b. Install with long joints continuous and with end joints staggered not less than 12 inches (305 mm) in adjacent rows.
   c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
   d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
   e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).
   f. Trim insulation so that water flow is unrestricted.
g. Fill gaps exceeding 1/4 inch (6 mm) with insulation.

h. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.

i. Loosely lay each layer of insulation units over substrate.

j. Mechanically attach base layer of insulation using mechanical fasteners and distribution plates specifically designed and sized for fastening specified board-type roof insulation to metal decks.

1) Fasten insulation according to requirements in roofing system manufacturer's written instructions, and Texas Department of Insurance (TDI) listed roof assembly requirements.

2) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.

3.5 INSTALLATION OF COVER BOARDS

A. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches (150 mm) in each direction.

1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.

2. At internal roof drains, conform to slope of drain sump.
   a. Trim cover board so that water flow is unrestricted.

3. Cut and fit cover board tight to nailers, projections, and penetrations.

4. Mechanically fasten cover boards over area to receive roofing according to roofing system manufacturer's written instructions.

B. As required by manufacturer, install slip sheet over cover board and immediately beneath roof membrane.

3.6 INSTALLATION OF ADHERED ROOF MEMBRANE

A. Adhere roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.

B. Unroll roof membrane and allow to relax before installing.

C. Start installation of roofing in presence of roofing system manufacturer's technical personnel, the Contractor, and Owner's representative.

D. Accurately align roof membrane, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
E. Bonding Adhesive: Apply to substrate and underside of roof membrane at rate required by manufacturer, and allow to partially dry before installing roof membrane. Do not apply to splice area of roof membrane.

F. Fabric-Backed Roof Membrane Adhesive: Apply to substrate at rate required by manufacturer, and install fabric-backed roof membrane.

G. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeter of roofing.

H. Apply roof membrane with side laps shingled with slope of roof deck where possible.

I. Seams: Clean seam areas, overlap roofing, and hot-air weld side and end laps of roof membrane and sheet flashings to ensure a watertight seam installation.
   1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roof membrane and sheet flashings.
   2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
   3. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.

J. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

3.7 INSTALLATION OF MECHANICALLY FASTENED ROOF MEMBRANE

A. Mechanically fasten roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.

B. Unroll roof membrane and allow to relax before installing.

C. For in-splice attachment, install roof membrane with long dimension perpendicular to steel roof deck flutes.

D. Start installation of roofing in presence of roofing system manufacturer's technical personnel, the Contractor, and Owner's representative.

E. Accurately align roof membrane, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

F. Mechanically fasten or adhere roof membrane securely at terminations, penetrations, and perimeter of roofing.

G. Apply roof membrane with side laps shingled with slope of roof deck where possible.

H. In-Seam Attachment: Secure one edge of PVC sheet using fastening plates or metal battens centered within seam, and mechanically fasten PVC sheet to roof deck.
I. **Seams**: Clean seam areas, overlap roof membrane, and hot-air weld side and end laps of roof membrane and sheet flashings to ensure a watertight seam installation.

   1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roof membrane and sheet flashings.
   2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
   3. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.

J. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

3.8 **INSTALLATION OF BASE FLASHING**

A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.9 **INSTALLATION OF WALKWAYS**

A. **Flexible Walkways**: Install walkway products according to manufacturer's written instructions.

   1. Install flexible walkways at the following locations:
      
      a. Perimeter of each rooftop unit.
      b. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
      c. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
      d. Top and bottom of each roof access ladder.
      e. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
      f. Locations indicated on Drawings.
      g. As required by roof membrane manufacturer's warranty requirements.

   2. Provide 6-inch (76-mm) clearance between adjoining pads.
3. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to inspect substrate conditions, surface preparation, roof membrane application, sheet flashings, protection, and drainage components, and to furnish reports to Architect.

B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion, in presence of Architect, and to prepare inspection report.

C. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.11 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.12 ROOFING INSTALLER'S WARRANTY

A. WHEREAS _______________________________ of ____________________________, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:

1. Owner: <Insert name of Owner>.
2. Address: <Insert address>.
3. Building Name/Type: <Insert information>.
4. Address: <Insert address>.
5. Area of Work: <Insert information>.
6. Acceptance Date: _________________.

7. Warranty Period: <Insert time>.
8. Expiration Date: ________________.

B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,

C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period Roofing Installer will, at Roofing Installer’s own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.

D. This Warranty is made subject to the following terms and conditions:

1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:
   a. lightning;
   b. peak gust wind speed exceeding in accordance with performance requirements indicated herein;
   c. fire;
   d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
   e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
   f. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.

2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.

3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.

4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.

6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.

7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this __________ day of ____________________, ________________.

1. Authorized Signature: ________________________________________.
2. Name: ________________________________________.
3. Title: ________________________________________.

END OF SECTION 07 54 19
SECTION 07 61 13 - STANDING-SEAM METAL ROOF PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. The scope of work includes the installation of a complete “turnkey” standing seam metal roof system complete with all fascia, trim, gutters and downspouts

B. This Section includes:
   1. Standing-seam metal roof panels.
   2. Roof flashing Trim and drip edge.

C. Roof System Components: The project incorporates standing seam metal roof panels over 1/2" plywood sheathing.

D. Related Sections:
   1. Section 06 10 00 - Rough Carpentry for plywood sheathing.

1.3 PREINSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at Project site.

   1. Meet with Owner, Architect, Owner’s insurer if applicable, metal panel Installer, metal panel manufacturer’s representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of roof accessories and roof-mounted equipment.
   2. Review and finalize construction schedule and verify availability of materials, Installer’s personnel, equipment, and facilities needed to make progress and avoid delays.
   3. Review methods and procedures related to metal panel installation, including manufacturer’s written instructions.
   4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
   5. Review structural loading limitations of deck and rafters during and after roofing.
   6. Review flashings, special details, drainage, penetrations, equipment curbs, and condition of other construction that affect metal panels.
7. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
8. Review temporary protection requirements for metal panel systems during and after installation.
10. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.4 ACTION SUBMITTALS

A. Submit in accordance with TPWD Division 1 – Section 01000 – Special Conditions Section 1.09 Submittals and UGC Article 8.

B. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

C. Shop Drawings: Show layouts of metal panels. Include details of each condition of installation, panel profiles, and attachment to building. Provide details at a minimum scale 1-1/2-inch per foot of edge conditions, joints, fastener and sealant placement, flashings, openings, penetrations, roof accessories, lightning arresting equipment, and special details. Make distinctions between factory and field assembled work
   1. Include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   2. Indicate points of supporting structure that must coordinate with metal panel system installation.
   3. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
   4. Include data indicating compliance with performance requirements.
   5. Verify location of structural members and openings in substrates by field measurements before fabrication and indicate measurements on Shop Drawings.
   6. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.

D. Samples for Initial Selection: For each exposed product specified including sealants. Provide representative color charts of manufacturer’s full range of colors with factory-applied color finishes.
   1. Include similar Samples of trim and accessories involving color selection.

E. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
1. Metal Panels: 18 inches long by actual panel width. Include clips, fasteners, closures, and other metal panel accessories.

1.5 INFORMATIONAL SUBMITTALS

A. Submit in accordance with TPWD Division 1 – Section 01000 – Special Conditions 1.09 Submittals and UGC Article 8.

B. Qualification Data: For Installer.

C. Product Test Reports: For each product, for tests performed by a qualified testing agency.

D. Field quality-control reports.

E. Manufacturer's Warranty: Sample copy of manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Closeout per UGC 12 and Special Conditions 1.13.

B. Maintenance Data: For metal panels to include in maintenance manuals.

C. Manufacturer's Warranty: Executed copy of manufacturer's special warranty.

1.7 QUALITY ASSURANCE

A. Quality Assurance per UGC Article 8 and Special Conditions 1.10.

B. Manufacturer/Source: Provide metal roof panel assembly and accessories from a single manufacturer providing fixed-base roll forming, and accredited under IAS AC 472 Part B.

C. Manufacturer Qualifications: Approved manufacturer listed in this Section with minimum five years experience in manufacture of similar products in successful use in similar applications.

D. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal panels during installation.

1.9 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.10 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

B. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.11 WARRANTY

A. Warranty per UGC Article 13 and Special Conditions 1.14.

B. Special Weathertight Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace roof panels that fail to remain weathertight within twenty (20) years from date of Final Acceptance (Substantial Completion).

1. Failures include, but are not limited to, the following:
   a. Structural failures including rupturing, cracking, or puncturing.
   b. Deterioration of metals and other materials beyond normal weathering.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
1. Wind Loads: Determine loads based on uniform pressure, importance factor, exposure category, and basic wind speed indicated on the Structural Drawings.
2. Snow Loads: 0 lbf/sq. ft.
3. Deflection Limits: For wind loads, no greater than 1/240 of the span.
4. Hail Resistance: SH.

B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) when tested according to ASTM E 1680 at the following test-pressure difference:

C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 1646 at the following test-pressure difference:

D. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E 2140.

E. Thermal Movements: Allow for thermal movements from variations in both ambient and internal temperatures. Accommodate movement of support structure caused by thermal expansion and contraction. Allow for deflection and design for thermal stresses caused by temperature differences from one side of the panel to the other.

2.2 STANDING-SEAM METAL ROOF PANELS

A. General: Provide mechanically-lock, Concealed Fastener, Metal Roof Panels: Structural metal roof panel consisting of formed metal sheet with vertical ribs at panel edges, installed by lapping and mechanically interlocking edges of adjacent panels, and attaching panels to supports using concealed clips and fasteners in a weathertight installation.

B. Metal Roof Panels: Formed with vertical ribs at panel edges and a flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging opposite edge of adjacent panels, and mechanically seaming panels together.

1. Basis-of-Design Product: McElroy Metal Medallion-Lok metal roof panels, or subject to compliance with requirements, provide a comparable product approved by Architect prior to bid by one of the following manufacturers:
   a. Architectural Metal Systems.
   b. MBCI Roof & Wall Systems.
   c. CENTRIA Architectural Systems.

2. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, structural quality, Grade 50, Coating Class AZ55 unpainted Galvalume® Plus® coating.
   a. Thickness: 24 gauge, minimum 0.032 inch (0.81 mm).
   b. Surface: Smooth with striations in pan.
c. Finish: Natural galvalume.

3. Clips: Provide panel clip of type specified, at spacing indicated on approved shop drawings designed to accommodate thermal movement.
      1) Material: 0.064-inch- (1.63-mm) nominal thickness.

4. Joint Type: Mechanically seamed.

5. Panel Coverage: 18 inches (406 mm).

6. Panel Height: 1.75 inches (51 mm).

2.3 UNDERLAYMENT MATERIALS

A. Self-adhering Sheet Waterproofing (High Temp): Minimum 30-mil (0.76-mm) nominal thickness, self-adhering sheet consisting of 37 mils (0.93mm) of rubberized asphalt laminated on one side to a 3.7-mil- (0.09-mm-) thick, polymeric-film reinforcement, and with release liner on adhesive side; formulated for application with primer or surface conditioner that complies with VOC limits of authorities having jurisdiction.

1. Basis-of-Design Product: Subject to compliance with requirements, provide GCP (Grace) Applied Technologies Inc., Grace Ultra™; or comparable product by one of the following:
   a. Carlisle Coatings & Waterproofing Inc.
   b. Henry Company.
   c. Protecto Wrap Company.
   d. Soprema, Inc.
   e. W.R. Meadows, Inc.
   f. York Manufacturing, Inc.

2. Physical Properties:
   a. Tensile Strength, Membrane: 250 psi (1.7 MPa) minimum; ASTM D412, Die C, modified.
   d. Low-Temperature Flexibility: Pass at minus 20 deg F (minus 29 deg C); ASTM D1970/D1970M.
   e. Crack Cycling: Unaffected after 100 cycles of 1/8-inch (3-mm) movement; ASTM C836/C836M.
   f. Puncture Resistance: 40 lbf (180 N) minimum; ASTM E154/E154M.
   g. Water Absorption: 0.2 percent weight-gain maximum after 48-hour immersion at 70 deg F (21 deg C); ASTM D570.
   h. Water Vapor Permeance: 0.05 perm (2.9 ng/Pa x s x sq. m) maximum; ASTM E96/E96M, Water Method.
   i. Hydrostatic-Head Resistance: 200 feet (60 m) minimum; ASTM D5385.
B. Sheet Strips: Self-adhering, rubberized-asphalt strips of same material and thickness as sheet waterproofing

2.4 MISCELLANEOUS MATERIALS

A. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- (25-mm) thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

B. Flashing and Trim and drip edge: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

C. Panel Fasteners: Self-tapping screws designed to withstand design loads.


D. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.

2.5 FABRICATION

A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.


3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.

4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.

5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.

6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
   a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal panel manufacturer for application, but not less than thickness of metal being secured.

2.6 FINISHES

A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Accessories: Same as metal panels.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.

1. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.
2. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.
   a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Miscellaneous Supports: Install miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.3 UNDERLAYMENT INSTALLATION

A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated below and on Drawings, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches (152 mm) staggered 24 inches (610 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Extend underlayment into gutter trough. Roll laps with roller. Cover underlayment within 14 days.

1. Apply over the entire roof deck insulation surface, and where indicated elsewhere on the Drawings.

B. Flashings: Install flashings to cover underlayment to comply with requirements specified in Section 07 62 00 "Sheet Metal Flashing and Trim."

3.4 METAL PANEL INSTALLATION

A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal panels.
2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
3. Install screw fasteners in predrilled holes.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as metal panel work proceeds.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using manufacturer’s approved fasteners according to manufacturers’ written instructions.

C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

D. Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.

1. Install clips to supports with self-tapping fasteners.
2. Install pressure plates at locations indicated in manufacturer’s written installation instructions.
3. Watertight Installation:
   a. Apply a continuous ribbon of sealant or tape to seal joints of metal panels, using sealant or tape as recommend in writing by manufacturer as needed to make panels watertight.
   b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
   c. At panel splices, nest panels with minimum 6-inch (152-mm) end lap, sealed with sealant and fastened together by interlocking clamping plates.

E. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal roof panel manufacturers; or, if not indicated, types recommended by metal roof panel manufacturer.

F. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet
metal flashing and trim to fit substrates and achieve waterproof and weather-resistant performance.

2. **Expansion Provisions:** Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (610 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

**G. Roof Curbs:** Install flashing around bases where they meet metal roof panels.

**H. Pipe Flashing:** Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

### 3.5 ERECTION TOLERANCES

**A. Installation Tolerances:** Shim and align metal panel units within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines as indicated and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

### 3.6 FIELD QUALITY CONTROL

**A. Manufacturer's Field Service:** Engage a factory-authorized service representative to test and inspect metal roof panel installation, including accessories. Report results in writing.

**B. Remove and replace applications of metal roof panels where tests and inspections indicate that they do not comply with specified requirements.

**C. Additional tests and inspections, at Contractor’s expense, are performed to determine compliance of replaced or additional work with specified requirements.

**D. Prepare test and inspection reports.

### 3.7 CLEANING AND PROTECTION

**A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

**B. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.
3.8 Mock-Ups:

A. Establish standards by which work will be judged. Mock-Ups: Install at project site a job mock-up using acceptable products and manufacturer approved installation methods. Obtain Owner’s and Architect’s acceptance of finish color, texture and pattern and workmanship standard.

END OF SECTION 07 61 13
SECTION 07 62 00 - SHEET METAL FLASHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes:

1. Formed Products:
   a. Formed 22 gauge galvalume through-wall flashing pan at windows.

B. Related Sections:

1. Division 06 Section, "Roofing Carpentry" for wood nailers, curbs, and blocking.

1.3 National Association of Architectural Metal Manufacturers (NAAMM): Metal Finishes Manual for Architectural and Metal Products

1.4 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing assemblies as indicated to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing shall not rattle, leak, or loosen, and shall remain watertight.

B. Thermal Movements: Provide sheet metal flashing that allows for thermal movements from ambient and surface temperature changes.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

C. Water Infiltration: Provide sheet metal flashing that do not allow water infiltration to building interior.

1.5 ACTION SUBMITTALS

A. Submit in accordance with TPWD Division 1 - Section 01000 – Special Conditions Section 1.09 Submittals and UGC Article 8.
B. Product List: Submit list of proposed Products and manufacturers, including all items specified in Part 2 – Products or otherwise required by the Work.

C. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

D. Shop Drawings: Show fabrication and installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work. Include the following:
   1. Identification of material, thickness, weight, and finish for each item and location in Project.
   2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
   3. Details for joining, supporting, and securing sheet metal flashing and trim, including layout of fasteners, cleats, clips, and other attachments. Include pattern of seams.
   4. Details of termination points and assemblies, including fixed points.
   5. Details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction.
   6. Details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
   7. Details of special conditions.
   8. Details of connections to adjoining work.
   9. Detail formed flashing and trim at a scale of not less than 3 inches per 12 inches.

E. Samples for Initial Selection: For each type of sheet metal flashing, trim, and accessory indicated with factory-applied color finishes involving color selection.

F. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
   1. Sheet Metal Flashing: 12 inches long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
   2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches long and in required profile. Include fasteners and other exposed accessories.
   3. Accessories and Miscellaneous Materials: Full-size Sample.

1.6 INFORMATIONAL SUBMITTALS

A. Submit in accordance with TPWD Division 1 - Section 01000 – Special Conditions Section 1.09 Submittals and UGC Article 8.

B. Qualification Data: For qualified fabricator.
C. Maintenance Data: For sheet metal flashing, trim, and accessories to include in maintenance manuals.

D. Warranty: Sample of special warranty.

1.7 QUALITY ASSURANCE

A. Quality Assurance per UGC Article 8 and Special Conditions 1.10.

B. General: Work of this Section to physically protect membrane roofing, base flashings, and expansion joints from damage that would permit water leakage to building interior.

C. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance, with three years minimum experience.

D. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.

E. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner’s insurer if applicable, Installer, and installers whose work interfaces with or affects sheet metal flashing and trim including installers of roofing materials, roof accessories, unit skylights, and roof-mounted equipment.

2. Review methods and procedures related to sheet metal flashing and trim.

3. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.

4. Review special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect sheet metal flashing.

5. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver sheet metal flashing materials and fabrications undamaged. Protect sheet metal flashing and trim materials and fabrications during transportation and handling.

B. Unload, store, and install sheet metal flashing materials and fabrications in a manner to prevent bending, warping, twisting, and surface damage.

C. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
D. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to the extent necessary for the period of sheet metal flashing and trim installation.

1.9 COORDINATION

A. Coordinate installation of sheet metal flashing trim with interfacing and adjoining construction to provide a leakproof, secure, and noncorrosive installation.

B. Coordinate with demolition work and with work of other trades to ensure sufficient materials and manpower are available to completely replace and make watertight all roofing removed each day.

C. Limit removal of existing sheet metal components, to ensure new membrane installation can be made watertight by end of day.

D. Coordinate installation of flanged metal components, including gravel guards, pitch pans, and accessories to ensure strip-in with hot bitumen (where applicable) on same day they are installed.

E. Schedule work to avoid storage on, and traffic over finished work.

1.10 WARRANTY

A. Warranty per UGC Article 13 and Special Conditions 1.14.

B. Special Warranty on Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
   a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SHEET METAL THROUGH WALL FLASHING

A.  
   1. Fabricate Through-wall window pan flashing from the following material
2. (22-gage) thick. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, structural quality, Grade 50, Coating Class AZ55 unpainted Galvalume® Plus® coating.
4. Color: As selected by Architect from manufacturer’s full range.

2.2 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.
   1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
      a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.
      b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
   2. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel. 1716.1.2.1 Non-Conditioned Spaces (ASTM A167, A123, A153, A653, A641, B695, or B633) 1716.1.2.2. Conditioned spaces (ASTM A899)
   3. Fasteners for Zinc-Coated (Galvanized) or Aluminum-Zinc Alloy-Coated Steel Sheet: Hot-dip galvanized steel according to ASTM A 153 or ASTM F 2329 or Series 300 stainless steel.
   4. Rust-resistant and compatible with materials to be joined.
   5. Length: As required for thickness of material to penetrate substrate 1/2-inch minimum.

C. Mechanical Fasteners for Sheet Metal to Substrate Anchorage:
   1. Masonry: One-step, screw-type drive anchor (nailin); heat-treated, stress relieved, stainless steel pin; zinc jacketed; sized for intended application; minimum 1-1/4-inch length x 1/4-inch diameter; Hammer-Screw® manufactured by Powers Fasteners, Inc.
   2. Wood Blocking: Hexagonal head screws, stainless steel, with neoprene rubber washers; jacket color to match pre-painted sheet metal.
   3. Concrete: Same as masonry or other power actuated fasteners, suitable for application.

D. Mechanical Fasteners for Sheet Metal to Metal Fabrications (Support Framing) Anchorage: Appropriate for purpose intended, size as required to suit application and achieve positive anchorage to substrate material.

E. Solder:
1. For Stainless Steel: ASTM B 32, Grade Sn60, with an acid flux of type recommended by stainless-steel sheet manufacturer.
2. For Lead: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead.
3. For Zinc-Coated (Galvanized) Steel: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead or Grade Sn60, 60 percent tin and 40 percent lead.

F. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

G. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant; low modulus, as specified in Division 07 Section “Sealants (for Roofing)”; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

H. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.


1. Curb Components: Precast, polymer modified cement or structural urethane.
2. Curb Adhesive: Special silicone sealant – DURALINK™.

K. Splash Blocks: Precast concrete of size and profile indicated; minimum 3000 psi at 28 days, with minimum 5 percent air entrainment; suitable for downspouts discharging at grade level or onto roof surface.

2.3 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing to comply with recommendations in SMACNA’s "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.

B. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.

1. Obtain field measurements for accurate fit before shop fabrication.

C. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.

1. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.
D. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

E. Sealed Joints: Form non-expansion but movable joints in metal to accommodate elastomeric sealant.

F. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1-inch deep, filled with elastomeric sealant concealed within joints.

1. Fabricate all components with allowance for expansion at joints. Provide enlarged or oval holes at all piercing fasteners.

G. Conceal fasteners and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.

H. Form all sheet metal components (except corners) in longest practical length up to 10-feet maximum; true to shape, square, accurate in size, and free from distortion or defects detrimental to appearance or performance.

I. Fabricate corners on all sheet metal components (gravel guards, copings, cap flashings, etc.) to form one piece with minimum 18-inch and maximum 36-inch long legs.

J. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

1. Fabricate cleats and attachment devices of sizes as recommended by SMACNA's "Architectural Sheet Metal Manual" for application, but not less than thickness of metal being secured.

K. Soldered Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.

L. Unsoldered Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.

M. Hem exposed edges of metal 1/2-inch; miter and seam corners.

N. Fabricate vertical faces with bottom edge formed outward 3/4-inch at 30 degrees and hemmed to form drip.

1. Where vertical height exceeds 8-inches, fabricate with stiffing grooves in accordance with SMACNA, unless specifically approved otherwise.

O. Form all sheet metal material to provide watertight joints:
1. Unprotected Horizontal Surfaces (expansion joint covers, etc.): Standing seam or drive cleat joints.
2. Vertical Surfaces (copings, cap flashings, gravel guards, etc.): Flat lock or cover and backer plate seams.

P. Miter all sheet metal corners and solder, weld, or fasten and seal all joints watertight:

1. Prepainted metallic-coated steel sheet: Apply minimum 1/4-inch bead of sealant between connecting metal flanges and drill and fasten with rivets at 2-inches o.c.
2. Stainless Steel: Solder joints watertight.
4. After soldering, remove flux. Wipe and wash solder joints clean.
5. Install sealant so it will not be visible on outside of joints.

Q. Fabricate elements complete with required connection pieces.

R. Fabricate all components with horizontal (flat) surfaces with built-in slope for drainage toward roof unless indicated otherwise.

S. Do not use graphite pencils to mark metal surfaces.

T. Parapet Scuppers: Fabricate scuppers to dimensions required, with closure flange trim to exterior, 4-inch- (100-mm-) wide wall flanges to interior, and base extending 4 inches (100 mm) beyond cant or tapered strip into field of roof. Fasten gravel guard angles to base of scupper. Fabricate from the following materials:

1. Stainless Steel: 0.022 inch (22-gage) thick.

U. Counterflashing: Fabricate from the following materials:

1. Stainless Steel: 0.022 inch (22-gage) thick.

V. Flashing Receivers: Fabricate from the following materials:

1. Stainless Steel: 0.019 inch (26-gage) thick.

W. Roof-Penetration Flashing: Fabricate from the following materials:

1. Stainless Steel: 0.019 inch (22-gage) thick.

X. Soil Pipe Flashing: Fabricate from the following material:

1. Lead: 4.0 lb/sq. ft., hard tempered.

2.4 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing: Fabricate from the following materials:
1. Prepainted Metallic Coated Galvalume Steel: 0.028 inch (22-gage) thick.

2.5 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of the Work.

1. Verify compliance with requirements for installation tolerances of substrates.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
3. Verify roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set, cant strips and reglets in place, and nailing strips located.
4. Verify membrane termination and base flashings are in place, sealed, and secure.

B. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

A. General: Install underlayment as recommended by SMACNA and as indicated on Drawings.

B. Polyethylene Sheet: Install polyethylene sheet with adhesive for anchorage to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped and taped joints of not less than 2 inches.
C. Felt Underlayment: Install felt underlayment with adhesive for temporary anchorage to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches.

3.3 INSTALLATION, GENERAL

A. Field measure site conditions prior to fabricating work.

B. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

i. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
ii. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
iii. Provide continuous cleats fastened not more than 12-inches on center. Anchor cleats with a minimum two fasteners.
iv. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
v. Install sealant tape where indicated.
vi. Torch cutting of sheet metal flashing and trim is not permitted.

C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.

i. Coat back side of stainless-steel and lead sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.

a. Minimum Dry Film Thickness: 15-mils.

ii. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene sheet.

iii. Bed flanges in thick coat of asphalt roofing cement where required for waterproof performance.

D. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10-feet. Provide joints within 18- to 36-inches of all corners or intersections. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1-inch deep, filled with elastomeric sealant concealed within joints.
E. **Fastener Sizes:** Use fasteners of sizes that will penetrate wood sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws; and metal decking not less than recommended by fastener manufacturer to achieve maximum pull-out resistance:

1. Galvanized or Prepainted, Metallic-Coated Steel: Use stainless-steel fasteners.
2. Stainless Steel: Use stainless-steel fasteners.

F. **Seal joints as shown and as required with elastomeric sealant for watertight construction.**

1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1-inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants (for Roofing)."

G. **Soldered Joints:** Clean surfaces to be soldered, removing oils and foreign matter. Pretin edges of sheets to be soldered to a width of 1-1/2 inches except reduce pre-tinning where pre-tinned surface would show in completed Work.

1. Do not solder pre-painted metallic-coated steel sheet.
2. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

H. **Rivets:** Rivet joints where indicated and where necessary for strength.

I. Protect all membrane penetrations as indicated and as recommended in SMACNA and NRCA manuals.

### 3.4 ROOF FLASHING INSTALLATION

A. **General:** Install sheet metal flashing and trim to comply with performance requirements and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

1. Install starter and edge strips, and cleats before starting installation.
2. Strip in all sheet metal flanges the same day they are installed.

B. **Roof Edge Flashing:** Anchor to resist uplift and outward forces specified in Part 1 and as indicated.
1. Backer Plates: Secure with fasteners suitable for substrate, 6-inches o.c. each face.
2. Interlock bottom edge of roof edge flashing with continuous cleats anchored to substrate at 12-inch centers.
3. Apply 1/4-inch bead of sealant between each layer of metal at each edge.
4. Cover Plates: Hook front or exposed face of cover plate over drip edge.
5. Do not use mastic between sheet metal components.

C. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4-inches over base flashing. Install stainless-steel draw band and tighten.

D. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4-inches over base flashing. Lap counterflashing joints a minimum of 4-inches and bed with elastomeric sealant.

1. Sawcut new reglets where required.
   a. Provide bayonet style lap joints, minimum 4-inch overlap.
   b. Fill voids between wedges with backer rod.
   c. Seal receiver to vertical face of wall.
2. Secure in a waterproof manner by means of snap-in installation and sealant or plastic wedges and sealant.
3. Install surface mounted reglets true to lines and levels.
   a. Seal top of reglets with sealant.
   b. Secure in place with neoprene head screws at maximum 12-inches on center.

E. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Install flashing as follows:

1. Install lead flashings at all soil pipe penetrations. Turn lead flashing down inside piping, being careful not to block vent piping with flashing.
2. Provide Penetration Seal System at all small penetrations not otherwise detailed.
   a. Clean roof surfaces to receive Penetration Seal Systems.
   b. Clean pipes and penetrating elements to remove plastic cement, bitumen, and other contaminants by wire brushing and scraping.
   c. Caulk around penetrating elements with curb adhesive.
   d. Apply beads of curb adhesive to flat side of first precast curb component. Place caulked curb onto roof surface to form half circle around penetrating element.
   e. Apply beads of curb adhesive to flat side and to scarf joints of second precast curb component. Place second section of curb onto roof surface to form circle with first section. Press scarf joints together firmly and press both sections down.
   f. Apply continuous bead of curb adhesive around outside edge of curb at roof.
   g. Fill around penetrating element with pourable sealant to top of curb.
3. Pitch pans are not desired. Install only where specifically indicated, or approved by Architect. Provide flanged umbrellas at all pitch pans.
a. Fill with non-shrink grout to 1-inch from top of flange.
b. Top with Pitch Pan Filler - Sealant Type ES-2.

4. Seal with elastomeric sealant and clamp flashing to pipes penetrating roof except for lead flashing on vent piping.

F. Protect all membrane penetrations as indicated and as recommended in SMACNA and NRCA manuals.

3.5 MISCELLANEOUS FLASHING INSTALLATION

A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

3.6 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.7 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder and sealants.

C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of installation, remove unused materials and clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.

D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

3.8 SCHEDULE - MATERIALS

A. Exposed to View Components:
   1. One-Piece Flashing and Expansion Joint Terminations: Stainless Steel Sheet.
   2. All Other Components: Stainless Steel Sheet.
B. Concealed from View Components, (Counterflashings, Expansion Joint Covers, Etc.): Stainless steel sheet.

C. Roof Penetration Flashings: Stainless steel sheet.

D. Rain Hoods and Umbrellas: Stainless steel sheet.

END OF SECTION 07 62 00
SECTION 07 92 00 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes sealants for the following applications, including those specified by reference to this Section:

B. This Section includes sealants for the following applications:

1. Exterior joints in the following vertical surfaces and non-traffic horizontal surfaces:
   a. Control and expansion joints in unit masonry.
   b. Joints between metal panels.
   c. Joints between different materials listed above.
   d. Perimeter joints between materials listed above and frames of doors, windows and louvers.
   e. Control and expansion joints in ceiling and overhead surfaces.
   f. Other joints as indicated.

2. Exterior joints in the following horizontal traffic surfaces:
   a. Control and expansion joints in brick pavers.
   b. Control, expansion, and isolation joints in cast-in-place concrete slabs.
   c. Tile control and expansion joints.
   d. Joints between different materials listed above.
   e. Other joints as indicated.

3. Interior joints in the following vertical surfaces and horizontal non-traffic surfaces:
   a. Control and expansion joints on exposed interior surfaces of exterior walls.
   b. Perimeter joints of exterior openings where indicated.
   c. Tile control and expansion joints.
   d. Vertical control joints on exposed surfaces of interior unit masonry.
   e. Perimeter joints between interior wall surfaces and frames of interior doors, windows, and elevator entrances.
   f. Joints between plumbing fixtures and adjoining walls, floors, and counters.
   g. Other joints as indicated.
4. Interior joints in the following horizontal traffic surfaces:
   a. Control and expansion joints in cast-in-place concrete slabs.
   b. Control and expansion joints in tile flooring.
   c. Other joints as indicated.

1.3 PERFORMANCE REQUIREMENTS

   A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

   B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.4 SUBMITTALS

   A. Submit in accordance with TPWD Division 1 – Section 01000 – Special Conditions Section 1.09 Submittals and UGC Article 8.

   B. Product Data: For each joint-sealant product indicated.

   C. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

   D. Samples for Verification: For each type and color of joint sealant required. Install joint sealants in wide joints formed between two long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

   E. Product Certificates: Signed by manufacturers of joint sealants certifying that products furnished comply with requirements and are suitable for the use indicated.

   F. SWRI Validation Certificate: For each elastomeric sealant specified to be validated by SWRI's Sealant Validation Program.

   G. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of CORs and Governments, and other information specified.

   H. Compatibility and Adhesion Test Reports: From sealant manufacturer indicating the following:

      1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
      2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
I. Product Test Reports: From a qualified testing agency indicating sealants comply with requirements, based on comprehensive testing of current product formulations.

J. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Quality Assurance per UGC Article 8 and Special Conditions 1.10.

B. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.

C. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

D. Pre-construction 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 manufacturers standard test methods to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
   a. Perform tests under environmental conditions replicating those that will exist during installation.

2. Submit not fewer than nine 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 the 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 of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

E. Product Testing: Obtain test results for "Product Test Reports" Paragraph in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36-month period.

1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated, as documented according to ASTM E 548.

2. Test elastomeric joint sealants for compliance with requirements specified by reference to ASTM C 920, and where applicable, to other standard test methods.

3. Test elastomeric joint sealants according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in peel, and indentation hardness.
4. Test other joint sealants for compliance with requirements indicated by referencing standard specifications and test methods.

F. Mockups: Before installing joint sealants, apply elastomeric sealants as follows to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution:

1. Joints in mockups of assemblies specified in other Sections that are indicated to receive elastomeric joint sealants, which are specified by reference to this Section.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multi-component materials.

B. Store and handle materials in compliance with manufacturers written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer.
2. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below.
3. When joint substrates are wet.

B. Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

C. Joint-Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.8 WARRANTY

A. Warranty per UGC Article 13 and Special Conditions Article 1.14.

B. General Warranty: Special warranties specified in this Article shall not deprive Government of other rights Government may have under other provisions of the Contract Documents and
shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

C. Special Installer’s Warranty: Written warranty, signed by Installer agreeing to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

D. Special Manufacturer’s Warranty: Written warranty, signed by elastomeric sealant manufacturer agreeing to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

E. Special warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:

1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer’s written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.
2. Disintegration of joint substrates from natural causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 PRODUCTS AND MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified in the sealant schedules at the end of Part 3.

B. Products: Subject to compliance with requirements, provide one of the products indicated for each type in the sealant schedules at the end of Part 3.

2.2 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, 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. Colors of Exposed Joint Sealants: As selected by COR from manufacturer's full range for this characteristic.

2.3 ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealant Standard: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant in the Elastomeric Joint-Sealant Schedule at the end of Part 3, including those referencing ASTM C 920 classifications for type, grade, class, and uses.

B. Additional Movement Capability: Where additional movement capability is specified in the Elastomeric Joint-Sealant Schedule, provide products with the capability, when 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 the time of installation and remain in compliance with other requirements of ASTM C 920 for uses indicated.

C. Stain-Test-Response Characteristics: Where elastomeric sealants are specified in the Elastomeric Joint-Sealant Schedule to be non-staining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

D. Continuous-Immersion-Test-Response Characteristics: Where elastomeric sealants will be immersed continuously in water, provide products that have undergone testing according to ASTM C 1247, including initial six-week immersion period and additional immersion periods specified below, and have not failed in adhesion or cohesion when tested with substrates indicated for Project.

1. One additional four-week immersion period.
2. Two additional four-week immersion periods.
3. Three additional four-week immersion periods.

E. Suitability for Contact with Food: Where elastomeric sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

2.4 LATEX JOINT SEALANTS

A. Latex Sealant Standard: Comply with ASTM C 834 for each product of this description indicated in the Latex Joint-Sealant Schedule at the end of Part 3.

2.5 JOINT-SEALANT BACKING

A. General: Provide sealant backings of material and type that are non-staining; 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. Cylindrical Sealant Backings: ASTM C 1330, of type indicated below and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

1. Type C: Closed-cell material with a surface skin.

C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to. Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and otherwise contribute to optimum sealant performance.

D. Bond-Breaker Tape: Polyethylene tape or other plastic tape 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.

2.8 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.

E. 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 joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants with joint substrates.

F. Masking Tape: Non-staining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

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 and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air. Porous joint surfaces include the following:
   a. Concrete.
   b. Masonry.
   c. Unglazed surfaces of ceramic tile.

3. Remove laitance and form-release agents from concrete.
4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
   a. Metal.
   b. Glass.
   c. Porcelain enamel.
   d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates 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.

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. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint sealant manufacturer’s written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations of ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
C. Acoustical Sealant Application Standard: Comply with recommendations of ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.

D. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

E. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and back of joints.

F. Install sealants by proven techniques to comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses provided for each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

G. Tooling of Non-sag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealants from surfaces adjacent to joint.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.
4. Provide flush joint configuration, per Figure 5B in ASTM C 1193, where indicated.
5. Provide recessed joint configuration, per Figure 5C in ASTM C 1193, of recess depth and at locations indicated.
   a. Use masking tape to protect adjacent surfaces of recessed tooled joints.

3.4 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field-test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed elastomeric sealant joints as follows:
a. Perform 10 random sample tests for each type of elastomeric sealant and joint substrate.

2. Test Method: Test joint sealants by hand-pull method described below:
   a. Make knife cuts from one side of joint to the other, followed by two cuts approximately long at sides of joint and meeting cross cut at one end. Place a mark from cross-cut end of piece.
   b. Use fingers to grasp piece of sealant between cross-cut end and mark; pull firmly at a 90-degree angle or more in direction of side cuts while holding a ruler along side of sealant. Pull sealant out of joint to the distance recommended by sealant manufacturer for testing adhesive capability, but not less than that equaling specified maximum movement capability in extension; hold this position for 10 seconds.
   c. For joints with dissimilar substrates, check adhesion to each substrate separately. Do this by extending cut along one side, checking adhesion to opposite side, and then repeating this procedure for opposite side.

3. Inspect joints for complete fill, for absence of voids, and for joint configuration complying with specified requirements. Record results in a field adhesion test log.

4. Repair sealants pulled from test area by applying new sealants following same procedures used to originally seal joints. Ensure that original sealant surfaces are clean and new sealant contacts original sealant.

B. Evaluation of Field-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements, will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

A. Clean off excess sealants 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.

3.6 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 so installations with repaired areas are indistinguishable from the original work.
3.7 ELASTOMERIC JOINT-SEALANT SCHEDULE

A. Low-Modulus Nonacid-Curing Silicone Sealant: Where joint sealants of this type are indicated, provide products complying with the following:

1. Products: Available products include the following:
   a. 790; Dow Corning.
   b. Silpruf; GE Silicones.
   c. UltraPruf SCS2300; GE Silicones.
   d. HiFlex 331; NUCO Industries, Inc.
   e. NuFlex 309; NUCO Industries, Inc.
   f. VP 275; Ohio Sealants, Inc.
   g. 864; Pecora Corporation.
   h. 890; Pecora Corporation.
   i. PSI-641; Polymeric Systems, Inc.
   j. Omniseal; Sonneborn Building Products Div., ChemRex Inc.
   k. Spectrem 1; Tremco.

2. Type and Grade: S (single component) and NS (non-sag).
4. Additional Movement Capability: 100 percent movement in extension and 50 percent movement in compression for a total of 100 percent movement.
5. Use Related to Exposure: NT (non-traffic).
6. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
7. Stain-Test-Response Characteristics: Non-staining to porous substrates per ASTM C 1248.

B. Multi-component Non-sag Urethane Sealant: Where joint sealants of this type are indicated, provide products complying with the following:

1. Products: Available products include the following:
   a. Vulkem 922; Mameco International.
   b. Dynatrol II; Pecora Corporation.
   c. Flexiprene 2000; Polymeric Systems, Inc.
   d. Sikaflex - 2c NS; Sika Corporation.
   e. DYmeric 511; Tremco.
   f. Sonneborne: NP-1.

2. Type and Grade: M (multi-component) and NS (non-sag).
4. Additional Movement Capability: 50 percent movement in extension and 50 percent in compression for a total of 100 percent movement.
5. Use Related to Exposure: NT (non-traffic).
6. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
   a. Use O Joint Substrates: Ceramic tile and wood.


C. Single-Component Pourable Urethane Sealant: Where joint sealants of this type are indicated, provide products complying with the following:

1. Products: Available products include the following:
   a. Chem-Calk 950; Bostik Inc.
   b. Vulkem 45; Mameco International.
   c. Vulkem Nova 300 SSL; Mameco International.
   d. NR-201; Pecora Corporation.
   e. Flexiprene PSI-951; Polymeric Systems, Inc.
   f. SL 1; Sonneborn Building Products Div., ChemRex Inc.

2. Type and Grade: S (single component) and P (pourable).
4. Use Related to Exposure: T (traffic).
5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
6. Applications: Expansion and control joints at concrete paving.

3.8 LATEX JOINT-SEALANT SCHEDULE

A. Latex Sealant: Where joint sealants of this type are indicated, provide products complying with the following:

1. Products: Available products include the following:
   a. Chem-Calk 600; Bostik Inc.
   b. NuFlex 330; NUCO Industries, Inc.
   c. LC 160 All Purpose Acrylic Caulk; Ohio Sealants, Inc.
   d. AC-20; Pecora Corporation.
   e. PSI-701; Polymeric Systems, Inc.
   f. Sonolac; Sonneborn Building Products Div., ChemRex, Inc.
   g. Tremflex 834; Tremco.

SECTION 08 14 33 - STILE AND RAIL WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Interior custom stile and rail wood doors.
   2. Interior custom stile and rail louvered wood doors.
   3. Exterior custom stile and rail wood doors with insect screening mesh panel.

B. Related Requirements:
   1. Section 061213 “Finish Carpentry” for insect screening not specified in this section.

1.3 ACTION SUBMITTALS

A. Submit in accordance with TPWD Division 1 – Section 01000 – Special Conditions Section 1.09 Submittals and UGC Article 8.

B. Product Data: For each type of product.
   1. Include details of construction and glazing.

C. Shop Drawings: For stile and rail wood doors. Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data, including those for stiles, rails and panels, and other pertinent data:
   1. Dimensions of doors for factory fitting.
   2. Locations and dimensions of mortises and holes for hardware.
   3. Doors to be mill finished and finish requirements.

D. Samples for Verification: Corner sections of doors, approximately 8 by 10 inches with door faces, edgings and panels.

1.4 INFORMATIONAL SUBMITTALS

A. Submit in accordance with TPWD Division 1 – Section 01000 – Special Conditions Section 1.09 Submittals and UGC Article 8.
B. Product Certificates: For each type of door, from manufacturer.

C. Quality Standard Compliance Certificates: AWI Quality Certification program certificates.

1.5 QUALITY ASSURANCE

A. Quality assurance per UGC Article 8 and Special Conditions 1.10.

B. Manufacturer Qualifications: A qualified manufacturer that is a certified participant in AWI’s Quality Certification Program.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer’s written instructions.

B. Package doors individually in opaque plastic bags or cardboard cartons.

C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during remainder of construction period.

1.8 WARRANTY

A. Warranty per UGC Article 13 and Special Conditions 1.14.

B. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship, or have warped (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section, within specified warranty period.

1. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.

2. Warranty shall be in effect during the following period of time from date of Substantial Completion:
   a. Interior Doors: Two years from date of substantial completion.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain stile and rail wood doors from single manufacturer.

2.2 MATERIALS

A. General: Use only materials that comply with referenced standards and other requirements specified.

1. Assemble interior doors, including components, with either dry-use or wet-use adhesives complying with ASTM D 5572 for finger joints and with ASTM D 5751 for joints other than finger joints.

2.3 INTERIOR STILE AND RAIL PARTITION WOOD DOORS

A. Interior Stile and Rail Wood Doors Interior doors complying with WDMA I.S.6, "Industry Standard for Wood Stile and Rail Doors," and with other requirements specified.

1. Finish and Grade: Clear.
2. Wood Species: Cypress.

2.4 STILE AND RAIL WOOD DOOR FABRICATION

A. Fabricate stile and rail wood doors in sizes indicated for field fitting.

B. Factory fit doors to suit frame-opening sizes indicated, with the following uniform clearances and bevels unless otherwise indicated:

1. Clearances: Provide 1/8 inch at jambs.
2. Bevel doors 1/8 inch in 2 inches at lock and hinge edges.

C. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, and hardware templates.

1. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before factory machining.

D. Glazed Openings: Trim openings indicated for glazing with solid wood moldings, with one side removable. Miter wood moldings at corner joints.

E. Transom and Side Panels: Fabricate panels to match adjoining doors in materials, finish, and quality of construction.
2.5 FINISHING

A. Finish wood doors at fabricator shop.

B. For doors indicated to be shop finished, comply with the AWI's, AWMAC's, and WI's "Architectural Woodwork Standards," and with other requirements specified.

   1. Finish faces and all four edges of doors, including mortises and cutouts.

C. Finish:

   1. Grade: Premium

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames, with Installer present, before hanging doors.

   1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
   2. Reject doors with defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Hardware: For installation, see Section 08 71 00 "Door Hardware."

B. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted with fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.

   2. Bevel doors 1/8 inch in 2 inches at lock and hinge edges.

C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

D. Factory/Shop-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.
3.3 ADJUSTING

A. Operation: Re-hang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 08 14 33
SECTION 08 16 13 - FIBERGLASS REINFORCED POLYESTER (FRP) DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Fiber Glass Reinforced (FRP) doors and FRP frames in accordance with schedules shown on drawings and as specified herein.

B. Related Requirements:
   1. Division 03, Section 03 30 00 "Cast-in-Place Concrete" for concrete structure for anchoring FRP frames.
   2. Division 08, Section 08 71 00 - "Door Hardware" for door hardware to be installed on doors.

1.3 DEFINITIONS

A. FRP is defined as "Fiberglass Reinforced Polyester" construction.

B. FRP doors and frames occur at exterior door locations.

1.4 QUALITY ASSURANCE

A. Quality assurance per UGC Article 8 and Special Conditions 1.10.

B. Referenced Standard: American Society for Testing and Materials (ASTM) parts 35 and 36 - "Standards and Tentatives on Plastics - General Test Methods; Nomenclature; Materials, Film, Reinforced and Cellular Plastics; Fiber Composites".

C. Manufacturer: Company specializing in the manufacture of FRP doors and frames with a minimum of five years documented experience.

D. Process: Certify that FRP doors are manufactured via press-molding technology.
E. Warranty: Provide written guarantee for FRP doors and frames as follows:

   1. One year for defects in material and workmanship.
   2. Lifetime warranty against failure due to chemicals in the named environment.
   3. Lifetime warranty against delamination of door faces.
   4. Lifetime warranty to stay flat.

1.5 SUBMITTALS

A. Submit in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.09 SUBMITTALS and UGC Article 8.

B. Performance Documentation: For exterior doors and frames, submit product documentation verifying that the product(s) submitted has been tested as a part of an assembly that meets the Performance Requirements for exterior wall openings as indicated in Section 01 41 00 - "Regulatory Requirements (Windstorm Construction Requirements).

C. Product Data: Provide catalog cut of FRP door detailing internal construction and reinforcements, materials used and description of molding process. TDI Windstorm pressures and missile impact resistant per section 01 33 00 1.4D.

D. Shop Drawings: To include the following specific information:

   1. Specifications relating to FRP door thickness, resin type, core material, finish color and type of glazing.
   2. Complete schedule of FRP doors and frames showing identifying mark numbers, door and frame types, typical elevations, nominal sizes, connections, handing, actual dimensions and clearances, and required hardware preps and reinforcements.
   3. Supporting reference drawings pertaining to frame mounting details, hardware locations and factory hardware cutouts.
   4. Engineering Calculation: Submit wind uplift pressure and connection calculations according to ASCE 7 wind speed for project location with respect to appropriate importance factor, exposure category and safety factor. Calculations shall be sealed by a professional engineer licensed to practice structural engineering in the state of Texas.

E. Color Samples: Provide a complete set of available finish colors from the manufacturer. Color chips to be cut from actual FRP door face composite to reveal details of laminate such as surface texture, color and thickness of gelcoat layer and thickness/reinforcement of backup laminate.

F. Door and Frame Sample: Furnish 6-inch (152 mm) x 12-inch (305 mm) door attached to frame, showing internal construction of door, hinge attachment and frame corner construction.
G. Installation Instructions: Include manufacturer's specific information describing procedures, sequence and required fasteners.

H. Production of FRP doors and frames shall not proceed until approval of submittals.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver FRP doors and frames to site on wooden pallets. Use soft plastic foam protective sheeting between doors and frames to prevent scuffing. Cover each shipment with heavy waferboard and enclose with double-wall cardboard for protection during transit.

B. Store at jobsite on original pallets in a dry indoor location. Do not wrap in plastic sheeting, which will foster condensate formation within. Rainwater or condensation must not be allowed to collect and lay between stored doors, or permanent discoloration can result!

C. Use care in handling FRP doors and frames to prevent damage to factory finishes. Wear protective gloves and do not slide or drag doors or frames against one another.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide doors and frames as manufactured by Special-Lite®; or a comparable product by a pre-approved manufacturer.

1. Tiger Door Co.
2. Chem-Pruf Door Co
3. Corrim Co.
4. Approved equal manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Performance Requirements: Exterior FRP doors and frames, as part of a tested assembly, shall comply with the Performance Requirements of exterior wall openings as indicated in Section 01 41 00 - "Regulatory Requirements (Windstorm Construction Requirements.)

2.3 FRP DOORS

A. Design: FRP doors shall be of seamless press-molded construction. Laminated FRP face sheets shall be applied while wet and uncured to an internal reinforcing structure and core and molded to the door under heat and pressure. The composite door panel must be integrally
fused over its entire surface area, not just bonded at stiles and rails. Doors shall remain under pressure during curing for flat, warp-free surfaces.

B. Core: For maximum rigidity and compressive strength a 3/8-inches (9.53 mm) cell phenolic resin impregnated kraft paper honeycomb core shall be used. Molding pressure and resin gel time shall be sufficient to allow for penetration of resin into the cellular structure of the core to maximize shear and peel strengths at the skin/core interface and eliminate the possibility of delamination. The honeycomb is to be completely enclosed within the stile and rail subframe.

C. Internal Reinforcement: Use only tubular FRP or high-density polymer compression blocks at all hardware locations. Wood blocking and steel or aluminum reinforcing plates, ribs, fittings or fasteners are not permitted.

D. Faces: Door facings shall utilize a chemical resistant thermosetting polyester resin system with glass fiber reinforcing layers. Chopped strand mat layers shall be used to provide bond integrity between gelcoat, laminated facings and the internal door structure. Structural reinforcement shall be in the form of a knitted multi-layer material with layers of unidirectional glass fiber oriented in both the vertical and horizontal directions for high stiffness and impact resistance.

E. Finish: The exposed surfaces of the FRP door must have an integrally molded 25 mil (wet thickness) ultra-violet light stabilized NPG type isophthalic polyester gelcoat. Facings shall have a slightly textured semi-gloss or smooth finish. Doors shall be shipped to allow for jobsite applied painted finish.

F. Astragals: Provide a heavy pultruded FRP angle astragal on the meeting stile edge of each inactive leaf of double door pairs.

2.4 FRP FRAMES

A. Design: Door frames furnished under this specification shall utilize a high modulus pultruded structural FRP section. Frame section shall be industry-standard 5-3/4-inch (154 mm) deep x 2-inch (50.8 mm) face, double rabbeted with integral 5/8-inches (15.88 mm) doorstop, to match typical hollow metal configurations.

B. Corner Joints: Jambs and header shall be joined at corners via butt connections with hidden FRP angle clips and 5/16-inches (7.94 mm) diameter stainless steel flat head screws. Corner screws shall not be visible on interior or exterior frame faces.

C. Anchors:

1. Bolt-in: Provide three (3) 3/8-inches (9.53 mm) diameter flat head Type 316 stainless steel anchors (sleeve type for masonry or concrete; machine screw with nut and washers for steel) per jamb side. Include extra anchors for additional frame height in
24-inch (610 mm) increments above 8'-0" (2.44 m). Provide a single bolt anchor at center of all headers over four feet in nominal width.

D. Finish: Frames, sash and borrowed lights shall have a factory applied two-part aliphatic polyurethane topcoat, to match the color and sheen of the doors, for superior weatherability and prepared for jobsite applied painted finish.

E. Provide two (2) silencers for each door leaf.

2.5 MECHANICAL PROPERTIES

A. Pultruded structural shapes for stiles, rails, frames, astragals and trim shall exhibit the following minimum longitudinal coupon properties (per ASTM):

1. Tensile strength (D638) 30,000 psi
2. Compressive strength (D695) 30,000 psi
3. Flexural strength (D790) 30,000 psi
4. Flexural modulus (D790) 1,600,000 psi
5. Shear strength (D2846) 4,500 psi
6. Impact, notched (D256) 25 ft-lb/in
7. Barcol hardness (D2583) 50

2.6 FASTENERS

A. All fasteners and metal appurtenances shall be Type 316L stainless steel.

2.7 HARDWARE PREPARATION

A. Doors shall be factory mortised and drilled for full mortise hinges, with #12 x 3-inch (76.2 mm) long Type 316 stainless steel screws pre-installed for hinge attachment. Provide 161 cylindrical lock bore or Type 86 mortise lock pocket as required.

B. Frames shall be factory mortised and drilled for hinges and ASA strike as required.

PART 3 - EXECUTION

3.1 IDENTIFICATION

A. Factory mark all doors and frames using a chemical resistant plastic tag or indelible marker with identifying number, keyed to shop drawings, prior to shipment.
3.2 INSTALLATION

A. NOTE: FRP door frames must be installed prior to installation of facade to allow for installation of concealed flashing at perimeter of door units. Exceptions to this requirement will not be permitted.

B. Frames: Install in strict accordance with manufacturer's instructions. Set plumb and square, using shims for bolt-in.

C. Doors: Hang per manufacturer's instructions using special screws provided for hinge attachment. Install doors to swing freely and to stand open at any angle. After installation, make final adjustments to hardware to allow for proper door operation and latching.

3.3 CLEANING

A. Clean exposed surfaces of FRP doors and frames with mild, non-abrasive cleaner and water.

END OF SECTION 08 16 13
SECTION 08 71 00 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Complete hardware for flush wood and hollow metal doors.

B. Section Includes:
   1. Mechanical door hardware for the following:
      a. Swinging doors.

C. Related Requirements:
   1. Section 08, "FRP Doors and Frames."
   2. Section 08, "Stile and Rail Wood Doors."

1.3 COORDINATION

A. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

1.4 PREINSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at Project site.
   1. Conference participants shall include Installer’s Architectural Hardware Consultant and Owner’s security consultant.

B. Keying Conference: Conduct conference at Project site.
   1. Conference participants shall include Architectural Hardware Consultant and Owner’s Representative.
   2. Incorporate conference decisions into keying schedule after reviewing door hardware keying system including, but not limited to, the following:
      a. Flow of traffic and degree of security required.
b. Preliminary key system schematic diagram.
c. Requirements for key control system.
d. Address for delivery of keys.

1.5 ACTION SUBMITTALS

A. Submit in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.09 SUBMITTALS and UGC Article 8.

B. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

C. Samples: For each exposed product in each finish specified, in manufacturer's standard size.
   1. Tag Samples with full product description to coordinate Samples with door hardware schedule.

D. Samples for Initial Selection: For each type of exposed finish as required.

E. Samples for Verification: For each type of exposed product, in each finish specified as required.
   1. Sample Size: Full-size units or minimum 2-by-4-inch for other products.
      a. Full-size Samples will be returned to Contractor. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated into the Work, within limitations of keying requirements.
   2. Tag Samples with full product description to coordinate Samples with door hardware schedule.

F. Door Hardware Schedule: Prepared by or under the supervision of Certified Architectural Hardware Consultant. Coordinate door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
   1. Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
   2. Format: Use scheduling sequence and vertical format and use same door numbers as in door hardware schedule in the Contract Documents.
   3. Content: Include the following information:
      a. Identification number, location, hand, fire rating, size, and material of each door and frame.
b. Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.

c. Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.

d. Fastenings and other installation information.

e. Explanation of abbreviations, symbols, and designations contained in door hardware schedule.

f. Mounting locations for door hardware.

g. List of related door devices specified in other Sections for each door and frame.

G. Keying Schedule: Prepared by or under the supervision of Architectural Hardware Consultant, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

1.6 INFORMATIONAL SUBMITTALS

A. Submit in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.09 SUBMITTALS and UGC Article 8.

B. Qualification Data: For Installer and Architectural Hardware Consultant, as required by architect.

C. Product Test Reports: For compliance with accessibility requirements, for tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.

D. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Closeout per UGC 12 and Special Conditions 1.13 and Warranty per UGC Article 13 and Special Conditions 1.14.

B. Maintenance Data: For each type of door hardware to include in maintenance manuals.

C. Schedules: Final door hardware and keying schedule.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Door Hardware:
   a. See hardware schedule on drawings.
1.9 QUALITY ASSURANCE

A. Quality Assurance per UGC Article 8 and Special Conditions 1.10.

B. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and of an Architectural Hardware Consultant who is available during the course of the Work to consult Contractor, Architect, and Owner about door hardware and keying.

1. Warehousing Facilities: In Project's vicinity.
2. Scheduling Responsibility: Preparation of door hardware and keying schedule.
3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

C. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as an Architectural Hardware Consultant (AHC).

1.10 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.

B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

C. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

D. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

1.11 WARRANTY

A. Warranty per UGC Article 13 and Special Conditions 1.14.

B. Special Warranty: Manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures including excessive deflection, cracking, or breakage.
   b. Faulty operation of doors and door hardware.
   c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
2. Warranty Period: One year from date of Substantial Completion unless otherwise indicated below:
   a. Exit Devices: Two years from date of Substantial Completion.
   b. Manual Closers: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

   A. Source Limitations: Obtain each type of door hardware from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

   A. Fire-Rated Door Assemblies: Where fire-rated doors are indicated, provide door hardware complying with NFPA 80 that is listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

   B. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that complies with requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.

      1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. at the tested pressure differential of 0.3-inch wg of water.

   C. Means of Egress Doors: Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

   D. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the "2012 Texas Accessibility Standards," and Technical Memorandum.

      1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
      2. Comply with the following maximum opening-force requirements:
         a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.
         b. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
      3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch high.
      4. Adjust door closer sweep periods so that, from an open position of 90 degrees, the door will take at least 5 seconds to move to a position of 12 degrees from the latch.
      5. Adjust spring hinges so that, from an open position of 70 degrees, the door will take at least 1.5 seconds to move to the closed position.
2.3 SCHEDULED DOOR HARDWARE

A. Provide products for each door that comply with requirements indicated in the door hardware schedule.

1. Door hardware is scheduled in drawings.

2.4 HINGES

A. Hinges: BHMA A156.1. See door hardware schedule on drawings.

2. Hagar Companies.
3. Ives.

2.5 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: As indicated in door hardware schedule on drawings.

B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:

1. Bored Locks: Minimum 1/2-inch latchbolt throw.

C. Lock Backset: 2-3/4 inches unless otherwise indicated.

D. Lock Trim:

1. Description: As indicated in hardware sets.
2. Levers: Cast.
4. Dummy Trim: Match lever lock trim and escutcheons.

E. Strikes: Provide manufacturer’s standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.

1. Flat-Lip Stripes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Manufacturer’s special strike box fabricated for aluminum framing.
4. Rabbet Front and Strike: Provide on locksets for rabbeted meeting stiles.
F. Bored Locks: BHMA A156.2; Grade 1; Series 4000.
   2. Schlage.
   3. Yale.

G. Mortise Locks: BHMA A156.13; Operational Grade 1; stamped steel case with steel or brass parts; Series 1000.
   2. Schlage.
   3. Yale.

2.6 AUXILIARY LOCKS

A. Bored Auxiliary Locks: BHMA A156.36: Grade 1; with strike that suits frame.
   2. Schlage.
   3. Yale.

2.7 SURFACE BOLTS

A. Surface Bolts: BHMA A156.16.
   1. Rockwood Manufacturing – Basis of design.
   2. Hagar Companies.
   3. Ives.

2.8 MANUAL FLUSH BOLTS

A. Manual Flush Bolts: BHMA A156.16; minimum 3/4-inch throw; designed for mortising into door edge.
   1. Rockwood Manufacturing – Basis of Design.
   2. Hagar Companies.
   3. Ives.

2.9 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver. Provide cylinder from same manufacturer of locking devices.
   2. Schlage.
3. Yale.

B. Standard Lock Cylinders: BHMA A156.5; Grade 1 permanent cores; face finished to match lockset.
   1. Core Type: Removable.


D. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

2.10 KEYING

A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, appendix. Provide one extra key blank for each lock. Incorporate decisions made in keying conference.
   1. Grand Master Key System: Change keys, a master key, and a grand master key operate cylinders. Or as determined in keying meeting.
      a. Provide three cylinder change keys and five each of master and grand master keys.

   2. Existing System:
      a. Master key or grand master key locks to Owner's existing system.

B. Keys: Nickel silver.
   1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:

2.11 KEY CONTROL SYSTEM

A. Key Control Cabinet: BHMA A156.28; metal cabinet with baked-enamel finish; containing key-holding hooks, labels, two sets of key tags with self-locking key holders, key-gathering envelopes, and temporary and permanent markers; with key capacity of 150 percent of the number of locks.
   1. Lund Key Cabinet
   2. Wall-Mounted Cabinet: Grade 1 cabinet with hinged-panel door equipped with key-holding panels and pin-tumbler cylinder door lock. Double tag system

B. Key Lock Boxes: Designed for storage of # of keys as required by local fire department
   1. Knox Box Recessed with hinged door location as required by fire department. Finish as selected by architect.
2.12 ACCESSORIES FOR PAIRS OF DOORS

A. Astragals: BHMA A156.22.

2.13 SURFACE CLOSERS

A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

1. Sargent Manufacturing - Basis of design.
2. LCN.

2.14 OVERHEAD STOPS AND HOLDERS

A. Overhead Stops and Holders: BHMA A156.8.

1. Rockwood manufacturing – Basis of Design
2. ABH Manufacturing

2.15 THRESHOLDS

A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

1. National Guard products – Basis of design.
2. Pemko Manufacturing.

2.16 METAL PROTECTIVE TRIM UNITS

A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.

1. Rockwood Manufacturing – Basis of design
2. Hagar Companies.
3. Ives.
2.17 FABRICATION

A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rating labels and as otherwise approved by Architect.

1. Manufacturer's identification is permitted on rim of lock cylinders only.

B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.

C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware unless otherwise indicated.

1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.

2. Fire-Rated Applications:
   a. Wood or Machine Screws: For the following:
      1) Hinges mortised to doors or frames; use threaded-to-the-head wood screws for wood doors and frames.
      2) Strike plates to frames.
      3) Closers to doors and frames.
   b. Steel Through Bolts: For the following unless door blocking is provided:
      1) Surface hinges to doors.
      2) Closers to doors and frames.
      3) Surface-mounted exit devices.

3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.

4. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.18 FINISHES

A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule located on the drawings.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance of the Work.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Wood Doors: Comply with door and hardware manufacturers' written instructions.

3.3 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.

   1. Wood Doors: DHI's "Recommended Locations for Architectural Hardware for Wood Flush Doors."

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.

   1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.

   2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

C. Hinges: Install types and in quantities indicated in door hardware schedule on drawings, but not fewer than the number recommended by manufacturer for application indicated or one
hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

D. Lock Cylinders: Install construction cores to secure building and areas during construction period.
   1. Replace construction cores with permanent cores as directed by Owner.
   2. Furnish permanent cores to Owner for installation.

E. Key Control System:
   1. Key Control Cabinet: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
   2. Key Lock Boxes: Install where indicated or approved by Architect to provide controlled access for fire and medical emergency personnel.

F. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."

G. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.

H. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
   1. Do not notch perimeter gasketing to install other surface-applied hardware.

I. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

J. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 FIELD QUALITY CONTROL

1. Independent Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

   1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
2. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 70 degrees and so that closing time complies with accessibility requirements of authorities having jurisdiction.

3. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.

B. Occupancy Adjustment: Approximately Three months after date of Substantial Completion, Installer shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.6 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.7 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

3.8 DEMONSTRATION

A. Engage Installer to train Owner's maintenance personnel to adjust, operate, and maintain door hardware.

3.9 HARDWARE SCHEDULE

A. Refer to Drawings for Door Hardware Schedule.

END OF SECTION 08 71 00
SECTION 09 24 00 - PORTLAND CEMENT PLASTER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY
   A. This Section includes the following:
      1. Portland cement plaster over cured notched modified thin-set adhesive.

1.3 SUBMITTALS
   A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections.
   B. Product Data for each product specified.
   C. Samples for initial selection in the form of manufacturer's color charts consisting of actual units or sections of units at least 12 inches square showing the full range of colors, textures and patterns available for each type of finish indicated.
      1. Where finish involves normal color and texture variations, include Sample sets composed of 2 or more units showing the full range of variations expected.
      2. Include similar Samples of material for joints and accessories involving color selection.

1.4 DELIVERY, STORAGE AND HANDLING
   A. Deliver cementitious materials to Project site in original packages, containers, or bundles, labeled with manufacturer's name, product brand name and lot number.
   B. Store materials inside, under cover, and dry, protected from weather, direct sunlight, surface contamination, aging, corrosion and damage from construction traffic and other causes.

1.5 PROJECT CONDITIONS
   A. Environmental Requirements, General: Comply with requirements of referenced plaster application standards and recommendations of plaster manufacturer for environmental conditions before, during, and after plaster application.
   B. Warm-Weather Requirements: Protect plaster against uneven and excessive evaporation and from strong flows of dry air, both natural and artificial. Apply and cure plaster as required by
climatic and job conditions to prevent dry out during cure period. Provide suitable coverings, moist curing, barriers to deflect sunlight and wind, or combinations of these, as required.

C. Exterior Plaster Work: Do not apply plaster when ambient temperature is below 40 deg F.

D. Interior Plaster Work: Maintain at least 50 deg F temperature in areas to be plastered for at least 48 hours before, during, and after application.

E. Ventilation: Provide natural or mechanical means of ventilation to properly dry interior spaces after portland cement plaster has cured.

F. Protect contiguous work from soiling and moisture deterioration caused by plastering. Provide temporary covering and other provisions necessary to minimize harmful spattering of plaster on other work.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Design Loads: As indicated on the structural drawings.

2.2 PLASTER MATERIALS

A. Base-Coat Cements: Type as indicated below:
   1. Portland cement, ASTM C 150, Type I.
   2. Masonry cement, ASTM C 91, Type N.

B. Job-Mixed Finish-Coat Cement: Material and color as indicated below:
   1. Portland cement, ASTM C 150, Type I.
   2. Masonry cement, ASTM C 91, Type N.

C. Cement Color: Grey.

D. Lime: Special hydrated lime for finishing purposes, ASTM C 206, Type S; or special hydrated lime for masonry purposes, ASTM C 207, Type S.

E. Sand Aggregate for Base Coats: ASTM C 897.

F. Aggregate for Finish Coats: ASTM C 897 system and as indicated below:
   1. Manufactured or natural sand, grey in color.

G. Finish: Match Portland Cement Plaster finish of approved sample.

2.3 MISCELLANEOUS MATERIALS
A. Fiber for Base Coat: Alkaline-resistant glass or polypropylene fibers, 1/2 inch long, free of contaminants, manufactured for use in portland cement plaster.


C. Bonding Agent: ASTM C 932.

D. Acid-Etching Solution: Muriatic acid (10 percent solution of commercial hydrochloric acid) mixed 1 part to not less than 6 nor more than 10 parts water.

E. Dash-Coat Material: 2 parts portland cement to 3 parts fine sand, mixed with water to a mushy-paste consistency.

2.4 PLASTER MIXES AND COMPOSITIONS

A. General: Comply with ASTM C 926 for base- and finish-coat mixes as applicable to plaster bases, materials, and other requirements indicated.

B. Base-Coat Mixes and Compositions: Proportion materials for respective base coats in parts by volume per sum of cementitious materials for aggregates to comply with the following requirements for each method of application and plaster base indicated. Adjust mix proportions below within limits specified to attain workability.

C. Fiber Content: Add fiber to following mixes after ingredients have mixed at least 2 minutes. Comply with fiber manufacturer's written instructions but do not exceed 1 lb/cu. ft. of cementitious materials. Reduce aggregate quantities accordingly to maintain workability.

D. Job-Mixed Finish Coats: Proportion materials for finish coats in parts by volume for cementitious materials and parts by volume per sum of cementitious materials to comply with the following requirements:

   1. Portland Cement Mix: For cementitious materials, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 1-1/2 to 3 parts aggregate per part of cementitious material.

2.5 MIXING

A. Mechanically mix cementitious and aggregate materials for plasters to comply with applicable referenced application standard and with recommendations of plaster manufacturer.

PART 3 - EXECUTION

3.1 PREPARATIONS FOR PLASTERING

A. Install temporary grounds and screeds to ensure accurate rodding of plaster to true surfaces; coordinate with scratch-coat work.
3.2 PLASTER APPLICATION

A. Plaster Application Standard: Apply plaster materials, composition, and mixes to comply with ASTM C 926.

B. Do not use materials that are frozen, caked, lumpy, dirty, or contaminated by foreign materials.

C. Do not use excessive water in mixing and applying plaster materials.

D. Flat Surface Tolerances: Do not deviate more than plus or minus 1/8 inch in 10 feet from a true plane in finished plaster surfaces, as measured by a 10-foot straightedge placed at any location on surface.

E. Sequence plaster application with installation and protection of other work so that neither will be damaged by installation of other.

F. Corners: See architectural drawing details.

G. Number of Coats: Apply plaster of composition indicated, to comply with the following requirements:
   1. One or two Coats based on the results of the mock-up: Over the following base:
      a. Modified notched cured thinset.

H. Finish Coats: Apply finish coats to comply with the following requirements:
   1. Float Finish: Apply finish coat to a minimum thickness of 1/8 inch to completely cover base coat, uniformly floated to a true even plane with "slick" trowel finish.

I. Moist-cure plaster base and finish coats to comply with ASTM C 926, including written instructions for time between coats and curing in "Annex A2 Design Considerations".

3.3 CUTTING AND PATCHING

A. Cut, patch, replace, repair, and point up plaster as necessary to accommodate other work. Repair cracks and indented surfaces. Point-up finish plaster surfaces around items that are built into or penetrate plaster surfaces. Repair or replace work to eliminate blisters, buckles, check cracking, dry outs, efflorescence, excessive pinholes, and similar defects. Repair or replace work as necessary to comply with required visual effects.

3.4 CLEANING AND PROTECTING

A. Remove temporary covering and other provisions made to minimize spattering of plaster on other work. Promptly remove plaster from door frames, windows, and other surfaces not to be plastered. Repair surfaces stained, marred or otherwise damaged during plastering work. When plastering work is completed, remove unused materials, containers, equipment, and plaster debris.
B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure plaster work is without damage or deterioration at the time of Substantial Completion.

END OF SECTION 09 24 00
SECTION 09 30 13 - CERAMIC TILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

1. This Section includes the following:

   1. 12x12 large format ceramic wall tile
   2. 12x24 large format ceramic floor tile
   3. 12x12 exterior wall tile

2. Related Sections include the following:

   1. Division 3 Section "Cast-in-Place Concrete" for monolithic slab finishes specified for tile substrates.
   2. Division 7 Section "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
   3. Division 9 Section "Gypsum Board Assemblies" for cementitious backer units, glass-mat, water-resistant backer board.

1.3 DEFINITIONS

1. Module Size: Actual tile size (minor facial dimension as measured per ASTM C 499 plus joint width indicated.

2. Facial Dimension: Nominal tile size as defined in ANSI A137.1.

1.4 SUBMITTALS

1. Submit in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.09 SUBMITTALS and UGC Article 8.

2. Product Data: For each type of product indicated.
3. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

4. Samples for Initial Selection: For each type of tile and grout indicated. Include Samples of accessories involving color selection.

5. Samples for Verification:
   1. Full-size units of each type and composition of tile and for each color and finish required.
   2. Assembled samples with grouted joints for each type and composition of tile and for each color and finish required, at least 12 inches square and mounted on rigid panel. Use grout of type and in color or colors approved for completed work.
   3. Full-size units of each type of trim and accessory for each color and finish required.

6. Master Grade Certificates: For each shipment, type and composition of tile, signed by tile manufacturer and Installer.

7. Product Certificates: For each type of product, signed by product manufacturer.

8. Qualification Data: For Installer.

9. Material Test Reports: For each tile-setting and -grouting product.

1.5 QUALITY ASSURANCE

1. Quality Assurance per UGC Article 8 and Special Conditions 1.10.

2. Source Limitations for Tile: Obtain all tile of same type and color or finish from one source or producer.
   1. Obtain tile from same production run and of consistent quality in appearance and physical properties for each contiguous area.

3. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.

4. Mockups: Build mockups to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution.
   1. Build mockup of each type of floor tile installation.
   2. Build mockup of each type of wall & base tile installation. Interior and exterior.
   3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
1.6 DELIVERY, STORAGE AND HANDLING

1. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement in ANSI A137.1 for labeling sealed tile packages.

2. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

3. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

4. Store liquid latexes and emulsion adhesives in unopened containers and protected from freezing.

5. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.7 PROJECT CONDITIONS

1. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer’s written instructions.

1.8 EXTRA MATERIALS

1. 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. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed, for each type, composition, color, pattern and size indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

1. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified.

2. Products: Subject to compliance with requirements, provide one of the products specified.
3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

5. Basis-of-Design Product: The design for each tile type is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by a pre-approved manufacturer.

2.2 PRODUCTS, GENERAL

1. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1, "Specifications for Ceramic Tile", for types, compositions and other characteristics indicated.
   1. Provide tile complying with Standard grade requirements, unless otherwise indicated.
   2. For facial dimensions of tile, comply with requirements relating to tile sizes specified in Part 1 "Definitions" Article.


3. Colors, Textures, and Patterns: Where manufacturer's standard products are indicated for tile, grout, and other products requiring selection of colors, surface textures, patterns, and other appearance characteristics, provide specific products or materials complying with the following requirements:
   1. Match Architect's samples.

4. Factory Blending: For tile exhibiting color variations within ranges selected during Sample submittals, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

5. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer, unless otherwise indicated.
   1. Where tile is indicated for installation on exteriors or in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.

6. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by pre-coating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.
1. Tile “CT1”: (Interior Wall) Dal-Tile (or equal) Glazed Ceramic Tile, 12” x 24,” Showscape Series, Glossy, Color SH09 "Stylish White" 

2. Tile “CT2”: (Interior Floors) Dal-Tile (or equal) Technical Porcelain Tile, 12” x 24", Unity Series, Textured, Color P405 "Ashgrey" 

3. Tile “CT3”: (Exterior Walls) D’HANIS 12x12x1/2” Color and texture to be selected by Architect from manufacturer's full range of colors.

2.4 SETTING AND GROUTING MATERIALS (INTERIOR)

1. Available Manufacturers:
   4. C-Cure.
   5. Custom Building Products.
   6. DAP, Inc.
   7. LATICRETE International Inc.
   8. MAPEI Corporation.
   10. Summitville Tiles, Inc.
   11. TEC Specialty Products Inc.

2. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4, consisting of the following:
   1. Prepackaged dry-mortar mix combined with styrene-butadiene-rubber liquid-latex additive.
      a. For wall applications, provide non-sagging mortar that complies with Paragraph F-4.6.1 in addition to the other requirements in ANSI A118.4.

3. Medium-Bed, Latex-Portland Cement Mortar: Provide materials composed as follows, with physical properties equaling or exceeding those required for thin-set mortars based on testing of medium-bed specimens according to ANSI A118.4:
   1. Prepackaged dry-mortar mix combined with styrene-butadiene-rubber liquid-latex additive.

4. Chemical-Resistant, Water-Cleanable, Grouting Epoxy (at All floor, base and wall applications): ANSI A118.3.
   1. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 deg F and 212 deg F, respectively, and certified by grout manufacturer for intended use.
a. Laticrete “Latapoxy SP-100” stainless epoxy grout or approved equal.
b. Un-sanded grout mixture for joints 1/8 inch and narrower.
c. Sanded grout mixture for joints 1/8 inch and wider.

2.5 SETTING AND GROUTING MATERIALS (EXTERIOR WALLS TILE)

1. Basis-of-Design Product: ARDEX X5 or approved equal. Meets or exceeds ANSI 118.4, ANSI 118.11.

2.6 ELASTOMERIC SEALANTS

1. Refer to Specification Section 07920 - Joint Sealants.

2.7 MISCELLANEOUS MATERIALS

1. Metal edge and corner trim: Schluter (or equal) to be provided at corners, edges and transition to non-tile material as follows: Verify final sizes with tile selection.
   1. Interior wall tile outside corners vertical – Jolly 3/8” brushed stainless steel edge trim
   2. Interior wall tile outside corners horizontal – Quadec 3/8” brushed stainless steel edge trim

2. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

3. Temporary Protective Coating: Either product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products; and easily removable after grouting is completed without damaging grout or tile.
   1. Petroleum paraffin wax, fully refined and odorless, containing at least 0.5 percent oil with a melting point of 120 to 140 deg F per ASTM D 87.
   2. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as temporary protective coating for tile.

4. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

2.8 MIXING MORTARS AND GROUT
1. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

2. Add materials, water, and additives in accurate proportions.

3. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

1. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
   
   1. Verify that substrates for setting tile are firm; dry; clean; free of oil, waxy films, and curing compounds; and within flatness tolerances required by referenced ANSI A108 Series of tile installation standards for installations indicated.
   
   2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed before installing tile.
   
   3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

   2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

1. Remove coatings, including curing compounds and other substances that contain soap, wax, oil, or silicone, that are incompatible with tile-setting materials.

2. After reviewing with Architect/Structural Engineer demolish concrete slab in existing showers as necessary to accommodate modeled shower tray.

3. Install membrane waterproofing system per manufacturer's instructions.

   
   1. Fill cracks, holes, and depressions with trowelable leveling and patching compound according to tile-setting material manufacturer's written instructions. Use product specifically recommended by tile-setting material manufacturer.
2. Remove protrusions, bumps, and ridges by sanding or grinding.

5. Blending: For tile exhibiting color variations within ranges selected during Sample submittals, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

6. Field-Applied Temporary Protective Coating: Where needed to prevent grout from staining or adhering to exposed tile surfaces, pre-coat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.3 INSTALLATION, GENERAL

1. ANSI Tile Installation Standards: Comply with parts of ANSI A108 Series "Specifications for Installation of Ceramic Tile" that apply to types of setting and grouting materials and to methods indicated in ceramic tile installation schedules.


3. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions, unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

4. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

5. Jointing Pattern: Lay tile in grid pattern, unless otherwise indicated. Align joints when adjoining tiles on floor, base, walls, and trim are same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise indicated.

   1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.

6. Lay out tile wainscots to next full tile beyond dimensions indicated. NO CUT TILES PERMITTED.

7. Install metal wall trim at all corners and edge transitions as per manufacturer’s printed instructions.

8. Expansion Joints: Locate expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
1. Locate joints in tile surfaces directly above joints in concrete substrates.
2. Prepare joints and apply sealants to comply with requirements in Division 7 Section "Joint Sealants".

9. Grout tile to comply with requirements of the following tile installation standards:
   1. For chemical-resistant epoxy grouts, comply with ANSI A108.6.

3.4 FLOOR TILE INSTALLATION

1. General: Install tile to comply with requirements in the Floor Tile Installation Schedule, including those referencing TCA installation methods and ANSI A108 Series of tile installation standards.

   1. For installations indicated below, follow procedures in ANSI A108 Series tile installation standards for providing 95 percent mortar coverage.
      a. Tile floors in wet areas.
      b. Tile floors composed of tiles 8 by 8 inches or larger.
      c. Tile floors composed of rib-backed tiles.

2. Joint Widths: Install tile on floors with the following joint widths:
   1. Large format tile: 1/8 inch.

3.5 INTERIOR WALL TILE INSTALLATION

1. Install types of tile designated for wall installations to comply with requirements in the Wall Tile Installation Schedule, including those referencing TCA installation methods and ANSI setting-bed standards.

2. Install metal lath and scratch coat for walls to comply with ANSI A108.1A, Section 4.1.

3. Joint Widths: Install tile on walls with the following joint widths:
   1. Large format tile: 1/8 inch.

3.6 EXTERIOR WALL TILE INSTALLATION

1. The exterior wall thinset shall be applied over the cementitious waterproofing with notched trowel. Apply the thinset over the entire wall surface, including the 5” joints between the tile. After the notched thinset has cured between the tiles then the cement plaster can be applied. Final coursing to be based on final tile dimensions from mock-up and selected tile.

2. Joint Widths: Install tile on walls with the following joint widths:
1. Saltillo tile: Custom grouting width varies, see details.

3.7 CLEANING AND PROTECTING

1. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
   1. Remove epoxy and latex-portland cement grout residue from tile as soon as possible.
   2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions, but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
   3. Remove temporary protective coating by method recommended by coating manufacturer that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent it from clogging drains.

2. When recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.

3. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

4. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

END OF SECTION 09 30 13
SECTION 09 91 00 - PAINTING

PART 1 - GENERAL

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

1.2 SUMMARY
A. This Section includes surface preparation and field painting of exposed exterior and interior items and surfaces.
   1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
B. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Architect will select from standard colors and finishes available.
   1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory-applied final finish.
C. Do Not Paint pre-finished items, concealed surfaces, finished metal surfaces, operating parts and labels.
   1. Pre-finished items include the following factory-finished components:
      a. Architectural woodwork.
      b. Light fixtures.
   2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:
      a. Foundation spaces.
      b. Furred areas.
      c. Ceiling plenums.
      d. Utility tunnels.
      e. Pipe spaces.
      f. Duct shafts.
   3. Finished metal surfaces include the following:
      a. Anodized or factory painted aluminum.
      b. Stainless steel.
c. Copper and copper alloys.

4. Operating parts include moving parts of operating equipment and the following:
   a. Valve and damper operators.
   b. Linkages.
   c. Sensing devices.
   d. Motor and fan shafts.

5. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

D. Related Sections include, but are not limited to, the following:
   1. Division 05, Section "Structural Steel Framing" for shop priming structural steel to receive paint.

1.3 REFERENCES

A. Publications and standards listed herein are part of the specification to the extent referenced. The criteria established in the specifications shall take precedence over the standards referenced herein.

1. SSPC - Society for Protective Coatings; "Surface Preparation Standards."
2. NACE International - The National Association of Corrosion Engineers International; "NACE Standards."
3. PDCA - Painting and Decorating Contractors of American; "PDCA Industry Standards."

1.4 DEFINITIONS

A. General: Standard coating terms defined in ASTM D 16 apply to this Section.

1. Flat, refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
2. Eggshell, refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
3. Semi-gloss, refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.
4. Full gloss, refers to high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.

1.5 SUBMITTALS

A. Submit in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.09 SUBMITTALS and UGC Article 8.

B. Product Data: For each paint system indicated. Include block fillers and primers.
1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.

2. Manufacturer’s Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.

C. Samples for Initial Selection: For each type of finish-coat material indicated.
   1. After color selection, Architect will furnish color chips for surfaces to be coated.

D. Samples for Verification: For each color and material to be applied, with texture to simulate actual conditions, on representative Samples of the actual substrate.
   1. Provide stepped Samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.
   2. Provide a list of materials and applications for each coat of each Sample. Label each Sample for location and application.
   3. Submit three (3) Samples on the following substrates for Architect's review of color and texture only:
      a. Concrete: 4-by-6-inch Samples for each color and finish.
      b. Painted Wood: 12-inch-square Samples for each color and material on hardboard.
      c. Stained or Natural Wood: 6-by-10-inch Samples of natural- or stained-wood finish on representative wood surfaces.
      d. Ferrous Metal: Square Samples of flat metal and 8-inch-long Samples of solid metal for each color and finish.

E. Qualification Data: For Applicator.

1.6 QUALITY ASSURANCE

A. Quality Assurance per UGC Article 8 and Special Conditions 1.10.

B. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

C. Source Limitations: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats.

D. Benchmark Samples (Mockups): Provide a full-coat benchmark finish sample for each type of coating and substrate required. Comply with procedures specified in PDCA PS. Duplicate finish of approved sample Submittals.
   1. Architect will select one room or surface to represent surfaces and conditions for application of each type of coating and substrate.
a. Wall Surfaces: Provide samples on at least 100 sq. ft.
b. Small Areas and Items: Architect will designate items or areas required.

2. Apply benchmark samples, according to requirements for the completed Work, after permanent lighting and other environmental services have been activated. Provide required sheen, color, and texture on each surface.
   a. After finishes are accepted, Architect will use the room or surface to evaluate coating systems of a similar nature.

3. Final approval of colors will be from benchmark samples.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:
   1. Product name or title of material.
   2. Product description (generic classification or binder type).
   3. Manufacturer's stock number and date of manufacture.
   4. Contents by volume, for pigment and vehicle constituents.
   5. Thinning instructions.
   6. Application instructions.
   7. Color name and number.
   8. VOC content.

B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain storage containers in a clean condition, free of foreign materials and residue.
   1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.

1.8 PROJECT CONDITIONS

A. Apply waterborne paints only when temperatures of surfaces to be painted and surrounding air are between 50 and 90 deg F.

B. Apply solvent-thinned paints only when temperatures of surfaces to be painted and surrounding air are between 45 and 95 deg F.

C. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
   1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.
1.9 EXTRA MATERIALS

A. Furnish extra paint materials from the same production run as the materials applied and in the quantities described below. Package with protective covering for storage and identify with labels describing contents. Deliver extra materials to Owner.

1. Quantity: Furnish Owner with an additional 3 percent, but not less than 1 gal. or 1 case, as appropriate, of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.

B. Manufacturers' Names: Painting Schedule at the end of this Section indicates paint products from PPG Industries. Equal products from the following additional manufacturers are approved for use on this Project:

1. Benjamin Moore & Co. (Benjamin Moore).
2. Glidden Professional (Glidden Professional/PPG).
3. PPG Industries, Inc. (Pittsburgh Paints).

2.2 PAINT MATERIALS, GENERAL

A. Material Compatibility: Provide block fillers, primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.

1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

C. Colors: As selected by Architect from manufacturer's full range. Color selection samples to include, at a minimum, the following areas:
1. misc. metals.

EXECUTION

2.3 PREPARATION

A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

B. Cleaning: Before applying paint or other surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning.

1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer’s written instructions for each particular substrate condition and as specified.

1. Provide barrier coats over incompatible primers or remove and reprime.
2. Cementitious Materials: Prepare concrete, concrete unit masonry, cement plaster, and mineral-fiber-reinforced cement panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
   a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
   b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces if moisture content exceeds that permitted in manufacturer’s written instructions.
   c. Clean concrete floors to be painted with a 5 percent solution of muriatic acid or other etching cleaner. Flush the floor with clean water to remove acid, neutralize with ammonia, rinse, allow to dry, and vacuum before painting.

3. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.
   a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
   b. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and back sides of wood, including cabinets, counters, cases, and paneling.
c. If transparent finish is required, backprime with spar varnish.
d. Backprime paneling on interior partitions where masonry, plaster, or other wet wall construction occurs on back side.
e. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.

4. Ferrous Metals: Clean un-galvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC's recommendations.
   a. Clean steel surfaces as recommended by paint system manufacturer.
   b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
   c. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.

5. Galvanized Surfaces: Clean galvanized surfaces with non-petroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

D. Material Preparation: Mix and prepare paint materials according to manufacturers written instructions.
   1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
   2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
   3. Use only thinners approved by paint manufacturer and only within recommended limits.

E. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

2.4 APPLICATION

A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
   1. Paint colors, surface treatments, and finishes are indicated in the paint schedules.
   2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
   3. Provide finish coats that are compatible with primers used.
   4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.

6. Paint interior surfaces of ducts with a flat, non-specular black paint where visible through registers or grilles.

7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.

8. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.

9. Finish interior of wall and base cabinets and similar field-finished casework to match exterior.

10. Sand lightly between each succeeding enamel or varnish coat.

B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer’s written instructions, sand between applications.

2. Omit primer over metal surfaces that have been shop primed and touchup painted.

3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.

4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.

C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer’s written instructions.

1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.

2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep’s wool as recommended by manufacturer for material and texture required.

3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.

D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer’s recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.

E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and occupied spaces.
F. Mechanical items to be painted include, but are not limited to, the following:
   1. Exposed un-insulated metal piping.
   2. Exposed un-insulated plastic piping.
   3. Exposed pipe hangers and supports.
   4. Exposed visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
   5. Exposed duct, equipment, and pipe insulation having "all-service jacket" or other paintable jacket material.
   6. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
   7. HVAC diffusers and grilles installed on or within painted wall or soffit surfaces.

G. Electrical items to be painted include, but are not limited to, the following:
   1. Electrical equipment that is located in areas exposed to the general public.

H. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.

I. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

J. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.
   1. Provide satin finish for final coats.

K. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

L. Field Repairs of Hot-Dip Galvanized Metal Finishes: Where approved by Architect, minor damages or imperfections may be refinished as follows:
   1. Preparation: Remove oil or soap film with detergent or emulsion cleaner. Power clean surface to SSPC SP 11.
   2. Surfaces to Receive Paint Finish: Apply one coat of Amercoat 68H Zinc Rich Epoxy, 3-5 mils dft. (Applied immediately after preparation completed.)
   3. Surface with Exposed Galvanized Finish: Apply two coats of Amercoat 68H Zinc Rich Epoxy, 3-5 mils dft. (Apply first coat immediately after preparation completed.)

2.5 FIELD QUALITY CONTROL
A. Owner reserves the right to invoke the following test procedure at any time and as often as Owner deems necessary during the period when paint is being applied:

1. Owner may engage a qualified independent testing agency to sample paint material being used. Samples of material delivered to Project will be taken, identified, sealed, and certified in the presence of Contractor.

2. Owner may direct Contractor to stop painting if test results show material being used does not comply with specified requirements. Contractor shall remove non-complying paint from Project site, pay for testing, and repaint surfaces previously coated with the non-complying paint. If necessary, Contractor may be required to remove non-complying paint from previously painted surfaces if, on repainting with specified paint, the two coatings are incompatible.

2.6 CLEANING

A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.

1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.

2.7 PROTECTION

A. Protect work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.

B. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.

1. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

2.8 PAINT SCHEDULE MISCELLANEOUS METALS

A. Ferrous Metal: Provide the following finish systems over unpainted miscellaneous metals. Primer is not required on shop-primed items.

1. Low-Luster Acrylic Finish :
   a. Primer: PPG; 90-912 Series Pitt-Tech Plus Int/Ext DTM Industrial Primer; 2.0 to 4.0 Dry Mils.
   b. Intermediate: PPG; 90-1110 Series Pitt-Tech® Plus Satin DTM Industrial Enamels; 2.0 to 4.0 Dry Mils.
   c. Finish Coat: PPG; 90-1110 Series Pitt-Tech® Plus Satin DTM Industrial Enamels; 2.0 to 4.0
2.9 EXTERIOR WOOD PAINT SCHEDULE
   A. EXTERIOR AND INTERIOR WOOD FOR NATURAL TRANSPARENT FINISH, INCLUDING
      BUT NOT LIMITED TO FASCIAS, SOFFITS, TRIM, FRAMES, EXTERIOR WOOD DOORS,
      INTERIOR WOOD DOORS:
      Wood Oil Finish: “Ultra Premium Red Label Penofin (Clear) - Apply per
      Manufacturer’s Instructions.

3.0 EXTERIOR HIGH PERFORMANCE SCHEDULE
   A. FRP DOORS: Where indicate, provide the following finish system over exterior ferrous metal.
      1. Eggshell Urethane Finish:
         a. Primer: PPG; Amerlock 2 VOC Epoxy Coating; 4.0 to 6.0 Dry Mils.
         b. Intermediate: PPG; Amercoat 450 HSG Semi-Gloss Urethane; 2.0 – 5.0 Dry Mils.
         c. Finish Coat: PPG; Amercoat 450 HSG Semi-Gloss Urethane; 2.0 – 5.0 Dry Mils
SECTION 09 97 23 – CONCRETE SEALERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Concrete floor sealer & floor wax for concrete floors that are indicated to receive a sealed finish and are not polished concrete (i.e. East Chase and West Chase).

B. Related Sections Include the following:

1. Division 03, Section "03 30 00 - Cast-in-Place Concrete."

1.3 SUBMITTALS

A. Submit in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.09 SUBMITTALS and UGC Article 8.

B. Product Data: Submit manufacturer’s product data, including surface preparation and application instructions.

C. Installer’s Project References: Submit list of successfully completed projects, including project name and location, name of architect, and type and quantity of concrete floor finishing

D. Maintenance Instructions: Submit manufacturer’s maintenance and cleaning instructions.

1.4 QUALITY ASSURANCE

A. Quality Assurance per UGC Article 8 and Special Conditions 1.10.

B. Single Source Responsibility: Concrete floor finish materials shall be products of a single manufacturer.

C. Installer’s Qualifications:

1. Successful experience in application of similar concrete floor finishes.

2. Employ persons trained for application of concrete floor finishes.
C. Preinstallation Meeting: Convene a preinstallation meeting before start of application of concrete floor finishes. Require attendance of parties directly affecting work of this section, including Contractor, Architect, and application. Review surface preparation, application, protection, and coordination with other work.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to site in manufacturer’s original, unopened containers and packaging, with labels clearly identifying manufacturer, product name, and concrete floor stain color.

B. Storage: Store materials in a clean, dry area indoors in accordance with manufacturer’s instructions. Keep containers sealed until ready for use.

C. Handling: Protect materials during handling and application to prevent damage or contamination.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Do not apply concrete floor finishes when air or surface temperature is below 40 degrees F.

B. Concrete Floor Sealer: Do not apply when air or surface temperature is below 55 degrees F.

1.7 SEQUENCING

A. Prepare surface and apply concrete floor finish after other interior finish work is completed and before baseboards and installed.

PART 2 - PRODUCTS

2.1 CONCRETE FLOOR SEALER

A. Clear, water-based, 40 percent alkylalkoxysilane penetrating sealer providing protection against moisture intrusion, freeze/thaw cycles, and chloride intrusion.

B. Concrete Floor Sealer: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. BASF Corporation.
2. Concrete Coatings Inc.
3. L & M Construction Chemicals, Inc.
4. The Euclid Chemical Company.
5. Or approved equal
C. **Basis-of-Design Product:** Provide clear, water-based, 40 percent alkylalkoxysilane penetrating sealer at all concrete floor surfaces indicated to receive a sealed finish; MasterProtect H 400 (formerly Enviroseal 40) by BASF; or approved equal.

D. **Water-repellent sealer** shall have the following minimum performance:

1. Compliance: Alberta DOT, Type 1b.
2. Flash Point, ASTM D3278, SETA: Greater than 200 degrees F (93 degrees C).
   a. 48 Hours: 0.42 percent.
   b. 50 Days: 1.2 percent.
4. Scaling Resistance Rating, ASTM C672, non-air-entrained concrete, 100 cycles treated concrete: 0; no scaling.
5. Resistance to Chloride-Ion Penetration, AASHTO T259 and T260.
   a. Criteria of 1.5 at 1/2 inch (13 mm): Less than 0.52 lbs per cy (0.31 kg/m$^3$).
   b. Criteria of 0.75 at 1 inch (25 mm): 0.00 lbs per cy (0.00 kg/m$^3$).
6. Water Weight Gain, NCHRP 244 Series II Cube Test: 85 percent reduction, exceeds criteria.
7. Absorbed Chloride, NCHRP 244 Series II Cube Test: 87 percent reduction, exceeds criteria.
8. Absorbed Chloride, NCHRP 244 Series IV Southern Climate: 99 percent reduction, exceeds criteria.
9. Water Repellent Performance, Alberta Transportation and Utilities Procedures Type 1b:
   a. Initial Performance: 89 percent.
   b. Post-Abrasion Performance: 89.4 percent.
10. Solids and Active Ingredients: 40 percent by weight.
11. Specific Gravity, 77 degrees F (25 degrees C): 0.95.
12. Density: 7.9 lbs per gal.
13. Penetration, average depth, depending upon substrate: 0.24 inch (6.1 mm).
14. VOC Content, EPA Method 24: Less than 2.92 lbs per gal (350 g/L), less water and exempt solvents.

E. **Concrete Floor Wax:** Provide 2 coats of manufacturer’s recommend slip-resistant, wax over all floors specified to receiving sealer.

**PART 3 - EXECUTION**

3.1 **EXAMINATION**

A. Examine surfaces to receive concrete floor finishes. Notify Architect if surfaces are not acceptable. Do not begin surface preparation or application until unacceptable conditions have been corrected.
3.2 SURFACE PREPARATION

A. Protection:
   1. Protect walls and surrounding surfaces not to receive concrete floor finishes.
   2. Do not allow stain to come in contact with wood or metal surfaces.

B. Prepare concrete surface in accordance with manufacture’s instructions.

C. Concrete shall be as specified in Section 03 30 00. Ensure concrete is a minimum of 28 days old.

D. Ensure concrete surface is clean, dry, structurally sound, and free from dirt, dust, oil, grease, solvents, paint, wax, asphalt, concrete curing compounds, sealing compounds, surface hardeners, bond breakers, adhesive residue, and other surface contaminants.

E. Do not acid wash or use heavy alkali cleaners.

3.3 APPLICATION

A. Apply concrete floor finishes in accordance with manufacture’s instructions at locations indicated on the drawings.

B. Concrete Floor Sealer: Apply concrete floor sealer over concrete floor stain in accordance with manufacturer’s instructions.

C. Keep material containers closed when not in use to avoid contamination.

D. Concrete Floor Wax: Apply to sealed concrete floor surfaces as per manufacturer written recommendation.

3.4 PROTECTION

A. Protect sealed concrete floor from damage during construction.

B. Protect concrete surfaces from foot traffic for a minimum of 24 hours.

C. Void washing concrete surfaces for a minimum of 48 hours.

END OF SECTION 09 97 23
SECTION 10 14 23 - ROOM IDENTIFICATION SIGNAGE

PART 1 - GENERAL

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

1.2 SUMMARY
   A. Section Includes:
      1. Room-identification, panel signs.

1.3 DEFINITIONS
   A. Accessible: In accordance with the accessibility standard.

1.4 COORDINATION
   A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.
   B. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.5 ACTION SUBMITTALS
   A. Submit in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.09 SUBMITTALS and UGC Article 8.
   B. Product Data: For each type of product.
   C. Shop Drawings: For panel signs.
      1. Include fabrication and installation details and attachments to other work.
      2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
      3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size scale.
D. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.
   1. Include representative Samples of available typestyles and graphic symbols.

E. Samples for Verification: For each type of sign assembly showing all components and with the required finish(s), in manufacturer's standard size unless otherwise indicated and as follows:
   1. Panel Signs: Full-size Sample.
   2. Exposed Accessories: Full-size Sample of each accessory type.

F. Product Schedule: For panel signs. Use same designations indicated on Drawings or specified.

1.6 INFORMATIONAL SUBMITTALS
A. Submit in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.09 SUBMITTALS and UGC Article 8.

B. Qualification Data: For Installer and manufacturer.

C. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS
A. Closeout per UGC 12 and Special Conditions 1.13 and Warranty per UGC Article 13 and Special Conditions 1.14.

B. Maintenance Data: For signs to include in maintenance manuals.

1.8 QUALITY ASSURANCE
A. Quality Assurance per UGC Article 8 and Special Conditions 1.10.

B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.9 FIELD CONDITIONS
A. Field Measurements: Verify locations of anchorage devices embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.10 WARRANTY
A. Warranty per UGC Article 13 and Special Conditions 1.14.
B. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Deterioration of finishes beyond normal weathering.
   b. Deterioration of embedded graphic image.
   c. Separation or delamination of sheet materials and components.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design, and the 2012 Texas Accessibility Standards (TAS)."

2.2 PANEL SIGNS

A. Panel Sign: ADA and ADA compliant signs with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. ARK Ramos.
   b. ASI Modulex, Inc.
   c. Best Sign System, Inc.
   d. Corpus Christi Stamp Works, Inc.
   e. Gemini Incorporated.
   f. Metal Arts.
   g. Southwell Company.
   h. System 290,
   i. Vomar Products.
   j. Or other approved manufacturer.

2. Engraved Plastic-Laminate Sign: Plastic-laminate face laminated to contrasting phenolic core to produce composite sheet.
   a. Composite-Sheet Thickness: 6.35 mm (0.25 inch).
   b. Engraved Graphics: Characters machine engraved through plastic-laminate face sheet to expose contrasting phenolic core.
   d. Core Color: Manufacturer's standard "White."
3. **Braille:** Raised Tactile Grade 2 Braille shall be integral with the sign face and be raised 0.031 mm (1/32”). Glass or metallic rasters to have .059 mm surface diameter with body of sphere pressure secured below face laminate. Glued on dots will NOT be acceptable.

4. **Raised symbols:** Shall be 76 mm (3” high), raised 0.031 mm (1/32”) from sign face and unitized with the acrylic sign core.

5. **Sign-Panel Perimeter:** Finish edges, polished smooth.
   a. **Edge Condition:** Square cut.
   b. **Corner Condition in Elevation:** Rounded to 3 mm (1/8”) radius.

6. **Mounting:** Two-face tape.

7. **Text and Typeface:** As indicated on the Drawings. Finish engraved characters to contrast with background color, and finish Braille to match background color.

8. **Flatness Tolerance:** Sign shall remain flat or uniformly curved under installed conditions as indicated on Drawings and within a tolerance of plus or minus 1.5 mm (1/16 inch) measured diagonally from corner to corner.

9. **Backer Panel:** For signs mounted on glass sidelites, provide a blank, plastic-laminate sheet the same size, shape, and color as the as the room-identifications; and, mount the backer panel to the glass sidelite, directly behind the room-identification sign with double sided tape.

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2.3 **PANEL-SIGN MATERIALS**

A. **Plastic-Laminate Sheet:** NEMA LD 3, general-purpose HGS grade, 1.2 mm (0.048-inch) nominal thickness.

2.4 **ACCESSORIES**

A. **Adhesive:** As recommended by sign manufacturer.

B. **Two-Face Tape:** Manufacturer's standard high-bond, foam-core tape, 1.14 mm (0.045 inch) thick, with adhesive on both sides.

2.5 **FABRICATION**

A. **General:** Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Preassemble signs in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.

2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.

3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side.
Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.

4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.

5. Internally brace signs for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners.

6. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

B. Surface-Engraved Graphics: Machine engrave characters and other graphic devices into indicated sign surface to produce precisely formed copy, incised to uniform depth.

1. Engraved Plastic Laminate: Engrave through exposed face ply of plastic-laminate sheet to expose contrasting core ply.

2.6 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.

C. Verify that anchorage devices embedded in permanent construction are correctly sized and located to accommodate signs.

D. Verify that electrical service is correctly sized and located to accommodate signs.

E. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Install signs so they do not protrude or obstruct according to the accessibility standard.
3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

B. Accessible Signage: Install in locations on walls as indicated on Drawings and according to the accessibility standard.

C. Mounting Methods:

1. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.

3.3 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by the Contracting Officer.

END OF SECTION 10 14 23
SECTION 10 21 13.13 - METAL TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Textured stainless-steel toilet compartments configured as toilet enclosures, shower compartment doors and urinal screens.

B. Related Requirements:
   1. Section 06 10 00 "Rough Carpentry" for blocking of overhead support of compartments and screens.
   2. Section 10 28 00 "Toilet, Bath, and Laundry Accessories" for toilet tissue dispensers, grab bars, purse shelves, and similar accessories mounted on toilet compartments.

1.3 ACTION SUBMITTALS

A. Submit in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.09 SUBMITTALS and UGC Article 8.

B. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for toilet compartments.

C. Shop Drawings: For toilet compartments.
   1. Include plans, elevations, sections, and attachment details.
   2. Show locations of cutouts for compartment-mounted toilet accessories.
   3. Show locations of reinforcements for compartment-mounted grab bars and locations of blocking for surface-mounted toilet accessories.
   4. Show locations of centerlines of toilet fixtures.
   5. Show locations of floor drains.
   6. Show support or bracing locations.

D. Samples for Initial Selection: For each type of toilet compartment material indicated.
1. Include Samples of hardware and accessories involving material and color selection.

E. Samples for Verification: For the following products, in manufacturer’s standard sizes unless otherwise indicated:
   1. Each type of material, color, and finish required for toilet compartments, prepared on 6-inch-(152-mm-) square Samples of same thickness and material indicated for Work.
   2. Each type of hardware and accessory.

F. Product Schedule: For toilet compartments, prepared by or under the supervision of supplier, detailing location and selected colors for toilet compartment material.

1.4 INFORMATIONAL SUBMITTALS

A. Submit in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.09 SUBMITTALS and UGC Article 8.

B. Product Certificates: For each type of toilet compartment.

1.5 CLOSEOUT SUBMITTALS

A. Closeout per UGC 12 and Special Conditions 1.13 and Warranty per UGC Article 13 and Special Conditions 1.14.

B. Maintenance Data: For toilet compartments to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

   1. Door Hinges: One hinge with associated fasteners.
   2. Latch and Keeper: One latch(es) and keeper(s) with associated fasteners.
   3. Door Bumper: One door bumper(s) with associated fasteners.
   4. Door Pull: One door pull(s) with associated fasteners.
   5. Fasteners: 10 fasteners of each size and type.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.
PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for toilet compartments designated as accessible.

2.2 TEXTURED STAINLESS STEEL TOILET COMPARTMENTS

A. Manufacturer: ASI Global Partitions or equal.

B. Pattern, Color: Stainless Steel, Diamond Texture.

C. Toilet-Enclosure Style: Floor anchored, overhead braced.

D. Shower Entrance-Screen Style: Wall hung

E. Urinal-Screen Style: Wall hung, flat panel

F. Door, Panel, and Pilaster Construction: Seamless, metal facing sheets pressure laminated to core material; with continuous, interlocking molding strip or lapped-and-formed edge closures; corners secured by welding or clips and exposed welds ground smooth. Exposed surfaces shall be free of pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections.

1. Core Material: Manufacturer's standard sound-deadening honeycomb of resin-impregnated kraft paper in thickness required to provide finished thickness of 1 inch (25 mm) for doors and panels and 1-1/4 inches (32 mm) for pilasters.

2. Grab-Bar Reinforcement: Provide concealed internal reinforcement for grab bars mounted on units of size and material adequate for panel to withstand applied downward load on grab bar of at least 250 lbf (1112 N), when tested according to ASTM F446, without deformation of panel.

3. Tapping Reinforcement: Provide concealed reinforcement for tapping (threading) at locations where machine screws are used for attaching items to units.

G. Urinal-Screen Construction:

1. Flat-Panel Urinal Screen: Matching panel construction.

H. Facing Sheets and Closures: 22 gauge stainless steel, sheet with nominal base-metal (uncoated) thicknesses as follows:

1. Pilasters, Braced at Both Ends: Manufacturer's standard thickness, but not less than 0.036 inch (0.91 mm).

2. Pilasters, Unbraced at One End: Manufacturer's standard thickness, but not less than 0.048 inch (1.21 mm).
3. Panels: Manufacturer's standard thickness, but not less than 0.030 inch (0.76 mm).
4. Doors: Manufacturer's standard thickness, but not less than 0.030 inch (0.76 mm).
5. Flat-Panel Urinal Screens: Thickness matching the panels.

I. Pilaster Shoes and Sleeves (Caps): Stainless steel sheet, not less than 0.031-inch (0.79-mm) nominal thickness and 3 inches (76 mm) high, finished to match hardware.

J. Brackets (Fittings):
   1. Stirrup Type: Ear or U-brackets; stainless steel.
   2. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel.

K. Steel Sheet Finish: Immediately after cleaning and pretreating, apply manufacturer's standard baked-on finish, including thermosetting, electrostatically applied, and powder coatings. Comply with coating manufacturer's written instructions for applying and baking.

2.3 HARDWARE AND ACCESSORIES

A. Hardware and Accessories: Manufacturer's heavy-duty operating hardware and accessories.
   1. Hinges: Manufacturer's minimum 0.062-inch (1.59-mm) thick, stainless steel continuous, cam type that swings to a closed or partially open position, allowing emergency access by lifting door. Mount with through-bolts.
   2. Latch and Keeper: Manufacturer's heavy-duty, surface-mounted, cast stainless steel latch unit designed to resist damage due to slamming, with combination rubber-faced door strike and keeper and with provision for emergency access. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible. Mount with through-bolts.
   5. Door Pull: Manufacturer's heavy-duty cast stainless steel pull at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible. Mount with through-bolts.

B. Overhead Bracing: Manufacturer's heavy-duty continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.

C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel compatible with related materials.
2.4 MATERIALS

A. Aluminum Castings: ASTM B26/B26M.

B. Aluminum Extrusions: ASTM B221 (ASTM B221M).

C. Brass Castings: ASTM B584.

D. Brass Extrusions: ASTM B455.

E. Steel Sheet: Commercial steel sheet for exposed applications; mill phosphatized and selected for smoothness.
   1. Electrolytically Zinc Coated: ASTM A879/A879M, 01Z (03G).

F. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, stretcher-leveled standard of flatness.

G. Stainless Steel Castings: ASTM A743/A743M.

H. Zamac: ASTM B86, commercial zinc-alloy die castings, chrome plated.

2.5 FABRICATION

A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories, and solid blocking within panel where required for attachment of toilet accessories.

B. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.

C. Door Size and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide, in-swinging doors for standard toilet compartments and 36-inch- (914-mm-) wide, out-swinging doors with a minimum 32-inch- (813-mm-) wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.
   1. Confirm location and adequacy of blocking and supports required for installation.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Coordinate layout and installation of supports, inserts, and anchors built into other units of work for toilet compartment anchorage.

3.2 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position indicated with manufacturer's recommended anchoring devices.

1. Maximum Clearances:
   a. Pilasters and Panels: 1/2 inch (13 mm).
   b. Panels and Walls: 1 inch (25 mm).

2. Full-Height (Continuous) Brackets: Secure panels to walls and to pilasters with full-height brackets.
   a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
   b. Align brackets at pilasters with brackets at walls.

B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches (44 mm) into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.

C. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.3 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors and doors in entrance screens to return doors to fully closed position.

END OF SECTION 10 21 13.13
SECTION 102800 - TOILET AND BATH ACCESSORIES

1.1 GENERAL

A. Submittals: Manufacturer's Product Data. Include construction details, material descriptions and thicknesses, dimensions, profiles, fastening and mounting methods, specified options, and finishes for each type of accessory specified.

B. Product Options: Accessory requirements, including those for materials, finishes, dimensions, capacities, and performance, are established by specific products indicated in the Toilet and Bath Accessory Schedule.

1. Products of other manufacturers with equal characteristics, as judged solely by Architect, may be provided.

1.2 REGULATORY REQUIREMENTS

A. Conform to ANSI A117.1 code for access for the handicapped.

1.3 PRODUCTS

A. Manufacturers: Subject to compliance with requirements, provide accessories by one of the following:

1. Toilet and Bath Accessories:
   a. Bobrick Washroom Equipment, Inc.
   c. Koala Kare Products
   d. World Dryer Corporation
   e. Metpar Corporation
   f. GOJO Industries, Inc.

B. Materials: As follows:

1. Stainless Steel: ASTM A 666, Type 304, with No. 4 finish (satin), in 0.0312-inch minimum nominal thickness, unless otherwise indicated.
2. Brass: ASTM B 19, leaded and unleaded flat products; ASTM B 16, rods, shapes, forgings, and flat products with finished edges; ASTM B 30, castings.
3. Sheet Steel: ASTM A 366/A 366M, cold rolled, commercial quality, 0.0359-inch minimum nominal thickness; surface preparation and metal pretreatment as required for applied finish.
7. Mirror Glass: ASTM C 1036, Type I, Class 1, Quality q2, nominal 6.0 mm thick, with silvering, electroplated copper coating, and protective organic coating complying with FS DD-M-411.
9. Fasteners: Stainless steel screws, bolts and other devices tamper and theft resistant when exposed, and of galvanized steel when fully concealed.
10. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

1.4 EXECUTION

A. Install accessories according to manufacturers written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb and firmly anchored in locations and at heights indicated.

1. Secure mirrors to walls in concealed, tamper-resistant manner with recommended adhesive. Set units level plumb, and square at locations indicated, according to manufacturer's written instructions for substrate indicated.
2. Install grab bars to withstand a downward load of at least 250 lbf, when tested according to method in ASTM F 446.
3. Install accessories in accordance with manufacturers instructions and ANSI A117.1.
4. Install plumb and level, securely and rigidly anchored to substrate.

B. Adjust accessories for unencumbered, smooth operation and verify that mechanisms function properly. Replace damaged or defective items.

C. Remove temporary labels and protective coatings.

D. Clean and polish exposed surfaces according to manufacturer's written recommendations.

1.5 TOILET ACCESSORIES SCHEDULE

A. See architectural drawings Sheet A601 for accessories schedule.

END OF SECTION 10801
SECTION 10 44 16 - FIRE-PROTECTION SPECIALTIES (FIRE EXTINGUISHERS)

1.1 GENERAL

A. Submittals: Submit the following:

   1. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire-protection specialties.
      a. Fire Extinguishers: Include rating and classification.

B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Standard for Portable Fire Extinguishers".

C. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

D. Coordinate size of cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

1.2 PRODUCTS

A. Portable Fire Extinguishers: Provide fire extinguishers of type, size, and capacity for each cabinet and other locations indicated.

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. Badger-Powhatan.
      c. J.L. Industries.
      d. Larsen’s Manufacturing Co.
      e. Samson Metal Products, Inc.
      f. Walter Kidde, Division of Kidde, Inc.

B. Fire Extinguishers: Provide fire extinguishers for each extinguisher cabinet and other locations indicated.

   1. Larsens MP-10 or equivalent.
   2. (3) Units Total

C. Fire Extinguisher Cabinets: Provide fire extinguisher cabinets where indicated (FEC), of suitable size for housing fire extinguishers of types and capacities indicated.

   1. Larsens Manuf. Co. or equivalent.
   2. CAMEO #AL-C2409-5R (Door: Clear/no letters).
   3. (2) Units Total @ Foyer.
D. Fire Extinguisher Brackets:

1. Larsens Manuf. Co. or equivalent B-2.
2. (2) Units Total: West & East Chases.
3. Securely fasten mounting brackets and fire extinguisher cabinets to structure, square and plumb, to comply with manufacturer’s instructions.

1.3 EXECUTION

A. Comply with manufacturer’s written instructions for installing fire-protection specialties.

B. Install in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.

   1. Prepare recesses for cabinets as required by type and size of cabinet and trim style.
   2. Fasten mounting brackets to structure and cabinets, square and plumb.

C. Adjust cabinet doors that do not swing or operate freely.

END OF SECTION 10 44 16
1.1 GENERAL CONDITIONS

A. Sections of the Specifications covering general and supplemental conditions are a part of the contract and Contractors shall observe all of the requirements thereof, insofar as they pertain and are applicable to their respective work. Reference to Contractor or Contractors shall imply Mechanical (Plumbing and HVAC) and Electrical Contractors.

B. Contractors shall examine all Drawings and Specifications, visit the site of proposed construction, become fully informed as to the extent and character of the work required, and make provisions for same in his bid. It will be assumed that the Contractor in submitting his bid has visited the premises and his bid covers all work necessary to properly install his work.

C. If any requirements of the Drawings and the Specifications appear to be difficult to perform, or if there is a question regarding performance, Contractor shall report same to the Architect during the bidding period. The right to make any reasonable change in the location of outlets, apparatus, and equipment up to the time of rough-in is reserved by the Architect without involving any additional expense.

D. If any discrepancies occur during construction between work being performed by the Contractor and work of other trades, it shall be the responsibility of the Contractor to notify the Architect immediately. Under no circumstances shall the Contractor proceed with any work conflicting with other trades until such time as the discrepancies have been corrected. In cases where interference develops, Architect shall decide which work is to be relocated regardless of which was first installed.

E. Contractor shall proceed with his work so as to conform to the progress of the work of other trades and not delay the project. Contractor shall complete all installations as soon as the conditions of the project will permit.

1.2 SCOPE OF WORK

A. Work to be done under this contract shall include the furnishing of all labor, materials, apparatus, and connections to complete, in finished operating condition, the work for Lake Corpus Christi State Park Restroom Replacement, Texas Parks and Wildlife Department.

B. All items of labor, material, or equipment not required in detail by the Specifications or Drawings, but incidental to, or necessary for the complete installation and proper operation of work described herein, or reasonably implied in connection therewith, shall be furnished as if called for in detail by the Specifications or Drawings.

C. Existing underground utilities are not indicated on the Drawings. The Contractor shall be responsible for jobsite locating and protecting all existing underground utilities prior to trenching or pier drilling.

1.3 WORKMANSHIP
A. All labor shall be performed in the best and most workmanlike manner by mechanics skilled in their particular trades. All installations shall be complete in both effectiveness and appearance whether finally enclosed or left exposed. Architect reserves the right to direct the removal or replacement of any item which in his opinion shall not present a reasonable neat or workmanlike appearance, providing that same can be properly installed in an orderly way by usual method for such work. All specialties and appurtenances shall be installed to conform to the manufacturer's recommendations unless otherwise specified.

1.4 CODES, PERMITS, AND FEES

A. Entire installation shall be done in strict accordance with all state and federal ordinances, codes, and regulations.

B. In the event there is a conflict between the Drawings and Specifications and the applicable codes, ordinances, and regulations, the codes, ordinances, and regulations requirements shall govern. However, if the contract requirements are in excess of these requirements and do not conflict with the requirements, the contract provisions shall govern. If any work indicated on the Drawings is in conflict with codes, ordinances and regulations, Contractor shall advise Architect at least one (1) week prior to bid dates so that discrepancies may be corrected by an addendum to the Drawings and Specifications. Failure by the Contractor to advise of any discrepancies shall leave the Contractor fully and completely responsible for compliance with all applicable codes and requirements.

C. All work shall comply with Standards contained in applicable NFPA pamphlets, all as published by the NFPA (National Fire Protection Association).

D. Contractor shall obtain all permits and pay all fees necessary in connection with his work.

1.5 SAFETY STANDARDS

A. It shall be Contractor's sole responsibility to initiate, maintain, and supervise all safety precautions required by state and federal laws, including OSHA (Occupational Health and Safety Administration) and trench safety laws.

1.6 MATERIALS AND EQUIPMENT

A. All materials and equipment furnished under this contract shall be in strict accordance with these Specifications, and shall be new. Equipment shall be of the latest or current products available. When two (2) or more articles of the same materials or equipment are required, the articles of each kind shall be standard products of a single reputable manufacturer. Electrical materials and equipment shall bear the label of UL (Underwriters Laboratories, Inc.).

B. All materials and equipment shall be clearly marked, stamped, or labeled for identification. Identification marks or labels shall be plainly visible for inspection and shall not be obscured or obliterated in any manner. Painting or covering shall not be done until so ordered by the Architect.

C. Contractor shall furnish to the Architect, within a reasonable time after award of contract, and prior to commencing any work, complete brochures of all materials and equipment which the Contractor proposes to furnish on the project. Data shall include descriptive literature,
performance data, diagrams, capacity information, etc., to substantiate that proposed equipment physical size and capacity will meet all of the requirements of the Drawings and Specifications.

D. All data must be checked and any required changes indicated thereon by the Contractor, signed, and dated prior to furnishing same to the Architect for approval. Contractor's attention is directed that it is mandatory that he thoroughly review data prior to furnishing same to assure that equipment is in accordance with Drawings and Specifications and to assure prompt return of the data.

E. Each brochure shall be neatly organized into a single binder or electronic PDF file. In each brochure provide cover sheet identifying project name and location, Architect, Engineer, General Contractor, and Mechanical, Electrical, or Plumbing Contractor. Include Contractor's addresses and phone numbers. Provide adequate space for Architect's and Engineer's stamps. Provide quantity of submittal copies required by other sections of the Specifications.

F. If above information is not provided complete as specified above and within the allocated time, all equipment shall be furnished exactly as specified without any substitutions.

G. In furnishing data of proposed equipment and materials, Contractor must, in writing, specifically call to the attention of the Architect every deviation from the Contract Drawings and Specifications.

H. Review of data, drawings, etc., shall not be construed as releasing the Contractor from further responsibility, but rather as a means to coordinate the work and to aid in the proper selection and installation of the equipment. All material and equipment shall be subject to final acceptance by the Architect at the completion of the project.

1.7 WARRANTY

A. Any defects from defective or improper materials or faults arising from improper workmanship which may appear within a period of twelve (12) months from the date of final acceptance of the building shall be amended and made good by the Contractor at his own cost. Architect shall furnish to the Contractor a letter indicating the date of final acceptance.

B. Where such defective work results in damage to the work installed under other sections of the Specifications, all such work shall be restored to its original condition at the expense of the Contractor by parties skilled in the particular work required.

1.8 DRAWINGS

A. These Specifications are accompanied by Drawings indicating typical layouts, pipe, conduit sizes, outlet and equipment locations, etc. Drawings and these Specifications are complementary each to the other and what is called for by one shall be as binding as if called for by both. All electrical outlets indicated on the Drawings are schematic. Exact location of each outlet shall be based upon exact architectural dimensions and related mechanical details.

B. Drawings as prepared are in general diagrammatic. Contractor shall carefully lay out his work at the site to conform to existing conditions, architectural, structural, mechanical, and electrical conditions, to avoid all obstructions and to conform to details of installation as indicated on the Drawings and supplied by the manufacturers of the equipment to be installed and thereby to
provide an integrated, satisfactorily operating installation. All necessary offsets in piping, fittings, etc., required to avoid interferences between piping, equipment, architectural, and structural shall be furnished and installed by the Contractor without additional expense to the Owner or Architect.

C. Routing paths for all piping, power feeders, and branch circuits are not indicated on the Drawings. Routing paths which are indicated are schematic and are not accompanied by dimensional data or detailed for every required offset. Contractor shall have his choice of routing paths for such piping and raceways provided that this routing does not interfere with existing conditions and does not violate the requirements of the Owner. In cases where inference develops or in cases where proposed routing is not in accordance with the requirements of the Owner, a representative of the Owner will direct the required path of routing. All trenching, tunneling, piping, conductors, conduit, boxes, fittings and supports required to install piping and raceways indicated on the power riser diagram, and floor plans are herby included in the project requirements and shall be included in the proposal submitted by the Contractor.

D. These Specifications and Drawings accompanying same are intended to cover systems which will not interfere with new building conditions, which will fit into the available spaces, and which will ensure complete and satisfactory systems. Contractor shall, therefore, carefully examine the Drawings and the building and shall be responsible for the proper fitting of his material and apparatus into the building.

E. Contractor's attention is directed that all equipment he proposes to furnish must fit into the space allocated for same on the Drawings. It shall be the Contractor's responsibility to furnish data to evident that sufficient space can be provided for the installation of proposed equipment and that adequate access will exist for service and maintenance of equipment. Should changes become necessary during construction, the Contractor shall make such necessary changes at his (the Contractor's) own expense.

1.9 CHANGES

A. Any changes from the Drawings necessary to make the installation conform to building construction, to make this work fit the work of other trades, or to make this work conform to the rules of the city and municipal bodies having jurisdiction shall be made by the Contractor at his (the Contractor's) own expense.

1.10 PROTECTION

A. All work, equipment, and materials shall be protected at all times to prevent damage or breakage either in transit, storage, installation, or testing. All openings shall be closed with caps or plugs during installation. All material and equipment shall be covered and protected against dirt, water, chemicals, or mechanical injury. Failure on the part of the Contractor to provide adequate protection will be cause for rejection of the unprotected equipment and materials.

1.11 CUTTING AND PATCHING

A. Work shall be carefully laid out in advance and the exact size and locations of openings required shall be furnished to the General Contractor. Contractor shall be responsible for the
furnishing and setting for the proper and permanent location of all sleeves, hangers, supports, inserts, plates, etc. If any cutting of the construction is necessary because of erroneous locations or to patch openings not used, the work shall be done at the expense of the Contractor by parties skilled in that particular work. No cutting or core drilling shall be done without permission of the Architect. All drilling and patching for expansion bolts, hangers, and other supports shall be done by the Contractor, subject to the approval of the Architect.

1.12 EXCAVATION AND BACKFILL

A. Each Contractor shall provide all necessary excavation and backfilling required for his work. Excavation shall be backfilled with approved material tamped and puddled compactly in place to a density required to leave surface of ground at original level without settlement.

1.13 SLEEVES

A. All piping (except uninsulated copper piping) and conduits which pass through new floors and exterior walls shall be provided with pipe sleeves. Copper pipe sleeves shall be used for uninsulated copper piping.

B. Sleeves must be secured in place and plumb. Sleeves must be of sufficient size so as to allow approximately 1/4” space between the sleeve and the pipe or, if the pipe is insulated, 1/4” space between the sleeve and the insulation.

C. All piping and conduit passing through the floors or exterior walls shall have the space between the sleeve and the pipe or conduit packed and caulked watertight and rodent proof.

1.14 CERTIFICATION OF INSTALLATION BY EQUIPMENT MANUFACTURER'S REPRESENTATIVE

A. In order to place responsibility for the furnishing of the proper equipment and to see that it is installed as intended by the manufacturer, the Contractor, during construction, shall request supervisory assistance from the equipment manufacturer's representatives so that the material installation will be properly installed. After installation, the Contractor shall again request the representatives to inspect and certify that the equipment is in proper working order.

B. Before final payment is issued, the representatives shall submit to the Architect, through the Contractor, a signed statement certifying to their inspection and that the equipment is properly installed and ready for operation.

1.15 ESCUTCHEONS

A. Where exposed pipes pass through floors, walls, or ceilings, they shall be fitted with chromium plated stainless steel escutcheons firmly secured to the pipes and held in place with set screws.

1.16 CLEANING

A. Contractor shall thoroughly clean all equipment, materials, and devices furnished and set by him. Contractor shall remove all of his debris that may have accumulated during the job. After the Architect inspects the equipment, any discrepancies shall be amended as directed.
1.17 USE OF ENGINEERS ELECTRONIC DRAWINGS

A. The Contractor may request the use of electronic copies of the Engineers Drawings for preparation of Contractor shop drawings. All such requests must be presented to the prime design firm. Upon receipt by the Engineer of the executed Engineer’s standard Waiver of Indemnification and upon receipt by the Engineer of compensation in the amount of two hundred fifty dollars ($250) to receive Drawings by mail and two hundred dollars ($200) to received Drawings electronically. The Engineer will forward requested Drawings (with Engineering seal removed) through the prime design firm for use by the Contractor.

1.18 OWNER TRAINING

A. Owner training is required by other sections of these Specifications. The Contractor must include evidence of completed Owner training with (bound within) the Operation and Maintenance manuals. Such evidence of completed Owner training shall include the following:

1. Owner training log to include:
   a. Typewritten names with job titles and signatures for each person in attendance.
   b. The time, date, and duration of each training session.
   c. A comprehensive list of all training topics covered.
   d. A comprehensive list of all demonstrations and/or hands-on training for items such as systems programming, maintenance techniques, etc.

2. Copy of audio and/or video recordings of training sessions where such recordings are required by other sections of these Specifications.

END OF SECTION 20 00 00
SECTION 22 05 00 - PLUMBING GENERAL CONDITIONS

PART 1 - GENERAL

1.1 SCOPE

A. The Work to be provided under this Division of Specification shall include the furnishing, delivering, transporting, unloading, hoisting, handling, scaffolding, storing, erecting, adjusting, and testing of all materials, apparatus, and equipment required for complete, properly adjusted and operable plumbing systems for this project in accordance with the Contract Documents. Provide all labor, supervision, coordination, equipment, tools, materials, permits, fees, and connection to utilities necessary for the completion of this Work.

B. If details or special conditions are required in addition to those shown on Drawings, provide all material and equipment usually furnished with such systems or required to complete their installation, whether noted in Contract Documents or not.

C. The Instructions to Bidders, Notice to Bidders, General Conditions, Special Conditions, all other preface Sections, all technical divisions and all appendixes of the Specifications, and any other pertinent documents issued by Owner’s representative shall be considered as part of this Division insofar as they may be applicable.

D. The Architectural, Civil, Structural, Plumbing, Heating, Ventilating and Air Conditioning (HVAC) and Electrical Plans and Specifications and any other pertinent documents issued by Owner’s representative shall be considered as part of this Division insofar as they may be applicable.

E. Refer to Division 1 Specifications for general requirements of the following items:
   1. Work by Owner.
   2. Work sequencing and phasing.
   3. Third party commissioning coordination requirements.

1.2 CODES AND STANDARDS

A. The Codes and Standards of the following organizations shall generally apply where applicable and where no specific Codes and Standards have been cited. In the event of conflict between the Codes and Standards of these organizations, the more stringent shall govern.

   ASHRAE: American Society of Heating Refrigeration and Air Conditioning Engineers.
   ASME: American Society of Mechanical Engineers.
   ASPE: American Society of Plumbing Engineers.
   AWS: American Welding Society.
   FM: Factory Mutual Engineering Company.
   IRI: Industrial Risk Insurers.
   ISA: Instrument Society of America.
   MSS: Manufacturers Standardization Society.
   NBS: National Bureau of Standards.
1.3 DEFINITIONS

A. "Contract Documents" shall refer to the complete package of Plans, Specifications, addenda, and special conditions used as a basis for the General Construction Contract for this project including but not limited to all General and Special Conditions, all Architectural and Engineering Divisions of Specifications and all Architectural and Engineering Plans.

B. "Owner" means the entity specified in the General Construction Contract as Owner.

C. "Contractor" means the entity contracting with the Owner for the performance of work.

D. "Work" means all of the Contractor's obligations under the Contract.

E. “Provide” shall mean furnished and installed, complete and ready for intended use by Contractor, except as otherwise noted.

F. “Furnish” shall mean purchase only by Contractor; installation by others, except as otherwise noted.

G. “Install” shall mean Contractor to set up for use, erect or construct only; purchase by others, except as otherwise noted.

H. "Directed" means "directed by Owner’s representative". This shall not imply that Architect's or Engineer's responsibility extends into the Contractor's area of construction supervision.

I. Where the words "similar" or "typical" are used, they shall be used in their general sense and shall not be interpreted as meaning identical. Details shall be worked out in relation to their location and connections to other parts of work.
J. Items such as but not limited to access doors, sleeves, cleanouts, trap-primers, roof flashings, or pipe supports that are to be installed repetitiously and are noted on the Plans as "typical" shall be installed at every location required by Specifications, codes, or good practice, whether specifically shown on Plans or not.

K. Where the terms "or equal" and "or approved equal" are used they shall be defined as "approved as equal by Owner’s representative".

1.4 CONTRACTOR'S RESPONSIBILITY

A. It shall be the responsibility of the Contractor to carefully examine all of the Contract Documents and to comply with them in every respect. Should there be omissions or discrepancies in the documents notify the Owner’s representative prior to the bid date so a written clarification can be issued.

1. Coordinate exact electrical requirements of all equipment prior to submittal review and make all modifications necessary for full compatibility with the final electrical installation.

B. It shall be responsibility of the Contractor to review all Divisions of the Contract Documents with respect to plumbing work that will be required by other divisions. Contractor shall thoroughly review all aspects of Plumbing Bid Proposal prior to bidding for the purpose of clearly defining the scope of Plumbing Bid Proposal with that of all other trades.

C. It shall be the responsibility of the Contractor to provide all equipment, materials, and labor, whether specifically indicated on Plans or called for in Specifications or not, which are necessary for the proper installation and function of the plumbing systems for this project.

D. It shall be the responsibility of the Contractor to carefully examine conditions of the project site and to check the work of other divisions that might affect the plumbing work. Include all costs of demolition, cutting, patching, and repairing of existing elements in bid proposal.

1. Visit the proposed project site prior to bid and carefully investigate existing streets, parking lots, paved areas, sidewalks, buildings, structures, and landscaping.

E. It shall be the responsibility of the Contractor to contact the Owner’s representative prior to commencement of any trenching or site utility work for assistance in locating underground utilities. Hand dig where necessary to verify depth and location and to avoid damage to existing.

F. It shall be the responsibility of the Contractor to coordinate work performed under the Plumbing Division of the Contract Documents with work performed under other divisions so as not to delay or damage any part of this installation.

G. It shall be the responsibility of the Contractor to coordinate the location of chases, openings, sleeves, flashings, trenches, and the like required for the work covered by the Plumbing Division of the Contract Documents. Do so in sufficient time for proper coordination with general construction, or assume the responsibility for required cutting and patching. No cutting of structural members shall be performed without approval of the Owner’s representative.

H. It shall be the responsibility of the Plumbing Division to include minor details necessary for proper installation and operation of materials, equipment, or fixtures as if specified or shown in Contract Documents.
I. It shall be the responsibility of the Contractor to install materials, equipment, and fixtures according to code requirements, manufacturer's recommendations or as required in Contract Documents, whichever is more stringent.

1.5 ADDITIONAL COMPENSATION

A. Failure to examine or to comply with Contract Documents shall not relieve Contractor of responsibility for the work or be used as basis for additional compensation.

B. No additional compensation will be awarded for conflict with Architectural, Structural, Electrical, or Mechanical components in installation of prefabricated materials or equipment.
   1. Piping shall be fabricated from field measurements. Adjust piping as necessary to fit space available. Contractor shall advise Owner’s representative of any discrepancies prior to fabrication.

C. No compensation will be awarded to the Contractor for minor relocations or deviations from plans. Changes in contract price will be allowed only for additions to or changes to original design intent and then only with written approval of the Owner’s representative.

D. Omission of Architectural, Civil, Structural, Electrical, or other pertinent details from Mechanical Contract Documents shall not be used as basis for additional compensation.

1.6 SUPERVISION, LABOR, AND WORKMANSHIP

A. Contractor shall provide proper supervision of mechanics and subcontractors performing work under this Division. Labor shall be performed by skilled mechanics experienced in their particular trade. Piping and equipment shall be installed square and plumb, with accessibility for proper operation and service. Any item that does not present a neat and workmanlike appearance shall be replaced or corrected at the direction of the Owner’s representative and without additional cost to the Owner or Design Professionals.

B. Submit welder’s certificates and resume of experience for all mechanics on this project when directed to do so by Owner’s representative.

1.7 FEES AND PERMITS

A. Contractor shall obtain and pay for all fees and permits required for the completion of the Work, including but not limited to construction permits; federal, state, and local inspection fees, connections to utilities, meter and tap fees, capitalization charges, temporary service charges, and any other associated fees or charges.

1.8 PROJECT/SITE CONDITIONS

A. Install Work in locations shown on Drawings, unless prevented by Project conditions.

B. These Specifications and the accompanying Drawings are intended to describe and illustrate systems which will not interfere with the structures, which will fit into available spaces, and which will ensure complete and satisfactorily operating installations. Coordinate the proper fitting of the material and apparatus into the available spaces without interfering with other building components. Prepare installation drawings at all locations where possible conflicts of HVAC, Plumbing, Electrical, Structural, or Architectural components may occur. The installation drawings
shall be submitted to the Owner’s representative prior to commencing the Work. They should illustrate the installation of work in relation to other portions of the Work. Interferences with other portions of work, or the building structure, shall be corrected before the work proceeds. Should changes become necessary on account of failure to comply with these stipulations, make such necessary changes.

1.9 PRE-INSTALLATION CONFERENCE

A. Contractor shall convene a pre-installation conference one (1) week prior to commencing work of this Division and in conjunction with work of other divisions and notify Owner’s representative of date and time of meeting.

B. Require attendance of parties directly affecting work of Division 22.

C. Review installation procedures and coordination required with related work.

D. Establish “right of way” and routes for conduit, wiring, cable trays, piping, ductwork, and similar elements in the available space above ceilings and vertical chases.

E. Coordinate exact HVAC and service access requirements of all plumbing and electrical equipment, as example, ventilation and exhaust of panelboards, transformers, or water heaters. Advise Owner’s representative of any requirements that will be necessary in addition to requirements on Contract Documents.

1.10 GENERAL REQUIREMENTS

A. Protection of Rough Work: All openings of every description shall be securely capped or otherwise protected against debris or other foreign material entering the system until such time as the equipment is permanently attached.

B. Cleaning and Adjusting: At the completion of the work all parts of the installation shall be thoroughly cleaned. All valves and controls shall be adjusted for proper operation. Upon completion of the work, the Contractor shall leave the building and project site in a neat condition.

C. Defective work: If inspection or testing show defects, such defective work or materials shall be replaced and inspection and test repeated. All repairs to piping shall be made with new material. No caulking of screwed joints will be acceptable.

D. Dielectric Connection: Where dissimilar metals are connected, provide approved dielectric connector to protect against dielectric corrosion.

E. Vents through Roof: Vents through roof shall be installed as closely as possible to locations shown on Drawings. However, in no case shall vents through roof be installed within ten feet of air conditioning outside air intakes. It shall be the responsibility of the Contractor to coordinate with the Plumbing and HVAC Divisions and offset vent piping as necessary. Offsets will be made at no additional cost to the Owner or Design Professionals.

F. Surveys and Measurements: Carefully survey project site prior to bidding and installation. Dimensions, both horizontal and vertical, shall be derived from Architectural, Civil, and Structural plans. Do not "scale” plans; that is do not measure plans with Architect's or Engineer's scale and base installation dimensions on such measurements.
G. Horizontal and vertical measurements shall be based on established benchmarks. Work shall agree with established lines and levels. Field verify measurements at project site. Check correctness of same as related to work prior to fabrication of shop made items and ordering of factory built items.

1. Notify Owner’s representative of discrepancies between plans and actual field conditions that will prevent the following of good practice or affect the intent of Plans and Specifications. Do not proceed with installation until instructions are received from Owner’s representative.

H. The accompanying plans show diagrammatically the sizes and location of the various equipment items and the sizes of the major interconnecting piping and ductwork, without showing exact details as to elevations, offsets, control lines, and other installation details. The Contractor shall carefully lay out his work to conform to the site conditions, to avoid obstructions and provide proper grading of lines. Exact locations of outlets, apparatus, and connections thereto shall be determined by reference to the accompanying Plans, to all detail drawings, equipment drawings, rough-in drawings, etc., by measurements at the building, and in cooperation with other divisions, and in all cases shall be subject to the approval of the Owner’s representative. Minor relocations necessitated by the conditions at the site or directed by the Owner’s representative shall be made without any additional cost to the Owner.

I. All work shall be run parallel or perpendicular to the lines of the building unless otherwise noted on the Drawings.

J. It is the intent of the Contract Documents to provide an installation complete in every respect. In the event that additional details or special construction may be required for work indicated or specified in this Section or work specified in other Sections, it shall be the responsibility of the Contractor to provide same as well as to provide material and equipment usually furnished with such systems or required to complete the installation, whether mentioned or not.

K. Should a discrepancy exist between the Plumbing Drawings and the Plumbing Specifications it is the Contractor’s responsibility to include that portion or portions of the more expensive item in bid proposal. Final approval and/or directive can then be forwarded to the Contractor during the submittal process.

1.11 FIXTURE AND EQUIPMENT SIZES AND REQUIREMENTS

A. Space allocations in machinery spaces are based on equipment scheduled in each case. Should the Contractor offer equipment of another make that requires more space in any critical dimension, the Contractor shall submit, together with other submittal data on the equipment, prints of drawings indicating how the equipment may be installed, indicating room for servicing and revisions in piping or ducting and any other details necessary for the Owner's representative to form a judgment as to the suitability of the substitute material, as to performance, suitability for the space and other variables.

B. Duties of certain equipment items, horsepower of driving motors and electrical characteristics are scheduled for equipment items of a particular make in each case. Should any substitute material be accepted which has other requirements that would involve allied equipment or the work of others, the Contractor shall be responsible for all modifications required at no change in contract price.

C. Structural steel members are indicated to provide supports for certain specific sizes and weights of equipment. Should other equipment be offered, the spacing of the supports shall be varied to
suit the equipment. Should the weight or size of a substituted item of equipment require additional supporting steel members, the Contractor shall be required to provide and install them at no change in contract price.

1.12 INTERFACE WITH OTHER PRODUCTS

A. Review millwork shop drawings. Confirm location and size of equipment and openings before ordering equipment, rough-in, and installation.

1.13 SUBMITTALS

A. Submit in accordance with TPWD Division 1 – Section 01 00 00 – Special Conditions Section 1.09 Submittals and UGC Article 8.

B. Submit in timely manner for review, brochures describing all materials, equipment, fixtures, and specially fabricated structures proposed for use in the performance of the work on this project.

C. Substitutions, unless a sole source manufacturer is justified and approved by Owner and / or Owner’s Representative in writing, shall be allowed for materials or equipment for which the performance, capacity and quality are equal to that scheduled or specified. Use the terms, "or approved equal," and include on the drawings and in the specifications the following paragraphs:

1. "It is the intent of the Drawings and/or Specifications neither to limit products to any particular manufacturer nor to discriminate against an APPROVED EQUAL product as produced by another manufacturer. Some proprietary products may be mentioned to set a definite standard for acceptance and to serve as a reference in comparison with other products. On the other hand, when a manufacturer's name appears in these Specifications or in the Drawings, it shall not be interpreted that the manufacturer is unconditionally acceptable as a provider of equipment for this project. The successful manufacturer or supplier shall meet all of the provisions of the appropriate specification(s)."

2. "The specified products have been used in preparing the Drawings and Specifications and thus establish minimum qualities with which substitutes must be at least equal to be considered acceptable. The burden of proof of equality rests with the Contractor. The decision of the Engineer is final."

3. "In the event that the Contractor submits a proposal for a substitution, and the review and negotiation of the substitution (if handled in a timely, expedited manner) results in a delay of the project, then a reasonable extension of time for the Contract may be allowed."

D. Items to be submitted shall include but shall not be limited to pipe, valves, fittings, materials, hangers, special supports, insulation, fixtures, equipment, controls, coordination drawings, and mechanical room layouts.

E. Contractor’s Coordination Drawings: The Contractor shall prepare a complete set of coordination drawings indicating the equipment actually purchased and the exact routing for piping, conduit, and ductwork. The elevations, locations, support points, load imposed on the structure at support and anchor points, and size of all lines shall be indicated. All beam penetrations and slab penetrations shall be indicated and sized and shall be coordinated. This requirement for coordination drawings shall not be construed as authorization for the Contractor to make any unauthorized changes to the Contract Drawings. All Design Drawing space
allocations shall be maintained, such as ceiling height, chase walls, equipment room size, and the like, unless proper written authorization is received from the Architect to change them.

F. Information shall be presented so that line-by-line comparison may be made with Contract Documents. Deviation from Contract Documents shall be enumerated on separate sheet and so entitled. Data of general nature will not be acceptable.

G. Each submittal will be reviewed for compliance with general requirements of design and arrangement only; it is not a contract document and acknowledgment of compliance does not remove the Contractor of responsibility for performance of the work in compliance with all provisions and requirements of the Contract Documents. Job measurements and the coordination of all the dimensions for proper fit of all parts of the work and performance of all equipment supplies to meet Specification requirements are and remain specific responsibilities of the Contractor.

H. Each submittal shall be neatly organized in binders with information arranged in order of specification section. Submit Plumbing divisions independently with a maximum of three separate packages for each division, as example, major equipment, materials, and controls. In each brochure provide cover sheet identifying project name and location, Architect, Engineer, General Contractor, and Plumbing Contractor. Include Contractor’s addresses and phone numbers. Provide adequate space for Architect's and Engineer's stamps. Contractor shall include and sign the following statement of compliance on the cover sheet:

I hereby certify that this shop drawing and/or brochure has been checked prior to submittal and that it complies in all respects with the requirements of the Contract Documents for this project.

(Company Name)
Signed
Date

Submittals forwarded without compliance statement and signature in each brochure will not be reviewed. Contractor will bear the risk of all delays, as if no submittal had been delivered.

Contractor’s statement of compliance shall constitute a representation to the Owner’s representative that Contractor has either determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data or assumes full responsibility for doing so, and that Contractor has reviewed or coordinated each submittal with the requirements of the work and the Contract Documents.

I. Engineer’s review of submittals does not relieve Contractor of his responsibility for deviations from Contract Documents or errors and omissions except when acceptance of the specific deviation is given in writing.

J. Engineer’s review and approval is only for conformance with the design concept of the project and for compliance with the information given in the Contract.
1. The review shall not extend to means, methods, sequences, techniques, or procedures of construction or to safety precautions or programs incident thereto.
2. The review shall not extend to review of quantities, dimensions, weight or gauges, fabrication processes or coordination with the work of other trades.
K. Submit brochures in sufficient time and of proper format so as to avoid delays or changes in construction. Failure to comply shall render Contractor liable for expenses of delays occasioned by failure to provide necessary information or drawings. Owner’s representative reserves the right to contact manufacturer directly to secure proper data and detail when deemed necessary. Contractor shall be liable for costs incurred by such action.

L. Any shop drawings prepared to illustrate how equipment, piping, ducts, and the like are to be fitted into available spaces will be examined under the assumption that the Contractor has verified all the conditions, and obtaining any approval thereon shall not relieve the Contractor of responsibility in the event the material cannot be installed as shown on those Drawings.

M. Any material or equipment installed without the Owner representative's prior approval shall, if so directed by the Owner's representative be removed and replaced with approved material or equipment at the Contractor's expense.

N. Any dimensional changes or rerouting of piping shall necessitate submittal or shop drawings of the system under consideration prior to fabrication or erection of material. Drawings will be utilized by the Owner's representative to evaluate the effect of the proposed changes on equipment performance.

O. Test Reports: The Contractor shall submit to the Owner's representative all test reports in accordance with details specifically called for in the various Sections of the Specifications in this Division.

1.14 OPERATION AND MAINTENANCE INSTRUCTIONS

A. Upon completion of work, provide three (3) sets of complete operations and maintenance instructions of plumbing equipment, neatly bound in 3 ring binders. Provide each binder with the name of Owner, Architect/Engineer, Contractor, and Title. During the construction period, accumulate the following for inclusion in the Operating and Maintenance Manuals:
1. Tabulation of equipment by manufacturer, model number, and serial number.
2. All warranties and guarantees and manufacturer's directions on equipment and material covered by the Contractor.
3. Approved fixture brochures, wiring diagrams, and control diagrams.
5. Operating instructions for all plumbing equipment and systems. Operating instructions shall include maintenance and seasonal changeover procedures.
6. Recommended maintenance procedures.
7. Repair parts list of all major items and equipment including name, address, and telephone number of local supplier or agent.
8. Valve tag charts and diagrams specified elsewhere herein.
9. Manufacturer’s letter certifying that the equipment has been installed per manufacturer’s installation manuals.
10. Contractor’s one (1) year warranty letter including start and finish dates.

B. Operation and Maintenance instructions shall be submitted and approved prior to instruction of Owner's personnel in the various systems operation and maintenance.
1.15 UTILITIES

A. The Contract Documents reflect the general location, size, and manner of routing for all utilities known to be required on this project. It shall be the responsibility of the Contractor to visit the site, in order to coordinate and confirm the exact requirements for all utilities. The bid submitted by the Contractor shall include costs for all such coordination work as well as any and all charges and/or fees.

1.16 BUILDING CONSTRUCTION AND LAYOUT OF WORK

A. The Contract Documents are diagrammatic in character and cannot show every connection in detail or every line or conduit its exact location. These details are subject to the requirements of ordinances and also Structural and Architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases unless specifically noted or indicated to be exposed. Work shall be installed to avoid crippling of structural members; therefore, inserts to accommodate hangers shall be set before concrete is poured, and proper openings through floor, walls, beams, etc. shall be provided as hereinafter specified or as otherwise indicated or required before concrete is poured. All work shall be run parallel or perpendicular to the lines of the building unless otherwise noted.

1.17 RECORD DRAWINGS

A. As part of the required plumbing work, a complete set of record drawings shall be made up and delivered to the Owner's representative.

B. The drawings shall reflect the following:
   1. All plumbing work installed exactly in accordance with the original design.
   2. All plumbing work installed as a modification or addition to the original design.
   3. The dimensional information necessary to delineate the exact location of all ductwork and piping runs which are so concealed as to be untraceable by inspection through the regular means of access established for inspection and maintenance. Where shop drawings have been prepared and approved, the record drawings shall be cross referenced to the respective shop drawings. In this case dimensions need not be shown on the record drawings.

C. Record drawings shall include the updating of all equipment schedules.

D. The record drawings shall be of a reproducible type as directed.

1.18 WARRANTY

A. All materials and equipment, to be furnished and installed under this Division of the Specifications shall be warranted to meet the specified performance requirements and to be free of defects in materials and workmanship for a period of one year after final acceptance. The Contractor to the complete satisfaction of the Owner’s representative shall remedy deficiencies caused by other than normal usage, without cost to the Owner or Design Professionals.

B. If there is any indication that the equipment does not meet the specified quantities, the Contractor shall, at his expense, institute a program to demonstrate the adequacy of the
installation. This program shall include all necessary testing and testing equipment. Should the Contractor not have the equipment or technical skill to perform the tests, it shall be his responsibility to employ recognized experts to perform the tests and shall provide certified laboratory tests, certified factory reports and work sheets, or other certified data to support results of any tests required.

C. Equipment warranties extending beyond the first year warranty generally include material only guarantees except where required by specific reference. Owner is responsible for additional expenses and the assembly of adequate record keeping during warranty period.

1.19 BILLINGS

A. Contractor shall provide a schedule of values of the plumbing work with each payment application. Provide a line item for labor and materials for each section of specifications. Provide additional breakdown where requested by Owner’s Representative.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. Coordinate exact electrical requirements of plumbing equipment prior to submittal and purchase. Equipment that is not compatible with electrical installation will be removed and replaced at no expense to the Owner or Design Professionals.

2.2 MATERIALS

A. Unless otherwise specified, provide only new, first grade equipment and materials which comply with requirements of this Specification and applicable Standards.

B. Furnish, if required, satisfactory evidence of kind and quality of materials proposed for use.

C. Similar items of material and equipment shall be product of same manufacturer.

2.3 SUBSTITUTIONS

A. The Specifications indicate a standard of quality for materials. Manufacturer's names and catalog numbers are used to designate materials or equipment to establish grade and quality. Where several manufacturers are named, the bid shall be based on those named manufacturer's products. Where only one manufacturer is named, unless stated otherwise, manufacturers of equal quality products will be considered as substitutions only if submitted at least 5 days before the bid date and when in compliance with all criteria set forth within Section 2.3:

1. Contractor is responsible for all coordination and additional costs which may be required for the work to be completed on time with no additional cost to the Owner or Design Professionals.

2. Contractor to verify during submittal that the product works dimensionally within the intent of the design.
   a. The ability to service components shall not be compromised.
   b. Any additional coordination due to interference with other elements of the project will be the responsibility of the Contractor with no additional cost to the Owner or Design Professionals.
B. It is fully the Contractor’s responsibility to assemble and submit sufficient technical information to fully illustrate that the material or equipment proposed for substitution is equal or superior as the Architect or Engineer is under no obligation to perform the service for the Contractor. The proposal shall be accompanied by manufacturer’s complete engineering data, specification sheet, and a sample, if practical or if requested. In no event shall a proposal for substitution be cause for delay of work.

C. Substitutions and deviations shall be clearly marked, indicated, or otherwise called to attention of the Owner’s representative in the submittal documents. Failure to indicate substituted materials and/or equipment or deviations from Contract Documents shall be construed as a representation that contractual obligations have not been meet and the submittal shall be rejected without further review.

D. Engineer reserves the right to accept or reject proposed substitutions and it is understood that his judgment shall be final.

2.4 ELECTRIC INTERLOCKS

A. When interlocking of equipment is required all wiring in excess of 50 volts to be provided by a licensed master electrician and coordinated by the Contractor. All other wiring 50 volts or less or as required by the controls/energy management system shall be fully coordinated by the Contractor to provide and assure a complete and fully operational system. All conduit for controls and or power wiring shall be in accordance with Division 26 requirements, and installed by licensed electrician and coordinated by the Contractor.

B. Except for such items that are normally wired up to their point of manufacture and so delivered and unless specifically noted to the contrary herein, the Contractor shall do all electric wiring of every character for interlocking, pilot, and control in accordance with methods and materials described within Division 26 of these Specifications. This includes conduits and mounting of all electrical devices.

C. Furnishing of complete wiring diagrams showing proper control and interlock wiring shall be work under the trade supplying the equipment. Diagrams shall be based on the approved equipment for this project and shall be complete integral drawings, not a series of manufacturers’ individual diagrams.

D. The electrical design and drawings are based on the equipment scheduled and shown on the plumbing Drawings and should any plumbing equipment requiring changes to the electrical design be approved, the required electrical changes shall be made at no cost to the Owner.

2.5 CONTROL POWER AND EQUIPMENT POWER FOR CONTROLS

A. Control power, whether it be DDC, 24 volt, or 120 volt, should be delivered to each piece of plumbing equipment, and/or control panels whether or not it is specifically indicated on the Contract Drawings. Plumbing Contractor shall coordinate with the Electrical Contractor for these requirements.

B. It is the Electrical Contractor’s responsibility to include in his or her bid all costs in connection with control wiring, and/or power, whether or not it is specifically indicated. Regardless of how large in nature or how incidental, no additional compensation will be approved by the Owner’s representative or Design Professionals concerning a failure on the Contractor’s part to include
these costs in bid proposal or a failure on the Contractor’s part to properly coordinate these important functions.

PART 3 - EXECUTION

3.1 PRODUCT HANDLING, RECEIVING, INSPECTION, AND STORAGE

A. Handling and Receiving: The Contractor shall receive and handle all materials and equipment with care so as not to cause damage. Use padded or strap slings, etc. as appropriate for the items being handled. Lift materials and equipment by lift points provided or recommended by the manufacturer.

B. Inspection: The Contractor shall upon receipt, inspect all materials and equipment for defects, damage, and compliance with the Specifications. When materials and equipment are received in acceptable condition, assume full responsibility for its storage, handling, and installation. Materials and equipment found to be incomplete or damaged shall be reported to the Carrier and Owner's representative immediately, within a maximum of three (3) days, for its replacement.

C. Identification: Upon receipt of all materials and equipment, the Contractor shall identify and tag, stencil, or otherwise permanently identify all materials and equipment with the appropriate equipment number.

D. Storage: Materials and equipment, which cannot be installed immediately after delivery, shall be stored in a safe, dry location provided by the Contractor. Materials and equipment damaged or stolen while in storage shall be replaced by the Contractor at no cost to the Owner.

3.2 COORDINATION WITH OTHER DIVISIONS AND OWNER

A. General: Cooperate to fullest extent with other Divisions and Owner to the end that all work shall be executed economically without delay and that it will not interfere with their operations.

B. Progress Schedule: Contractor shall inform himself of progress schedules of all Divisions and shall work in accordance with schedules for completion of work.

C. Examine work of other trades that comes in contact with or is covered by this work. Do not attach to, cover, or finish against any defective work, or install work of this Division in a manner which will prevent other trades from properly installing their work. Consult all Drawings, Specifications, and details of other Divisions of the work.

D. Do not install equipment with electrical characteristics that are not compatible with the electrical installation.

E. Building Systems Commissioning will be performed by an independent agency under direct contract with the Owner. This Division shall assist the Commissioning Agent in the performance of his duties as required. Refer to Division 01 for the Scope of Work required of Division 22.
3.3 EQUIPMENT ACCESSORY REQUIREMENT

A. It shall be the Contractor's responsibility to assure all packaged equipment ancillary devices shall be completely wired, piped, and calibrated. All systems shall be commissioned for acceptance by the Owner.

3.4 INSTALLATION

A. Space and Equipment Arrangement: All equipment shall be installed in a manner to permit access to parts requiring service and to comply with code-mandated and manufacturer required clearances. Contractor shall notify Owner’s representative prior to installation of any equipment where said clearances cannot be maintained for further direction.

B. Materials and equipment installed under this Contract shall be new in every respect, and installed in a first-class manner in accordance with the manufacturer's recommendations and applicable codes and standards.

C. The Contractor shall plan and coordinate his Work to provide all equipment and materials necessary to provide the Owner with a neat, functional, and serviceable installation.

D. The Contractor shall protect all work, materials, and equipment against damage until Final Acceptance by the Owner’s representative. Replace, or repair to the satisfaction of the Owner's representative, any work, materials, or equipment that becomes damaged prior to Final Acceptance.

E. The Contractor shall make a detailed inspection of the work area and adjoining construction prior to beginning installation of any materials or equipment. Verify governing dimensions and other permissible dimensional tolerances. The Contractor shall report in writing to the Owner's representative unsatisfactory conditions encountered; do not begin installation until conditions are correct. Beginning installation signifies acceptance of conditions.

3.5 EXCAVATION AND BACKFILL

A. Prior to any excavation, the Contractor shall have all utilities marked. The Contractor shall perform all excavation of every description required in the execution of his work. Excavation shall be through whatever substance encountered, to the depths indicated on the Drawings, or as required. Contractor shall hand dig wherever necessary to prevent damage to existing utilities. Excavated material suitable for backfill shall be piled in an orderly manner a sufficient distance from the trench to prevent overloading sides and cave-ins. Excavated materials not suitable for backfill shall be removed from the site or stored as directed. Grading shall be done to protect the excavation from surface water. Trenches shall be maintained in a dry condition by bailing, pumping, or other approved methods. Pipe shall not be laid in wet trenches. Sheetng and shoring shall be provided as required for the protection of the work and the safety of personnel.

B. Trenches shall be of the necessary width and depth to provide for proper installation of pipe and appurtenances, with banks as nearly vertical as possible. Bottoms of trenches shall be excavated to the grade and depth indicated or required, and barrel of pipe shall be laid on a minimum 12-inch sand bed. Bell holes, of a size to permit proper make-up of grading, shall be provided as required. Existing underground piping shall be protected from damage during excavation and backfilling, and if damaged, shall be repaired to the satisfaction of the Owner’s
representative, at the Contractor’s expense. Provide 3,000 pound concrete of 3” minimum enclosure around lines that cross electrical utility lines or telephone cables.

C. Trenches shall not be backfilled until all required tests have been performed. This requirement does not preclude sectional testing and backfilling of the various systems. Trenches shall be carefully backfilled with approved sand, free from large earth clods, rocks, and/or foreign materials, laid in 6” layers, moistened thoroughly, and carefully rammed to an elevation of one foot above top of pipe. The remainder of the backfill to finish grade shall be placed in one-foot layers soaked with water, and well tamped. Under roadways, backfill to bottom of road bed material with sand only. Where settlement occurs, trenches shall be re-opened to depth required for proper compaction, re-filled, and compacted.

D. Open trenches abutting foundation or basement excavations, building walls, and grade beams, will not be permitted, but shall be backfilled and completed, for a distance of not less than 10’ from the above features, as soon as possible. All damage resulting from flooding or other stresses due to open trenches shall be paid for by the Contractor.

E. Where excavation requires, existing walks, street, drives, or other existing pavement to be cut to install new lines and to make new connections to existing lines, the size of the cut shall be held to a minimum, consistent with the work to be accomplished. After the installation of the new materials is completed and the excavation has been backfilled, the paving shall be patched, using materials to match those cut out. The patches shall be thoroughly bound with the original surfaces, and shall be level with them.

F. All excavation shall conform to the laws of the State of Texas and shall be done in conformance with all applicable OSHA regulations.

3.6 CUTTING AND PATCHING

A. This Contractor shall do all necessary cutting and drilling of present walls, floor, ceilings, etc. for the installation of new work or for modifications to the existing work, but no structural work shall be cut unless specifically approved by the Owner’s representative. Patching and painting of surfaces as required shall be by the Contractor, unless specified hereinafter.

B. Cutting and patching or repairing of work in place, made necessary by the negligence of the Contractor or anyone employed by him, shall be paid for by the Contractor.

C. All cutting and patching shall be coordinated with the Architect prior to proceeding.

3.7 OUTAGES

A. Outages of services as required by the project will be permitted, but only at a time approved by the Owner. The Contractor shall notify the Owner in writing two weeks in advance of the requested outage in order to schedule required outages. No outages shall be taken unless written approval has first been received from the Owner. The time allowed for outages will not be during normal working hours unless otherwise approved by the Owner. All costs of outages, including overtime charges, shall be included in the Contract amount.
3.8 CONNECTION OF EQUIPMENT FURNISHED BY OTHERS

A. The Plumbing Division shall provide all plumbing connections to equipment furnished by other Divisions or the Owner that require service connections and/or ductwork.
   1. The Plumbing Division shall furnish materials and labor required for the connection of equipment except where indicated on Drawings as furnished by others.

B. The respective supplier shall furnish proper roughing-in diagrams for the installation of these items. All items shall be roughed-in and connected in strict accordance therewith.

3.9 INSPECTIONS

A. Contractor shall arrange for all inspections required by local building officials and state agencies. Correct deficiencies required to comply with codes and standards and to receive certificate of occupancy. Upon completion of this project, submit written evidence of compliance with the above to Owner’s representative. Final acceptance will not be issued and the warranty date will not be established until such compliance is demonstrated.

3.10 SYSTEMS START-UP

A. Upon completion of the installation of the work, start-up all plumbing systems and test, balance and adjust systems until they are fully operational and functioning as intended by Engineer.

3.11 FINAL CONSTRUCTION REVIEW

A. Schedule: Upon completion of the Contract, there shall be a final construction review of the completed installation. Prior to this walk through, all work under this Division shall have been completed, tested, balanced and adjusted in final operating condition and the test report shall have been submitted to and approved by the Owner’s representative.

B. Personnel: A qualified person representing the Contractor must be present at this final construction review to demonstrate the system and prove the performance of the equipment.

3.12 CERTIFICATIONS

A. Before receiving final payment, the Contractor shall certify that all equipment furnished and all work done is in compliance with all applicable codes mentioned in these Specifications and with manufacturer’s requirements.

B. Certification is specifically required from the following:
   1. Leak test of all renovated and new draining systems.
   2. Pressure test of all renovated and new pressure piping systems.
   3. Sterilization of all renovated and new water piping systems.
   4. Equipment performance tests.

END OF SECTION 22 05 00
PART 1 - GENERAL

1.1 SUMMARY

A. Section includes pipe and equipment supports, hangers, flashings, curbs, equipment bases, foundations, sleeves, and sealing of work to adjacent construction.

1.2 SUBMITTALS

A. Submit in accordance with TPWD Division 1 – Section 01 00 00 – Special Conditions Section 1.09 Submittals and UGC Article 8.

B. Section 22 05 00 – Plumbing General Conditions: Submittals.

C. Shop Drawings: Indicate system layout with location and detail of trapeze hangers.

D. Product Data: Submit manufacturers catalog data including load capacity.

E. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.

F. Manufacturer's Installation Instructions: Submit special procedures and assembly of components.

1.2 QUALITY ASSURANCE

A. Quality Assurance in accordance with TPWD Division 1 – Section 01 00 00 – Special Conditions Section 1.10 Quality Assurance and UGC Article 8.

B. Perform work in accordance with code for piping support and in conformance with NFPA 13 and 14 for support of sprinkler piping and standpipes.

C. Perform Work in accordance with AWS D1.1 for welding hanger and support attachments to building structure.

PART 2 - PRODUCTS

2.2 PIPE HANGERS AND SUPPORTS

B. Manufacturers:
1. Elcen.
4. Sioux Chief.
5. ITT Grinnell.
7. Substitutions: Section -22 05 00 – Plumbing General Conditions.

100% CONSTRUCTION DOCUMENTS
HANGERS, SUPPORTS, AND FOUNDATIONS
12.04.2020
C. Plumbing Piping – DWV:
1. Conform to ASME B31.9 ASTM F708.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron or carbon steel, adjustable swivel, split ring.
3. Hangers for Pipe Sizes 2 inches and Over: Carbon steel, adjustable, clevis.
4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
5. Wall Support for Pipe Sizes to 3 inches: Pipe clamps and channel bracing secured to wall framing.
6. Wall Support for Pipe Sizes to 4 inches and over: Welded steel bracket and wrought steel clamp.
8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
9. Copper Pipe Support: Copper-plated, carbon-steel adjustable, ring.

D. Plumbing Piping - Water:
1. Conform to ASME B31.9 ASTM F708.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron or carbon steel, adjustable swivel, split ring, and coated for non-insulated copper piping.
3. Hangers for Cold Pipe Sizes 2 inches and Over: Carbon steel, adjustable, clevis, and coated for non-insulated copper piping.
5. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
6. Wall Support for Pipe Sizes to 3 inches: Pipe clamps and channel bracing secured to wall framing.
8. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
9. Floor Support for Hot Pipe Sizes to 4 inches: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
10. Copper Pipe Support: Copper-plated, carbon-steel ring.
11. Copper Piping Concealed in Stud Walls: Copper plated stud brackets.

2.3 ACCESSORIES

B. Hanger Rods: Hot dipped galvanized mild steel threaded both ends, threaded on one end, or continuous threaded.

2.4 PROTECTION OF HANGERS

B. Steel hangers, hanger rod and appurtenances located in crawl spaces, ventilated mechanical rooms, unconditioned attics or exposed to outdoors shall be hot dipped galvanized.
1. As an alternate method, components such as rollers, chairs, pipe stands, steel supports, etc., may be primed with PPG or equal Inhibitor Red Primer 6-208, and painted with two (2) coats of PPG or equal Enamel 54 Line.
2. All surfaces to be painted shall be free of dust, rust, scale, grease, or other foreign material, and shall be dry at time of painting.
2.5 INSERTS

B. Manufacturers:
   1. ITT Grinnell.
   3. Elcen.
   5. Substitutions: Section 22 05 00 – Plumbing General Conditions.

C. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.6 FLASHING

B. Metal Flashing: 26 gage thick galvanized steel.

C. Metal Counterflashing: 22 gage thick galvanized steel.

D. Lead Flashing:
   1. Waterproofing: 5 lb./sq. ft sheet lead.
   2. Soundproofing: 1 lb./sq. ft sheet lead.

E. Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing.

F. Caps: Steel, 22-gage minimum; 16 gage at fire resistant elements.

G. Plumbing Vents through Roof (VTR): Refer to Part 3 Execution, Flashing.

2.7 SLEEVES

B. Manufacturers:
   1. Pro Set.
   2. Substitutions: Section 22 05 00 – Plumbing General Conditions.

C. Sleeves for Pipes through Non-fire Rated Floors: 18 gage thick galvanized steel.

D. Sleeves for Pipes through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.

E. Sleeves for Pipes through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.

F. Sealant: Acrylic in non-fire rated application.

G. Where approved by Engineer prior to installation, at floor penetration of slab on grade construction, flexible foam pipe wrap such as “Flex-Wrap” by Cal-Western may be substituted for sleeve.

H. Cover trap primer piping embedded in concrete floors and walls with “Poly-Sleeve” or equal polyethylene sleeve material.
2.8 FIRE STOP SYSTEMS

B. Manufacturers:
   1. 3m Model 2000.
   2. Spec Seal Model 100.
   3. Hilti.
   4. Substitutions: Section 22 05 00 – Plumbing General Conditions.

C. General Purpose Fire Stopping Sealant: Water based non-slumping, premixed sealant with intumescent properties, rated for 3 hours in accordance with ASTM E814 and UL 1479.

D. General Purpose Vibration Resistant Fire Stopping Sealant: Silicone based, non-slumping, premixed sealant with intumescent properties, vibration and moisture resistant, rated for 3 hours in accordance with ASTM E814 and UL 1479.

E. Plastic Pipe Systems Fire Stopping Sealant: Silicone based, premixed sealant with intumescent properties, vibration and moisture resistant, rated for 3 hours in accordance with ASTM E814 and UL 1479 with metal collars.

PART 3 - EXECUTION

3.2 INSTALLATION

B. Install in accordance with manufacturer’s instructions.

C. Install cast iron piping in accordance with CISPI Standards.

3.3 INSERTS

B. Install inserts for placement in concrete forms.

C. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

D. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.

E. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

F. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.4 PIPE HANGERS AND SUPPORTS

B. Piping systems shall be installed so as to be freely floating. They shall be securely supported from structure but shall be able to expand and contract independently of structure without causing undue stress or damage to the piping system. Piping shall not support itself. Piping systems shall be rigidly attached to structure only were shown on plans, as required by Specifications and codes, or as required for proper installation of equipment or fixtures. Provide sleeves, rollers, expansion fittings, expansion loops, or special fittings as required to prevent transmission or vibration to the structure or for the proper operation of systems whether specifically shown on plans or not.
C. Install in accordance with ASME B31.9, ASTM708.

D. Support horizontal piping as scheduled.

E. Install hangers with minimum 1/2-inch space between finished covering and adjacent work.

F. Place hangers within 12 inches of each horizontal elbow.

G. Use hangers with 1-1/2 inch minimum vertical adjustment.

H. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.

I. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.

J. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.

K. Support riser piping independently of connected horizontal piping.

L. Provide copper plated hangers and supports for copper piping.

M. Design hangers for pipe movement without disengagement of supported pipe.

N. Support base of risers above ceilings with braces, blocks, rodding or other suitable method, to prevent movement of pipe or separation of joints and fittings.

O. Provide non-conducting dielectric connections wherever dissimilar metals come in contact such as between pipe and hangers or pipe and metal structure and wall studs.

P. Paint pipe and equipment supports exposed to weather with galvanizing paint or other approved method.

Q. Where piping is suspended in excess of 18 inches, provide sway bracing to secure against horizontal movement.

3.5 EQUIPMENT BASES, FOUNDATIONS, PIERS, SUPPORTS, AND ATTACHMENTS

B. Provide necessary foundations, supports, pads, equipment bases and piers, as required and shown on Drawings or as required by manufacturer for equipment furnished by Mechanical Division. Materials, fixtures, and equipment shall be securely attached to the building structure. Attachments shall be strong, durable, and suitable for their intended application.

C. Provide housekeeping pads or foundations for every item of floor mounted equipment specified herein or indicated on the Drawings.

D. Provide housekeeping pads of concrete, minimum 4 inches thick and extending 6 inches beyond supported equipment. Steel members may be substituted for concrete pad where approved prior to installation, or as shown on drawings.
E. All corners of the foundations shall be neatly chamfered at a 45 degree angle.

F. After removal of the forms, the surface of the foundation shall be hand rubbed.

G. All concrete work performed by the Contractor shall conform entirely to the requirements of the General Specifications which describe this class of work.

H. Provide additional steel framing to raise equipment above housekeeping pad where necessary to properly construct equipment drains.

3.6 FLASHING

B. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.

C. Flash vent and soil pipes projecting 10 inches minimum above finished roof surface with lead worked 1 inch minimum into hub, 12 inches minimum clear on sides with 24 x 24 inches sheet size. For pipes through outside walls, turn flanges back into wall and caulk, metal counterflash, and seal. At metal roofs, provide dielectrically compatible flashing.

D. Flash floor drains in floors with topping over finished areas with lead, 10 inches clear on sides with minimum 36 x 36 inch sheet size. Fasten flashing to drain clamp device.

E. Seal floor, shower and mop sink drains watertight to adjacent materials.

F. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms for sound control.

G. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.7 SLEEVES

B. Set sleeves in position in forms. Provide reinforcing around sleeves.

C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

D. Extend sleeves through floors 2 inches above finished floor level. Caulk sleeves.

E. Where piping penetrates floor, ceiling, or wall, close off space between pipe and adjacent work with stuffing or fire stopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

F. Install chrome plated steel escutcheons at finished surfaces.
### G. SCHEDULES

<table>
<thead>
<tr>
<th>PIPE SIZE</th>
<th>MAX. HANGER SPACING</th>
<th>DIAMETER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inches</td>
<td>Feet</td>
<td>Inches</td>
</tr>
<tr>
<td>1/2 to 1-1/4</td>
<td>6.5</td>
<td>3/8</td>
</tr>
<tr>
<td>1-1/2 to 2</td>
<td>10</td>
<td>3/8</td>
</tr>
<tr>
<td>2-1/2 to 3</td>
<td>10</td>
<td>1/2</td>
</tr>
<tr>
<td>4 to 6</td>
<td>10</td>
<td>1/2</td>
</tr>
<tr>
<td>PVC (All Sizes)</td>
<td>6</td>
<td>3/8</td>
</tr>
</tbody>
</table>

END OF SECTION 22 05 29
SECTION 22 05 53 - PLUMBING IDENTIFICATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes nameplates, tags, stencils, and pipe markers.

1.2 SUBMITTALS

A. Submit in accordance with TPWD Division 1 – Section 01 00 00 – Special Conditions Section 1.09 Submittals and UGC Article 8

B. Section 22 05 00 – Plumbing General Conditions: Submittal Procedures.

1.3 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.4 QUALITY ASSURANCE

A. Quality Assurance in accordance with TPWD Division 1 – Section 01 00 00 – Special Conditions Section 1.10 Quality Assurance and UGC Article 8

B. Materials: Flame spread/smoke developed rating of 25/50 or less in accordance with ASTM E84, NFPA 255, UL 723.

C. Maintain one copy of each document on site.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years documented experience.

PART 2 - PRODUCTS

2.1 NAMEPLATES

A. Manufacturers:

1. Brady.
2. Seton.
3. LEM.
4. Substitutions: Section 22 05 00 – Plumbing General Conditions.

B. Product Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.
2.2 TAGS

A. Metal Tags:
   1. Manufacturers:
      a. Brady.
      b. LEM.
      c. Seton.
      d. Substitutions: Refer to Section 22 05 00 – Plumbing General Conditions.
   2. Brass with stamped letters; tag size minimum 1-1/2 inches diameter with finished edges.

B. Tag Chart: Typewritten letter size list of applied tags and location in anodized aluminum frame.

2.3 PIPE MARKERS


B. Plastic Pipe Markers:
   1. Manufacturers:
      a. Brady.
      b. LEM.
      c. Seton.
      d. Substitutions: Refer to Section 22 05 00 – Plumbing General Conditions.
   2. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.

2.4 CEILING TACKS

A. Manufacturers:
   1. Brady.
   2. LEM.
   4. Substitutions: Section 22 05 00 – Plumbing General Conditions.

B. Description: Steel with 3/4-inch diameter color-coded head or adhesive backed color coded paper.

PART 3 - EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

A. Install identifying devices after completion of coverings and painting.

B. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.

C. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer.

D. Install tags using corrosion resistant chain. Number tags consecutively by location.
E. Equipment: Identify domestic water heaters, and other mechanical equipment with plastic nameplates. Identify valves and other small devices with tags.

F. Identify valves in main and branch piping with tags. Provide plastic tags indicated what valves serve for pipe manifolds.

G. Tag automatic controls, instruments, and relays. Key to control schematic.

H. Piping: Identify piping, concealed or exposed, with plastic pipe markers. Identify service and flow direction. Identify domestic hot and cold water. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

I. Provide ceiling tacks to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION 22 05 53
SECTION 22 05 58 - ACCESS DOORS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install access doors in wall or ceiling locations as required or shown for access to valves, controls, regulating devices, water hammer arrestors, trap-primers, cleanouts, and other equipment requiring maintenance, adjustment or operation.

B. All access door locations shall be approved by the Architect prior to installation of equipment, valves, etc. requiring access.

PART 2 - PRODUCTS

2.1 NON-FIRE RATED ACCESS DOORS

A. Furnish Inryco/Milcor, Acudor, Elmdor, or equal with 16 gauge frames, 14-gauge panels and 22-gauge casing head. Provide continuous concealed hinges and flush screwdriver cam lock. Use Style K access doors for plastered surfaces, Style M for masonry or gypboard surfaces. Use Style AP for acoustical plaster ceiling, with 18-gauge panel and all-galvanized construction.

2.2 FIRE RATED ACCESS DOORS

A. Furnish Inryco/Milcor, Acudor, Elmdor, or equal, UL listed, 1-1/2 hour Label “B”, access doors with 16-gauge steel frames, and 20-gauge insulated sandwich-type door panel. Provide door with continuous concealed hinge and automatic closing and latching mechanism.

2.3 FINISHED AREAS

A. Provide stainless steel access doors where located in finished areas that are accessible to the general public such as but not limited to Toilet Rooms, Offices, Corridors, and Classrooms and/or access doors prepared for painting. Coordinate with the Architect before installation of access panel.

PART 3 - EXECUTION

3.1 Access doors specified in Division 22 will be installed by other Divisions. Not all required access doors are shown. Coordinate with the Contractor to locate access doors for ease of operation and maintenance of concealed equipment.

3.2 Installation shall be in accordance with the manufacturer’s printed instructions.

3.3 Access doors shall be of sufficient size to perform all necessary service and maintenance tasks.

3.4 Coordination of access doors shall be coordinated with the Architect for final installation.

END OF SECTION 22 05 58
PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulation jackets, covering, thermal insulation for piping systems including vapor retarders, jackets, and accessories.

1.2 SUBMITTALS

A. Submit in accordance with TPWD Division 1 – Section 010000 – Special Conditions Section 1.09 Submittals and UGC Article 8.

B. Section 22 05 00 - Plumbing General Conditions: Submittals.

C. Product Data: Submit product description, thermal characteristics, and list of materials and thickness for each service, and location.

1.3 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three (3) years documented experience.

B. Applicator: Company specializing in performing work of this Section whose primary business is insulation with minimum three (3) years documented experience.

1.4 QUALITY ASSURANCE

A. Quality Assurance in accordance with TPWD Division 1 – Section 010000 – Special Conditions Section 1.10 Quality Assurance and UGC Article 8.

B. Materials: Flame spread/smoke developed rating of 25/50 or less in accordance with ASTM E84, NFPA 255, UL 723.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.

B. Maintain temperature during and after installation for minimum period of 24 hours.
1.7 REGULATORY COMPLIANCE


PART 2 - PRODUCTS

2.1 POLYISOCYANurate FOAM FOR PIPING OR USE AS INSERTS


B. Insulation: ASTM C591, rigid molded modified polyisocyanurate cellular plastic.
1. K Value: ASTM 518; Initial – 0.14 at 75 degrees F.; Aged 180 days – 0.19 at 75 degrees F.
2. Minimum Service Temperature: -250 degrees F.
3. Maximum Service Temperature: 300 degrees F.
7. Vapor seal seams with suitable mastic.
8. Minimum R-Value: Refer to Part 3 Schedules.

C. Vapor Barrier Jacket:
1. ASTM C921, Factory applied, all service jacket, white kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
2. Moisture Vapor Transmission: ASTM E96; 0.02 perm inches.
3. Secure with self-sealing longitudinal laps and butt strips, then with outward clinch expanding staples and vapor barrier finish.

D. Fittings:
1. Material and thickness to be same as adjacent pipe. Fittings to be mitered with a minimum of 3 miters per fitting. Secure with glass fabric and mastic and cover with PVC fitting covers. Vapor seal seams with suitable mastic.
2. All joint and fitting fabrication work to be out in accordance with ASTM C-585 and C-450.

E. Tie Wire: 16 gage stainless steel with twisted ends on maximum 12 inch centers. In mechanical rooms, cover wire with ASJ tape.

F. Vapor Barrier Lap Adhesive:
1. Self sealing by manufacturer.
2. Compatible with insulation.
3. Provide additional vapor seal by coating lap with Foster 30-35.

G. Fibrous Glass Fabric:
1. Manufacturers:
   a. Childers #10 CHILL-GLAS.
   b. Foster MAST-A-FAB.
2. Cloth: Untreated: 1.6oz/sq yd weight.
H. Indoor Vapor Barrier Finish:
   1. Manufacturers:
      b. Fosters 30-35.
   2. Vinyl emulsion type acrylic, compatible with insulation, white color.

I. Outdoor Vapor Barrier Finish:
   2. Vinyl emulsion type acrylic, compatible with insulation, white color.

J. Insulating Cement:
   1. Manufacturers: Newell PRO-TEC KOTES Model 1MWP.
   2. ASTM C449.

K. Inserts: Provide inserts at hangers on pipe sizes 8 inches and larger.

L. May be used for inserts in piping installed indoors where insulation thickness is 1 inch or less (25/50; 1 1/2 inches and over – 25/100).

2.2 GLASS FIBER, RIGID FOR PIPING

A. Manufacturers:
   1. Johns Manville Model Microlok.
   2. Knauf Model 850 ASJ-SSL.
   3. Owens Corning Model ASJ-SSL-II.

B. Insulation: ASTM C612; rigid, noncombustible.
   1. K Value: ASTM C177 or ASTM C518, 0.24 at 75 degrees F.
   2. Maximum Service Temperature: 850 degrees F.
   3. Maximum Moisture Absorption: 0.1 percent by volume.

C. Vapor Barrier Jacket:
   1. ASTM C921, Factory applied all service jacket, white kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
   2. Moisture Vapor Transmission: ASTM E96; 0.02 perm inches.
   3. Secure with self-sealing longitudinal laps and butt strips, then with outward clinch expanding staples and vapor barrier finish.

D. Fittings: Material and thickness to be same as adjacent pipe. Fittings to be mitered with a minimum of 3 miters per fitting. Secure with glass fabric and mastic and cover with PVC fitting covers. Vapor seal seams with suitable mastic.

E. Vapor Barrier Lap Adhesive:
   1. Self sealing by manufacturer.
   2. Compatible with insulation.
   3. Provide additional vapor seal by coating lap with Foster 30-35.

F. Fibrous Glass Fabric:
   1. Manufacturers:
      a. Childers #10 CHILL-GLAS.
b. Fosters MAST-A-FAB.

2. Cloth: Untreated; 9-oz/sq yd (305-g/sq m) weight.

G. Indoor Vapor Barrier Finish:
   1. Manufacturers:
      b. Fosters 30-35.
   2. Vinyl emulsion type acrylic, compatible with insulation, white color.

H. Outdoor Vapor Barrier Finish:
   2. Vinyl emulsion type acrylic, compatible with insulation, white color.

I. Insulating Cement:
   1. Manufacturers:
      a. Newell PRO-TEC KOTES Model 1MWP.
      b. ASTM C449.

J. Inserts: Provide inserts at all hangers for all pipe sizes.

2.3 CELLULAR GLASS FOR USE AS INSERT

A. Manufacturers: Pittsburg Corning Model Foamglas.

B. Insulation: ASTM C552, Type II – pipe and tubing insulation, Class 2 - Jacketed.
   1. K Value: ASTM C177 or ASTM C518, 0.33 at 75 degrees F.
   2. Density: 8.0 pounds per cubic foot.

2.4 HYDROUS CALCIUM SILICATE FOR HOT WATER PIPING

A. Manufacturers: Johns Manville Model Thermo Gold 12.

B. Calcium Silicate Block and Pipe Thermal Insulation: ASTM C533, Type I Asbestos – free – for use on surfaces up to 1200 F.
   1. K Value: ASTM C177 or ASTM C518, 0.42 at 300 degrees F. (0.061 at 149 degrees C.).

C. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

D. Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement: ASTM C449/C449M.

2.5 ELASTOMERIC CELLULAR FOAM FOR PIPING OR EQUIPMENT

A. Manufacturers: Armstrong Model AP Armaflex.

B. Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular form: ASTM C534; Type I, Tubular form. CFC, HCFC, HFC free.
   1. K Value: ASTM C177 or ASTM C518, 0.27 at 75 degrees F.
   2. Minimum Service Temperature: -70 degrees F.
3. Maximum Service Temperature: +220 degrees F.
   a. 3/4 inch thickness and less: Flame Spread – 25, Smoke Developed – 50.
   a. 3/4 inch thickness and less: Flame Spread – 25, Smoke Developed – 50.
6. Water Vapor Permeability: ASTM E96-90, 0.10 perm-in.
7. Minimum R-Value: Refer to Part 3 Schedules.

C. Elastomeric Foam Adhesive:
   1. Manufacturers:
      a. Armstrong Model 520.
      b. Substitutions: Section 22 05 00 - Plumbing General Conditions.
   2. Air dried, contact adhesive, compatible with insulation.

D. Insulation Tape: Elastomeric foam tape of same material as insulation.

E. Insert Material: Compression resistant elastomeric foam material.

2.6 PLENUM WRAP

A. Manufacturers: 3M 5A.

B. Installation shall be in strict accordance with manufacturer’s written instructions, as shown on
   the approved shop drawings. Plenum Wrap density shall be nominal 6 pcf and have a nominal
   1/2 inch thickness. The fiber blanket shall have a continuous use limit in excess of 1832°F.
   Flame Spread Index and Smoke Developed Index of the foil encapsulated blanket shall be <25
   /<50.

C. Wrap non-metallic piping located in return air plenums with thickness as required by code.

2.7 JACKETS

A. PVC Plastic: Fittings in all locations, piping inside Mechanical Equipment Rooms (AHU,
   Water Heater Rooms), and where exposed to view in finished spaces:
   1. Manufacturers:
      a. Proto Corporation Model Lo Smoke.
      b. Owens Corning Model Zeston.
      c. Owens Corning Model Ceel-Co.
   2. Jacket: ASTM C921, One-piece molded type fitting covers and sheet material, off white
      color, factory applied coloring to identify individual services.
      a. Minimum Service Temperature: -40 degrees F.
      b. Maximum Service Temperature: 150 degrees F.
      c. Moisture Vapor Transmission: ASTM E96; 0.002 perm inches.
      d. Maximum Flame Spread: ASTM E84; 25.
      e. Maximum Smoke Developed: ASTM E84; 50.
      f. Thickness: 20 mil.
      g. Connections: As recommended by manufacturer.
   3. Covering Adhesive Mastic: Manufacturers:
      b. Compatible with insulation.
   1. Thickness: 0.016 inch sheet.
   2. Finish: Smooth.
   4. Fittings: 0.24 inch thick die shaped fitting covers with factory attached protective liner.
   5. Metal Jacket Bands: 1/2 inch wide; 0.015 inch thick aluminum.

C. Asphalt Impregnated Sheathing – Underground Valves and Piping.
   1. Asphalt Impregnated Sheathing, 50 mil thickness:
      a. Manufacturers:
         1) Polyguard Insul-wrap 50.
         2) Serva-Wrap.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify piping, equipment, and ductwork have been tested before applying insulation materials.

B. Verify surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION

A. Install in accordance with NAIMA National Insulation Standards and Manufacturers instructions.

B. It shall be the responsibility of the contractor to ensure that an effective insulation and vapor seal is achieved on all cold surfaces which will eliminate any sweating or condensation on any cold surfaces installed by the contractor.

C. Exposed Piping: Locate insulation and cover seams in least visible locations.

D. Insulated Pipes Conveying Fluids Below Ambient Temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, expansion joints, air separators, suction diffusers, expansion tanks and chemical feeders.
   1. Furnish factory-applied or field-applied vapor retarder jackets. Secure jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips, then with outward clinch expanding staples. Seal staple penetrations with vapor retarder mastic.
   2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe or as specified in Part 3 - 3.3 Schedules. Finish with glass cloth and vapor retarder adhesive or PVC fitting covers.
   3. Insulate piping components such as nipples, valve stems or other cold surfaces where condensation forms with elastomeric cellular foam tape.

E. For hot piping conveying fluids over 140 degrees F., insulate flanges and unions at equipment.
F. Insulated Pipes Conveying Fluids Above Ambient Temperature: Insulate entire piping system including fittings, valves, unions, flanges, flexible connections, expansion joints:
   1. Furnish factory-applied or field-applied standard jackets. Secure with outward clinch expanding staples and pressure sensitive adhesive system on standard factory-applied jacket and butt strips.
   2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe or as specified in Part 3 Schedules. Finish with glass cloth and adhesive or PVC fitting covers.

G. Underground Valves: Insulate valve body and flanges and cover installation with asphalt impregnated jacket.

H. Equipment Connections: Seal piping at point of connection to equipment to maintain vapor barrier.

I. Inserts and Shields:
   1. Application: Piping or Equipment 1 1/2 inches diameter or larger.
   2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts. Length shall be 4 inches shorter than insert to allow for vapor retarding butt joints.
   3. Insert location: Between support shield and piping and under finish jacket.
   4. Insert configuration: 12 inches long for pipe sizes 1 1/2 to 6 inch, 16 inches for pipe sizes 8 and 10 inch and 22 inches for pipe sizes 12 inch and larger. Thickness and contour to match adjoining insulation; may be factory fabricated.
   5. Insert material: Cellular glass or Calcium Silicate material. Where Elastomeric Foam material is used, provide compression resistant insulating material furnished by insulation manufacturer and suitable for planned temperature range and service.

J. Elastomeric Cellular Foam Insulation – Piping:
   1. Apply adhesive at butt ends of joints and fittings.
   2. Fittings shall be mitered or template-cut in accordance with manufacturer’s instructions. Do not slide tubing over 90 degree elbows.
   3. Inserts: Provide rigid elastomeric insulation at pipe hangers for pipe sizes 1 1/2 inch and larger to prevent compression of insulation.

K. Continue insulation through penetrations of building assemblies or portions of assemblies having fire resistance rating of one (1) hour or less. Provide intumescent firestopping when continuing insulation through assembly. Finish at supports, protrusions, and interruptions. Refer to architectural for penetrations of assemblies with fire resistance rating greater than one hour.

L. Exterior Applications: Provide vapor retarder jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor retarder cement. Cover with aluminum jacket with seams located at 3 or 9 o’clock position on side of horizontal piping with overlap facing down to shed water or on bottom side of horizontal equipment.

M. Domestic Cold Water – Where piping rises up form below grade and enters building, cover entrance riser with insulation and aluminum jacketing.

N. Sanitary Waste Piping and Drains receiving HVAC Condensate: Insulate drain body, p-trap, and waste piping between drain and first major sanitary branch.
O. Sanitary Waste Piping receiving Chilled Drinking Water: Insulate p-trap and waste piping between drain and first major sanitary branch.

P. Roof Drains and Roof Drain Piping not within columns: Insulate drain body, drain riser and horizontal piping up to eight foot of run.

Q. Heat Traced Piping: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size insulation large enough to enclose pipe and heat tracer.

R. Factory Insulated Equipment: Do not insulate, except when indicated on Drawings, or other sections of Specifications.

S. Exposed Equipment: Locate insulation and cover seams in least visible locations.

T. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.

U. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retarder cement.

V. Insulated Equipment Containing Fluids Below Ambient Temperature: Insulate entire system.

W. For hot equipment containing fluids over 140 degrees F., Insulate flanges and unions with removable sections and jackets.

X. Finish insulation at supports, protrusions, and interruptions.

Y. Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.

Z. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation for easy removal and replacement without damage.

3.3 SCHEDULES

A. Provide minimum thickness or R-value as follows. Increase as necessary for compliance with local code. R-values are installed values.

B. Plumbing Systems:
1. Domestic Hot Water Supply:
   a. Rigid Glass Fiber Insulation:
      1) Pipe Size Range: All sizes.
      2) Thickness: 1 inch.
   b. Elastomeric Cellular Foam:
      1) Pipe Size Range: All sizes.
      2) Thickness: 1 inch.
2. Domestic Cold Water:
   a. Rigid Glass Fiber Insulation:
      1) All piping located outside of building envelope insulation; all piping subject to freezing; all piping within warehouse; all piping in exterior walls (regardless of building insulation envelope); water entrance riser.
2) Thickness: 1 inch.

b. Elastomeric Cellular Foam:
   1) All piping located outside of building envelope insulation; all piping in
      exterior walls (regardless of building insulation envelope); water entrance
      riser.
   2) Thickness: 1 inch.

3. Drains and waste piping receiving HVAC condensate and chilled drinking water (refer to
   3.2):
   a. Elastomeric Cellular Foam:
      1) Pipe size Range: All sizes.
      2) Thickness: 3/4 inch.
   b. Flexible Glass Fiber Insulation:
      1) Pipe Size Range: All sizes.
      2) Thickness: 1 1/2 inch.

4. Chilled Drinking Water:
   a. Elastomeric Cellular Foam Insulation:
      1) Pipe Size Range: All sizes.
      2) Thickness: 3/4 inch.

END OF SECTION 22 07 00
SECTION 22 11 16 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract are a part of these Plumbing Specifications.

B. Sections of the Specifications covering General Conditions and supplements are a part of the Contract. Contractor shall observe all requirements thereof, insofar as they pertain to his work.

1.2 SUMMARY

A. Provide materials and installation for complete first class plumbing system, within and to five feet beyond building perimeter unless noted otherwise on Contract Drawings, Domestic Water Piping, Domestic Water Valves, Testing and other normal parts that make the systems operable, code compliant and acceptable to the authorities having jurisdiction.

1.3 REFERENCES

A. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

4. ASTM E84: surface burning characteristics of building materials.
5. ASTM F1807: specification for metal insert fittings utilizing a copper crimp ring for SDR9 cross-linked polyethylene (PEX) tubing.
6. ASTM F2023: test method for evaluating the oxidative resistance of cross-linked (PEX) tubing and systems to hot chlorinated water.
7. ASTM F2159: specification for plastic insert fittings utilizing a copper crimp ring for SDR9 cross-linked polyethylene (PEX) tubing.
10. ASTM F876: specification for cross-linked polyethylene (PEX) tubing.
11. ASTM F877: specification for cross-linked polyethylene (PEX) plastic hot and cold water distribution systems.
12. AWWA C904: cross-linked polyethylene (PEX) pressure pipe, ½ in. through 2 in., for water service.
13. CAN/ULC S102.2: standard method of testing for surface burning characteristics of flooring, floor covering and miscellaneous materials and assemblies.
14. CSA CAN/CSA B137.5: cross-linked polyethylene (PEX) tubing systems for pressure applications.
15. cULus - UL 1821: listing for multipurpose residential fire sprinkler systems (Viega Pureflow PEX black with PureFlow press bronze and polymer fittings in sizes ¾ to 2).
20. NSF 61: drinking water system components – health effects.

1.4 SUBMITTALS

A. Submit in accordance with TPWD Division 1 – Section 010000 – Special Conditions Section 1.09 Submittals and UGC Article 8.

B. Section 22 05 00 - Plumbing General Conditions: Submittals.

C. Product Data: Submit data on pipe materials; pipe fittings, valves, and accessories. Submit manufacturers catalog information. Indicate valve data and ratings.

D. Manufacturer's Installation Instructions: Submit installation instructions for valves and accessories.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of valves and equipment.

B. Operation and Maintenance Data: Submit spare parts list, exploded assembly views and recommended maintenance intervals.

1.6 QUALITY CONTROL

A. Manufacturer’s name and pressure rating shall be permanently marked on valve body.

B. The Contractor shall notify the manufacturer’s representative prior to installing any copper press fittings. The Contractor shall obtain the representative’s guidance in any unfamiliar installation procedures. The manufacturer’s representative of copper press fittings shall conduct periodic inspections of the installation and shall report in writing to the Contractor and Owner of any observed deviations from manufacturer’s recommended installation practices.

C. Manufacturer Qualifications: Company shall have minimum three years documented experience specializing in manufacturing the products specified in this Section.

D. Installer Qualifications:

1. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three (3) years documented experience.

2. The installer shall be a qualified installer, licensed within the jurisdiction, and familiar with the installation of cross-linked polyethylene (PEX) tubing systems.

3. The installation of cross-linked polyethylene (PEX) tubing for hot and cold water distribution systems shall conform to the requirements of the ICC International Plumbing Code or IAPMO Uniform Plumbing Code.
1.7 DELIVERY, STORAGE, AND HANDLING

A. All materials shall be new and undamaged.

B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

C. Protect all materials that are to be installed within this project from exposure to rain, freezing temperatures and direct sunlight. EXCEPTION: Materials manufactured for exterior locations.

D. The cross-linked polyethylene (PEX) tubing shall be shipped to the job site on truck or in such a manner to protect the tubing. The cross-linked polyethylene fittings and manifolds shall not be handled roughly during shipment. The tubing and fittings shall be unloaded with reasonable care.

E. Cross-linked polyethylene plastic tubing and fittings shall be stored in a flat, dry, well ventilated location, not exposed to direct sunlight. Normal care in handling shall be exercised to avoid abuse of the tubing. The tubing and fittings shall not be thrown or dropped on the ground, walked on, or dragged.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Do not install underground piping when bedding is wet or frozen.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.10 TEMPORARY CONNECTIONS

A. Plumbing Contractor shall provide temporary water connection required for construction purposes.

1.11 RELATED WORK SPECIFIED ELSEWHERE

A. The following related work is specified elsewhere.
   1. Condensate drain piping from equipment furnished by the HVAC Contractor to drains provided by the Plumbing Contractor.
   2. Installation of flashing and waterproofing.
   3. Electrical wiring required for electric water coolers, electric water heaters, and electrical fixture sensors.
   4. Splashblocks.

1.12 DISPOSAL OF EXCAVATED MATERIAL

A. Excavated materials, so far as needed and of a suitable and acceptable character, shall be piled adjacent to the excavations to be used as backfill as required. All excavated material that is unsuitable for backfilling purposes, or which is in excess of the amount required or needed to satisfactorily complete the backfill, shall be piled at a location on the site designated by the Owner.
1.13 SERVICE CONNECTIONS

A. Domestic water piping located outside lines of building shall be terminated outside lines of building at locations indicated on the Drawings.

1.14 TEST OF WATER PIPING

A. Water piping shall be tested under 125 PSI hydrostatic pressure for a period of no less than twelve (12) hours. Any leaks made evident shall be repaired and the test repeated to completion.

PART 2 - PRODUCTS

2.1 WATER PIPING UNDER FLOOR SLAB AND TRAP-PRIMER PIPING

A. Pex Tubing: ASTM F876, Viega PureFlow PEX high-density cross-linked polyethylene tubing. 2" pipe size and smaller. The following three standard grade ratings are required:
   1. 200 degrees F at 80 psig.
   2. 180 degrees F at 100 psig.
   3. 73.4 degrees F at 160 psig.

B. Fittings: No fittings below slab or within sleeves.

C. Joints: No joints allowed below slab.

D. Trap-primers: All piping below slab or installed in concrete or masonry floors and walls shall be encased in a polyethylene sleeve.

E. Pressure Water Piping: All piping below slab on grade shall be encased in a Schedule 40 PVC Electrical Conduit sleeve with long elbow sweeps.

2.2 WATER PIPING, ABOVE GRADE

A. Pex Tubing: ASTM F876, Viega PureFlow PEX high-density cross-linked polyethylene tubing. 2" pipe size and smaller. The following three standard grade ratings are required:
   1. 200 degrees F at 80 psig.
   2. 180 degrees F at 100 psig.
   3. 73.4 degrees F at 160 psig.

B. Fittings: No fittings below slab or within sleeves.

C. Joints: No joints allowed below slab.

D. Trap-primers: All piping below slab or installed in concrete or masonry floors and walls shall be encased in a polyethylene sleeve.

2.3 FLANGES, UNIONS, AND COUPLINGS

A. Pipe Size 2 inches and Under:
   1. Ferrous Pipe: Class 150 malleable iron threaded unions.
   2. Copper Tube and Pipe: Class 150 bronze unions with soldered joints.
B. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, and water impervious isolation barrier.

2.4 PIPE HANGERS AND SUPPORTS

A. Plumbing Piping: Conform to ASME B31.9 ASTM F708.

B. Refer to Section 22 05 29 – Hangers, Supports, and Foundations.

2.5 BALL VALVES

A. Manufacturers:
   1. Viega.
   2. Jenkins.
   4. Crane.
   5. Substitutions: Section 22 05 00 – Plumbing General Conditions.

B. Construction, 2 inches and Smaller: Class 150, bronze, one piece body, chrome plated brass ball, regular port, teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, solder or threaded ends with union.

2.6 SWING CHECK VALVES

A. Manufacturers:
   1. Mission Model Duo-Chek.
   2. Stockham.
   3. Crane.
   4. Jenkins.
   5. Substitutions: Section 22 05 00 – Plumbing General Conditions.

B. Up to and Including 2 inches: Class 125, bronze body and cap, bronze swing disc with rubber seat, solder or threaded ends.

C. 2 inches and Larger: Class 125, iron body, bronze swing disc, renewable disc seal and seat, flanged ends.

2.7 SPRING LOADED CHECK VALVES

A. Manufacturers:
   1. Mission.
   2. Stockham.
   3. Crane.
   4. Jenkins.
   5. Substitutions: Section 22 05 00 – Plumbing General Conditions.

B. Class 125, iron body, bronze trim, stainless steel springs, bronze disc, Buna N seals, wafer style ends.
2.8 RELIEF VALVES

A. Manufacturers:
   1. Watts.
   2. Substitutions: Section 22 05 00 – Plumbing General Conditions.

B. Temperature and Pressure Relief: AGA Z21.22 certified, bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees F, capacity ASME SEC IV certified and labeled.

2.9 FIRE STOP SYSTEMS

A. Manufacturers:
   1. 3M Model 2000.
   2. Spec Seal Model 100.
   3. Hilti.
   4. Substitutions: Section 22 05 00 – Plumbing General Conditions.

B. General Purpose Fire Stopping Sealant: Water based, non-slumping, premixed sealant with intumescent properties, rated for three (3) hours in accordance with ASTM E814 and UL 1479.

2.10 HOSE BIBBS

A. Refer to Plumbing Fixture Schedule on Drawings for specification of hose bibbs.

B. Select inlet configuration to match thickness of wall for wall hydrants.

2.11 RECESSED VALVE BOX

A. Manufacturers:
   1. Sioux Chief.
   2. Substitutions: Section 22 05 00 – Plumbing General Conditions.

B. Refer to Plumbing Fixture Schedule on Drawings for Specifications of recessed valve boxes.

2.12 BACKFLOW PREVENTERS

A. Manufacturers:
   1. Watts.
   2. Substitutions: Section 22 05 00 – Plumbing General Conditions.

2.13 WATER HAMMER ARRESTORS

A. Manufacturers:
   1. Zurn.
   2. Wade.
   4. Substitutions: Section 22 05 00 – Plumbing General Conditions.

B. ANSI A1126.1; stainless steel copper construction, bellows type sized in accordance with PDI WH-201.
C. Pre-charged suitable for operation in temperature range -100 to 300 degrees F (-73 to 149 degrees C) 34 to 250 degrees F (1 to 120 degrees C) and maximum 250-psi (1700 kPa) 150 psi (1000 kPa) working pressure.

2.14 THERMOMETERS

A. Furnish and install thermometers where indicated. Thermometers shall be Trerice or equal Catalog No. A405 industrial thermometer, 9” aluminum case, adjustable angle, brass separable socket, 30 to 240 degrees F. range.

2.15 SLEEVES

A. For pipes 4” and under and passing through partitions, walls, and floors – galvanized steel pipe.
B. For pipes 4” and over and passing through partitions, walls, and floors – minimum 16 gauge galvanized sheet metal.
C. Where approved by Engineer prior to installation, at floor penetration in slab on grade construction, flexible foam pipe wrap such as “Flex-Wrap” by Cal-Western may be substituted for sleeve.
D. Cover trap-primer piping embedded in concrete floors and walls with “Poly-sleeve” or equal polyethylene sleeve material.

2.16 TRAP-PRIMERS

A. Refer to Plumbing Fixture Schedule and Details on Drawings for specification of trap-primers.

2.17 UNDER COUNTER PROTECTIVE PIPE COVERS

A. Manufacturers:
   1. Trubro.
   2. Plumberex.
   3. Substitutions: Section 22 05 00 – Plumbing General Conditions.
B. Insulate per ADA 4.19.4 and ICC/A117.1, all drainage piping including all hot and cold water valve and supplies under lavatories and / or sinks. PVC insulation material shall also meet IBC testing standards ASTM E84-07.

2.18 SUPPLY STOPS

A. Lead Free, Quarter-Turn, Chrome-plated, brass body angle stop with loose key handle, chrome-plated supply tube or stainless steel braided supply hose and chrome-plated escutcheon. McGuire Convertible II compression or sweat or as indicated on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify excavations are to required grade, dry, and not over-excavate.
3.2 PREPARATION

A. Ream pipe and tube ends. Remove burrs.
B. Remove scale and dirt, on inside and outside, before assembly.
C. Prepare piping connections to equipment with flanges or unions.
D. Excavate and backfill in accordance with Architectural Specifications and Specification Section 22 05 00 – Plumbing General Conditions.

3.3 INSTALLATION

A. Install Work in accordance with manufacturer’s instructions.
B. Install shut-off valves located above ceilings at a height and location that is readily and safely accessible to maintenance personnel from an eight-foot stepladder.
C. Install non-conducting dielectric connections wherever jointing dissimilar metals.
D. No bushings will be allowed in any piping. Copper or brass adapters shall be used for joining copper pipe to screwed valves or fittings.
E. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
F. Install piping to maintain headroom without interfering with use of space or taking more space than necessary.
G. Group piping whenever practical at common elevations.
H. Furnish and install compression type stops on supply piping to all fixtures including kitchen equipment and fixtures.
I. Install PEX tubing that is free of blemishes, cuts, gouges, kinks or noticeable fading of color.
J. The installation of PEX tubing shall not exceed an eight times the tubing outside diameter (OD) free bend radius or a five times the tubing OD supported bend radius, with use of a Viega approved bend support. Install fittings for changes in direction where any minimum bend radius is exceeded and branch connections.
K. PureFlow Crimp fittings shall be made in accordance with the manufacturer’s installation instructions. The copper crimp ring shall be placed over the end of the squared off PEX tubing then the PureFlow Crimp fitting fully inserted into the tubing. Position the crimp ring ⅛ to ¼ from the end of the tubing before engaging a crimp connection. The PureFlow Crimp connection shall be made with a Viega supplied full circle crimp tool or equivalent.
L. Threaded joints shall have a potable water listed joint sealant tape applied to the male threads only. Tighten joint with a wrench and backup wrench as required.
M. Protect PEX tubing from exposure to direct and indirect sunlight exposure. PEX tubing shall be stored under cover, shielded from direct and indirect sunlight when material is stored for any length of time.

N. Provide hose bib, or wall hydrant where shown on plans, at each entrance for system drain down. Valve and hose bib shall be arranged so as not to interfere with normal pedestrian traffic.

O. Hot water relief lines shall not discharge onto water entrance.

P. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.

Q. Install valves with stems upright or horizontal, not inverted.

R. Install water piping in accordance with ASME B31.9.

S. Install concrete thrust blocks at all changes in direction of underground piping.

T. Sleeve pipes passing through partitions, walls and floors. At penetrations of exterior walls, fill annular space in sleeve with non-combustible material. Caulk and seal weather-tight and vermin-tight.

U. Provide fire-stopping sealant at all piping penetrations of fire rated barriers.

V. Install potable water protection devices on plumbing lines where contamination of domestic water may occur; on make-up water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibs.

W. Pipe relief from valves, back-flow preventers and drains to nearest floor drain. Pipe relief from temperature and pressure relief valves to outdoors where possible.

X. Install water hammer arrestors on cold water supply piping where shown on Drawings or as required for all fast closing valves as per code.

Y. Install air chambers on hot and cold water supply piping to each fixture or group of fixtures. Fabricate same size as supply pipe or 3/4 inch minimum and minimum 18 inches long. Air chambers need not be installed where water hammer arrestors are in place.

Z. Cover water and waste piping underneath ADA compliant fixtures with protective pipe covering kits.

AA. Trench safety system shall comply with the appropriate requirements established in the Occupational Safety and Health Administration (OSHA) Safety Health Requirements, Part 1926, Subpart P, Excavation, Trenching, and Shoring.

BB. Identify piping utilizing copper press fittings with markers stating, “Press-Fit” adjacent to each content identification marker.

3.4 INTERFACE WITH OTHER PRODUCTS

A. Install unions downstream of valves and at equipment or apparatus connections.
B. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.

C. Install gate or ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

D. Install globe or ball valves for throttling, bypass, or manual flow control services.

E. Provide spring loaded check valves on discharge of water pumps.

F. Provide flow controls in water circulating systems where indicated.

3.5 ERECTION TOLERANCES

A. Slope water piping minimum 0.25 percent and arrange to drain at low points.

3.6 DISINFECTING OF DOMESTIC WATER

A. Prior to starting work, verify system is complete, flushed, and clean.

B. Verify pH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

C. Inject disinfectant, free chlorine in liquid, powder and tablet or gas form, throughout system to obtain residual from 50 to 80 mg/L.

D. Bleed water from outlets to obtain distribution and test for disinfectant residual at minimum 15 percent of outlets.

E. Maintain disinfectant in system for 24 hours.

F. When final disinfectant residual tests less than 25 mg/L, repeat treatment.

G. Flush disinfectant from system until residual concentration is equal to incoming water or 1.0 mg/L.

H. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

3.7 METAL PIPE HANGER SPACING

A. Pipe size: 1/2 to 1-1/4 inches:
   1. Maximum hanger spacing: 6.5 ft.

B. Pipe size: 1-1/2 to 2 inches:
   1. Maximum hanger spacing: 10 ft.

C. Pipe size: 2-1/2 to 3 inches:
   1. Maximum hanger spacing: 10 ft.
   2. Hanger rod diameter: 1/2 inch.
D. Pipe size: 4 to 6 inches:
   1. Maximum hanger spacing: 10 ft.

END OF SECTION 22 11 16
SECTION 22 13 16- SANITARY WASTE, VENT AND DRAIN PIPING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including the “Mechanical and Electrical Specifications (Common Conditions)”, is a part of these Plumbing Specifications.

B. Sections of the Specifications covering General Conditions and supplements are a part of the contract. Contractor shall observe all requirements thereof, insofar as they pertain to his work.

1.2 SUMMARY

A. Provide materials and installation for complete first class plumbing system, within and to five (5) feet beyond building perimeter unless noted otherwise on Contract Drawings. Sanitary, Waste, and Vent piping, pipefitting, connections, equipment for sanitary sewer piping systems, floor drains, cleanouts, testing, and other normal parts that make the system operable, code compliant, and acceptable to the authorities having jurisdiction.

1.3 REFERENCES

A. The latest published editions of a reference shall be applicable to this project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this project.

C. All materials, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references: 2003 Edition of the International Plumbing Code.

1.4 SUBMITTALS

A. Submit in accordance with TPWD Division 1 – Section 010000 – Special Conditions Section 1.09 Submittals and UGC Article 8.

B. Section 22 05 00 - Plumbing General Conditions: Submittals.

C. Product Data: Submit data on pipe materials, fittings, and accessories. Submit manufacturers catalog information. Indicate component sizes, rough-in requirements, service sizes, and finishes.

D. Manufacturer’s Installation Instructions.

E. Provide full written description of manufacturer’s warranty.

1.5 CLOSEOUT SUBMITTALS

A. Section 22 05 00 – Plumbing General Conditions.
B. Project Record Documents: Record actual locations of clean-outs.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Section 22 05 00 – Plumbing General Conditions: Product Handling, Receiving, Inspection, and Storage.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Do not install underground piping when bedding is wet or frozen.

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.9 WARRANTY

A. Refer to Section 22 05 00 – Plumbing General Conditions.

1.10 TEST OF SOIL, WASTE, AND VENT PIPING SYSTEMS

A. Soil, waste, and vent piping shall be given a water test. Piping shall have openings plugged necessary and be filled with water to the level of top of vent pipe and allowed to stand for not less than twelve (12) hours for inspection, after which, if the lines prove tight, the water shall be drawn off, and the fixtures connected.

1.11 SERVICE CONNECTIONS

A. Sanitary sewer piping shall be terminated outside lines of buildings at locations indicated on the Drawings.

B. Refer to Civil Drawings for new sanitary sewer service. Contact Utility Company and make all arrangements for tie-in. Include all costs in bid proposal. Prior to commencement of work, verify that invert elevations of new and existing sewers are sufficient to maintain slopes and depth below frost line.

PART 2 - PRODUCTS

2.1 SANITARY SEWER WASTE PIPING BURIED WITHIN 5 FEET OF BUILDING

A. PVC Pipe: ASTM D2665 or ASTM D3034.
   1. Fittings: PVC – DWV.

2.2 SANITARY SEWER, AND DRAIN PIPING, ABOVE GRADE

A. PVC Pipe: ASTM D2665 or ASTM D3034.
   1. Fittings: PVC – DWV.
2.3 PIPE HANGERS AND SUPPORTS
   
   
   B. Refer to Section 22 05 29 – Hangers, Supports, and Foundations.

2.4 FIRE STOP SYSTEMS

   A. Manufacturers:
      1. 3M Model 2000.
      2. Spec Seal Model 100.
      3. Hilti.

   B. General Purpose Fire Stopping Sealant: Water based, non-slumping, premixed sealant with intumescent properties, rated for three (3) hours in accordance with ASTM E814 and UL 1479.

   C. General Purpose Vibration Resistant Fire Stopping Sealant: Silicone based, non-slumping, premixed sealant with intumescent properties, vibration and moisture resistant, rated for 3 hours in accordance with ASTM E814 and UL 1479.

   D. DWV Plastic Pipe Systems Fire Stopping Sealant: Silicone based, premixed sealant with intumescent properties, vibration and moisture resistant, rated for three (3) hours in accordance with ASTM E814 and UL 1479 with metal collars.

2.5 FLOOR DRAINS

   A. Refer to Approved Manufacturers Schedule on Drawings with regards to acceptable floor drain manufacturers.

   B. Refer to Plumbing Fixture Schedule on Drawings for Specifications on floor drains.

   C. Substitutions: Section 22 05 00 – Plumbing General Conditions.

   D. Floor Drain: ANSI A1121.1; lacquered cast iron two piece body with double drainage flange, weep holes, reversible clamping collar and adjustable nickel-bronze strainer.

   E. Accessories: Provide strainers as indicated on Drawings. On second floor and above, provide lead flashing and flashing flange, or other flashing material as required by Contract Documents.

2.6 CLEANOUTS

   A. Refer to Approved Manufacturers Schedule on Drawings with regards to acceptable cleanout manufacturers.

   B. Refer to Plumbing Fixture Schedule on Drawings for Specifications on cleanouts.

   C. Substitutions: Section 22 05 00 – Plumbing General Conditions.

   D. Exterior Surfaced and Unsurfaced Areas: Round cast nickel bronze access frame and non-skid cover.
E. Interior Finished Floor Areas: Lacquered cast iron body with polished nickel bronze scoriated top, adjustable housing, anchor flange, reversible clamping collar, threaded top assembly, and round scored cover with gasket in service areas and round depressed cover with gasket to accept floor finish in finished floor areas.

F. Interior Finished Wall Areas: Line type with lacquered cast iron body and round epoxy coated cover with gasket, and round stainless steel access cover secured with machine screw.

G. Interior Unfinished Accessible Areas: Calked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

PART 3 - EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

D. Excavate and backfill in accordance with Architectural Specifications, and Section 22 05 00 – Plumbing General Conditions.

3.2 INSTALLATION

A. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Provide clearances at cleanout for snaking drainage system.

B. Encase exterior cleanouts in concrete flush with grade.

C. Install floor cleanouts at elevation to accommodate finished floor.

D. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

E. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

F. Install piping to maintain headroom. Do not spread piping, conserving space.

G. Group piping whenever practical at common elevations.

H. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

I. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 22 07 00 – Plumbing Insulation.

J. Provide access where valves and fittings are not exposed. Provide access panels in accessible walls and ceilings.
K. Establish elevations of buried piping outside building to provide not less than three (3) feet of cover.

L. Maintain code-mandated clearances between sanitary sewer, domestic water, natural gas piping, and electrical conduit.

M. Install piping penetrating roofed areas to maintain integrity of roof assembly.

N. At vents-through-roof, provide flashing and install in accordance with Section 22 05 29 – Hangers, Supports, and Foundations.

O. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

P. Install bell and spigot pipe with bell end upstream.

Q. Sanitary tees shall be installed in a vertical position only. Where installation is in the horizontal position, provide a sanitary wye and ¼ bend or combination fitting. Tapped tees may be installed in the vertical position at drinking fountains, lavatories, or cleanouts only. Tapped crosses are prohibited except where specifically indicated on Drawings.

R. Sleeve pipes passing through partitions, walls, and floors. Where approved by Engineer prior to construction, at floor penetration in slab on grade, flexible foam wrap such as “Flex-Wrap” by Cal-Western may be substituted for sleeve.

S. Piping below slab on grade shall be hub and spigot up through the first joint above slab.

T. Coat PVC piping exposed to sunlight with ultraviolet resistant paint.

3.3 ERECTION TOLERANCES

A. Establish invert elevations, slopes for drainage to 1/4 inch per foot minimum. Maintain gradients. Where existing conditions require, 1/8 inch per foot slope may be used on 4 inch and larger pipe where approved by the State prior to installation.

3.4 SCHEDULES

A. PLASTIC-PIPE HANGER SPACING:
   1. All Sizes:
      b. Hanger rod diameter: 3/8 inch.

END OF SECTION 22 13 16
SECTION 22 14 13 - STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes pipe, pipe fittings and connections for storm water piping systems. This Section also includes roof drains, overflow roof drains and cleanouts.

1.2 SUBMITTALS

A. Submit in accordance with TPWD Division 1 – Section 01 00 00 – Special Conditions Section 1.09 Submittals and UGC Article 8.

B. Section 22 05 00 – Plumbing General Conditions: Submittals.

C. Product Data: Submit data on pipe materials, fittings, and accessories. Submit manufacturers catalog information. Submit component sizes, rough-in requirements, service sizes, and finishes.

1.3 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of equipment and clean-outs.

B. Operation and Maintenance Data: Submit spare parts lists, exploded assembly views for pumps and equipment.

1.4 ENVIRONMENTAL REQUIREMENTS

A. Do not install underground piping when bedding is wet or frozen.

1.5 WARRANTY

A. Refer to Section 22 05 00 – Plumbing General Conditions.

PART 2 - PRODUCTS

2.1 STORM WATER PIPING, ABOVE GRADE

A. PVC Pipe: ASTM 2665, Schedule 40.
1. Fittings: PVC - DWV.

B. Plastic pipe if installed in a return air plenum shall be wrapped with 3M Fire Barrier Wrap 5A. Wrap exposed pipes, tape with ¾” filament tape and secure with ½” 0.015 inches thick carbon or stainless steel bands with steel banding clips.

2.2 PIPE HANGERS AND SUPPORTS

A. Storm drainage piping: Conform to ASME B31.9 ASTM F708.
2.3 FIRE STOP SYSTEMS

A. Manufacturers:
   1. 3m Model 2000.
   2. Spec Seal Model 100.
   3. Hilti.
   4. Substitutions: Section 22 05 00 – Plumbing General Conditions.

B. General Purpose Fire Stopping Sealant: Water based, non-slumping, premixed sealant with intumescent properties, rated for 3 hours in accordance with ASTM E814 and UL 1479.

C. General Purpose Vibration Resistant Fire Stopping Sealant: Silicone based, non-slumping, premixed sealant with intumescent properties, vibration and moisture resistant, rated for 3 hours in accordance with ASTM E814 and UL 1479.

D. DWV Plastic Pipe Systems Fire Stopping Sealant: Silicone based, premixed sealant with intumescent properties, vibration and moisture resistant, rated for 3 hours in accordance with ASTM E814 and UL 1479 with metal collars.

2.4 PRIMARY ROOF DRAINS

A. Manufacturers:
   1. Zurn.
   2. Wade.
   5. Substitutions: Section 22 05 00 – Plumbing General Conditions.

B. ANSI A112.21.2; lacquered galvanized cast iron body with sump.

C. Strainer: Removable cast iron dome with vandal proof screws.

D. Accessories: Coordinate with roofing type; refer to Architectural Sections.
   1. Membrane flange and membrane clamp with integral gravel stop.
   2. Adjustable under deck clamp.
   3. Roof sump receiver.
   5. Leveling frame.
   6. Adjustable extension sleeve for roof insulation.

PART 3 - EXECUTION

3.1 CEILING PLENUM

A. If storm drain piping is located within occupied spaces where there is no suspended ceiling or ceiling space is used as a return air plenum, storm drain piping shall be constructed of cast iron material with flame spread/smoke development rating of 25/50.
3.2 EXAMINATION
   A. Verify excavations are to required grade, dry, and not over-excavated.

3.3 PREPARATION
   A. Ream pipe and tube ends. Remove burrs.
   B. Remove scale and dirt, on inside and outside, before assembly.
   C. Prepare piping connections to equipment with flanges or unions.
   D. Excavate and backfill in accordance with Architectural Specifications and Section 22 05 00 – Plumbing General Conditions.

3.4 INSTALLATION
   A. Install non-conducting dielectric connections wherever jointing dissimilar metals.
   B. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
   C. Install piping to maintain headroom. Group piping to conserve space.
   D. Group piping whenever practical at common elevations.
   E. Install cleanouts on roof drain piping connected to underground storm system.
   F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 22 05 16 – Plumbing Piping Expansion Compensation.
   G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to cleanouts. Refer to Section 22 07 00 – Plumbing Insulation.
   H. Insulate bottom side of roof drain body with 1 1/2” thick insulation if not installed within concrete column. Refer to Section 22 07 00 – Plumbing Insulation.
   I. Insulate vertical drop from roof drain and all horizontal piping if piping not installed within concrete column. Refer to Section 22 07 00 – Plumbing Insulation.
   J. Establish elevations of buried piping outside building to provide not less than 2 ft of cover.
   K. Install piping penetrating roofed areas to maintain integrity of roof assembly.
   L. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
   M. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.
N. Sleeve pipes passing through partitions, walls and floors. Where approved by Engineer prior to construction, at floor penetration of slab on grade flexible foam wrap such as “Flex-Wrap” by Cal-Western may be substituted for sleeve.

O. Pipe Hangers and Supports:
   1. Install in accordance with ASME B31.9 ASTM F708.
   2. Refer to Section 22 05 29 – Hangers, Supports, and Foundations.

3.5 ERECTION TOLERANCES

   A. Establish invert elevations, slopes for drainage to 1/4 inch per foot minimum, or as shown on Drawings. Maintain gradients.

3.6 SCHEDULES

   A. METAL-PIPE HANGER SPACING:
      1. Pipe size: 4 to 6 inch:
         a. Maximum hanger spacing: 10 ft.
         b. Hanger rod diameter: 5/8 inch.
      2. Pipe size: 8 to 12 inch:
         b. Hanger rod diameter: 7/8 inch.

END OF SECTION 22 14 13
SECTION 22 33 13 - DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. This section covers providing all labor and materials for the complete first class tank type domestic water heaters indicated on Contract Drawings complete with all controls, piping, valves, wiring, supports, accessories, testing, and other normal parts required for complete, code compliant, operable installation that is acceptable to the authorities having jurisdiction.

1.2 REFERENCES

C. Underwriters Laboratories (UL) Listings.

1.3 SUBMITTALS

A. Submit in accordance with TPWD Division 1 – Section 01 00 00 – Special Conditions Section 1.09 Submittals and UGC Article 8.
B. Submit under provisions of Section 22 05 00 – Plumbing General Conditions.
C. Shop Drawings: Include dimensions of tanks, tank lining methods, tappings, and drains.
D. Product Data:
   1. Include dimension drawings of water heaters indicating components and connections to other equipment and piping.
   2. Provide electrical characteristics and connection requirements.
E. Manufacturer's Installation Instructions.

1.4 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 22 05 00 – Plumbing General Conditions.
B. Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with State of Texas standards.
B. Quality Assurance in accordance with TPWD Division 1 – Section 01 00 00 – Special Conditions Section 1.10 Quality Assurance and UGC Article 8.
C. Heaters shall be designed to limit the maximum temperature to avoid scalding.

D. Manufacturer Qualifications: Company shall have minimum three (3) years documented experience specializing in manufacturing the products specified in this section.

E. Provide equipment with manufacturer’s name, model number, and rating/capacity permanently identified.

F. Water heater shall meet or exceed the minimum energy factor requirements of ASHRAE Standard 90.1b -2001.

G. Installer Qualifications: Company shall have minimum three (3) years documented experience specializing in performing the Work of this section. Installation of plumbing systems shall be performed by individuals licensed by the Texas State Board of Plumbing Examiners as a Journeyman or Master Plumber. Installation may be performed by Apprentice Plumbers provided they are registered with the Texas Board of Plumbing Examiners and under the direct supervision of a licensed plumber. All installation shall be supervised by a licensed Master Plumber.

H. Products and installation of specified products shall be in conformance with recommendations and requirements of the following:
   1. National Sanitation Foundation (NSF).

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products to site.

B. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.7 WARRANTY

A. Provide three (3) year warranty under provisions of Section 22 05 00 – Plumbing General Conditions.

B. Warranty: Include coverage of domestic water heaters.

PART 2 - PRODUCTS

2.1 GENERAL

A. See Plumbing Fixture Schedule on plans for description.

2.2 DOMESTIC WATER HEATERS

A. Acceptable Manufacturers
   2. State.
   3. Rheem.

B. Furnish and install domestic hot water heaters with dimensions, capacities and electrical characteristics as scheduled on the Contract Drawings and as outlined herein. This Specification describes minimum quality and performance requirements. Variations of system components by the individual referenced manufacturers are acceptable for installation in this project provided they meet or exceed all of the requirements indicated herein, are compatible with the electrical service provided and fit properly in the allocated space.

C. Heating elements element shall be controlled by an individually mounted thermostat and high temperature cutoff switch. Heaters having double-elements shall be provided with simultaneous wiring to permit both elements to operate at the same time.

D. Water heater shall have a properly sized, factory provided temperature and pressure relief valve.

E. The tank drain valve shall be located in the front for ease of servicing.

2.3 VACUUM RELIEF VALVES

A. Construction shall be bronze body with silicone disc having a dry guide which is located out of the water. Unit shall open at less than 1/2" vacuum and be suitable for use within a system having a maximum water pressure of 200 psi and a maximum temperature of 250°F. Vacuum relief valves shall be in compliance with the appropriate requirements of ANSI Z21.22.

B. Vacuum relief valves shall be manufactured by Watts Regulator, Wilkins or Conbraco.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate with millwork and architectural drawings before installation of water heater. Provide proper wall supports.

3.2 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state, and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer’s published recommendations.

C. Install water heaters, piping, wiring, and accessories in accordance with the manufacturer’s installation instructions.

D. Furnish all supports required by the equipment included in this Contract in accordance with the manufacturer’s published instructions.

E. Relief valve shall not discharge into safety pan.
F. Safety pan and relief valve drain lines shall be copper and installed so that all water will drain completely out of the piping. Where it is impractical or physically impossible to extend a drain line to the building exterior, drain lines shall discharge separately into a floor drain, housekeeping mop sink or other location approved by the Engineer.

G. Each water heater shall be provided with clear access and unobstructed passageway that is adequate to allow removal and replacement.

H. Install heater in a vertical position with required manufacturer clearances servicing. Coordinate location of unit to avoid conflicts with other system or building components.

I. Furnish and install all necessary valves, strainers, unions, etc. to facilitate proper functioning and servicing of equipment.

J. Provide dielectric isolation device where copper lines connect to ferrous lines or equipment.

K. Install an accessible line size shutoff valve in cold water inlet within two feet of heater.

L. Provide heat trap inlet piping for storage type heaters to prevention migration of heated water into cold water system.

M. Provide heat trap in outlet piping for storage type heaters serving non-circulated distribution systems.

N. Provide a vacuum relief valve in cold water supply to heaters having bottom feed inlet. Install valve in accordance with manufacturer's recommendations.

O. Provide a temperature gauge in the outlet piping adjacent to storage type heaters. Locate gauge in an easily readable position.

P. Flush water supply line to remove all air, scale, and dirt prior to connecting heater.

Q. Take precautions to prevent heat generated by soldering procedures from being transmitted to heater components.

R. Coordinate with Electrical Contractor for power and wiring required. Verify that electrical power is connected to a properly grounded dedicated branch circuit of proper voltage rating and equipped with ground fault interrupter. Each heater shall be provided with an independent circuit. Ensure that the correct wire and circuit breaker sizes are provided.

S. When all plumbing installation is completed, check for leaks and take corrective action before proceeding. Flow hot water until temperature has stabilized. Verify and ensure that the water meets scheduled temperature at all outlets. Clean water heater prior to final inspection of installation.

3.3 TRAINING

A. Contractor shall instruct and acquaint the Owner with the proper functioning, operation and maintenance of the water heater and all associated installed components.
END OF SECTION 22 33 13
SECTION 22 40 00 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Water Closets.
B. Urinals.
C. Lavatories.
D. Sinks.
E. Mop Basins.
F. Hose Bibbs.
G. Drinking Fountains.
H. Flush Valves.
I. Carriers.

1.2 RELATED SECTIONS

A. Section 22 05 29 – Hangers, Supports, and Foundations.
B. Section 22 11 16 – Domestic Water Piping.
D. Section 01010 – Summary of Work: Product requirements for Owner furnished fixtures.
E. Section 10800 – Toilet and Bath Accessories: Product requirements for integral lavatory counter tops for placement by this Section.

1.3 REFERENCES

A. ASME A112.6.1 - Supports for Off-the-Floor Plumbing Fixtures for Public Use.
B. ASME A112.18.1 - Finished and Rough Brass Plumbing Fixture Fittings.
C. ASME A112.19.2 - Vitreous China Plumbing Fixtures.
D. ASME A112.19.5 - Trim for Water-Closet Bowls, Tanks, and Urinals.
E. NFPA 70 - National Electrical Code.
1.4 SUBMITTALS FOR REVIEW
   A. Submit in accordance with TPWD Division 1 – Section 01 00 00 – Special Conditions Section 1.09 Submittals and UGC Article 8.
   B. Section 22 05 00 – Plumbing General Conditions: Submittals.
   C. Product Data: Provide catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.

1.5 SUBMITTALS FOR INFORMATION
   A. Section 22 05 00 – Plumbing General Conditions: Submittals.
   B. Manufacturer's Instructions: Indicate installation methods and procedures.

1.6 SUBMITTALS AT PROJECT CLOSEOUT
   A. Maintenance Data: Include fixture trim exploded view and replacement parts lists.
   B. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.7 QUALITY ASSURANCE
   A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this Section with minimum three (3) years documented experience.
   B. Quality Assurance in accordance with TPWD Division 1 – Section 01 00 00 – Special Conditions Section 1.10 Quality Assurance and UGC Article 8.

1.8 REGULATORY REQUIREMENTS
   A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories, Inc., as suitable for the purpose specified and indicated.

1.9 DELIVERY, STORAGE, AND PROTECTION
   A. Transport, handle, store, and protect products.
   B. Accept fixtures on site in factory packaging. Inspect for damage.
   C. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.
1.10 CONNECTIONS AND SERVICES TO EQUIPMENT SPECIFIED ELSEWHERE

A. Certain fixtures and equipment, indicated on Drawings with an asterisk, will be furnished by Owner and / or General Contractor which will require rough-in and final connections by the Plumbing Contractor.

B. Prior to rough-in for fixtures and equipment, Plumbing Contractor shall obtain certified rough-in prints of fixtures and equipment. Plumbing Contractor shall verify that these prints have been checked by the Architect and have been approved by the Architect. No rough-in shall be done by Plumbing Contractor until certified prints are obtained.

C. Plumbing Contractor shall furnish and install the following for the fixtures and equipment: water and waste piping, install shut-off valves on water piping at each piece of equipment requiring water, furnish and install all pipe fittings required, furnish and install traps, and make final connections.

1.11 RELATED WORK SPECIFIED ELSEWHERE

A. The following related work is specified elsewhere:
   1. Condensate drain piping from equipment furnished by the HVAC Contractor to indirect waste drains and floor drains provided by the Plumbing Contractor.
   2. Installation of flashing and waterproofing.
   3. Electrical wiring required for electric water coolers, and electric water heaters.
   4. Installation of access panels if any access panels are required.
   5. Power wiring to the alarm panel.

PART 2 - PRODUCTS

2.1 GENERAL

A. See Plumbing Fixture Schedule on Plans for descriptions.

B. Acceptable Manufacturers:
   4. Mop Basin: Oberon, Fiat, Crane.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that walls and floor finishes are prepared and ready for installation of fixtures.
C. Verify that electric power is available and of the correct characteristics.

D. Confirm that millwork is constructed with adequate provision for the installation of counter top lavatories and sinks.

3.2 PREPARATION

A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

B. Coordinate work of this Section with other affected work.

3.3 INSTALLATION

A. Install each fixture with trap, easily removable for servicing and cleaning.

B. Provide chrome plated rigid or flexible supplies to fixtures with loose key stops, reducers, and escutcheons.

C. Install components level and plumb.

D. Install and secure fixtures in place with wall carriers and bolts.

E. Seal fixtures to wall and floor surfaces with sealant, color to match fixture.

F. Solidly attach water closets to floor with lag screws. Lead flashing is not intended to hold fixture in place.

3.4 INTERFACE WITH OTHER PRODUCTS

A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3.5 ADJUSTING

A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.6 CLEANING

A. Clean plumbing fixtures and equipment.

3.7 PROTECTION OF FINISHED WORK

A. Do not permit use of fixtures.

END OF SECTION 22 40 00
PART 1 - GENERAL

1.1 SCOPE

A. The Work to be provided under this Division of Specification shall include the furnishing, delivering, transporting, unloading, hoisting, handling, scaffolding, storing, erecting, adjusting, and testing of all materials, apparatus, and equipment required for complete, properly adjusted and operable mechanical systems for the Lake Corpus Christi State Park Restroom Replacement project in accordance with the Contract Documents. Provide all labor, supervision, coordination, equipment, tools, materials, permits, fees, and connection to utilities necessary for the completion of this Work.

B. If details or special conditions are required in addition to those shown on Drawings, provide all material and equipment usually furnished with such systems or required to complete their installation, whether noted in Contract Documents or not.

C. The Instructions to Bidders, Notice to Bidders, General Conditions, Special Conditions, all other preface Sections, all technical divisions and all appendixes of the Specifications, and any other pertinent documents issued by Owner’s representative shall be considered as part of this Division insofar as they may be applicable.

D. The Architectural, Civil, Structural, Plumbing, Fire Protection, Heating, Ventilating and Air Conditioning (HVAC) and Electrical Plans and Specifications and any other pertinent documents issued by Owner’s representative shall be considered as part of this Division insofar as they may be applicable.

E. Refer to Division 1 Specifications for general requirements of the following items:
   1. Work by Owner.
   2. Work sequencing and phasing.
   3. Bid Alternates.

F. Related Specifications:
   1. Refer to the following specifications for coordination and HVAC Contractor requirements:
      a. Specification 01 23 00 Alternates.
      b. Specification 23 05 93 Testing, Adjusting and Balancing.
      c. Specification 23 09 23 Equipment Controls Coordination.
      d. Specification 26 00 00 Electrical Specifications (Wiring and Conduits).

G. All HVAC related work shall be performed by an HVAC Contractor with a minimum Class “A” license in the State of Texas.
1.2 CODES AND STANDARDS

A. The Codes and Standards of the following organizations shall generally apply where applicable and where no specific Codes and Standards have been cited. In the event of conflict between the Codes and Standards of these organizations, the more stringent shall govern.

ADC: Air Diffuser Council.
ARI: American Refrigeration Institute.
ASHRAE: American Society of Heating Refrigeration and Air Conditioning Engineers.
ASME: American Society of Mechanical Engineers.
ASPE: American Society of Plumbing Engineers.
AWS: American Welding Society.
CGA: Compressed Gas Association.
CTI: Cooling Tower Institute.
FM: Factory Mutual Engineering Company.
IRI: Industrial Risk Insurers.
ISA: Instrument Society of America.
MSS: Manufacturers Standardization Society.
NBS: National Bureau of Standards.
NEMA: National Electrical Manufacturer's Association.
OSHA: Occupation Safety and Health Administration.
PDI: Plumbing and Drainage Institute.
PFI: Pipe Fabrication Institute.
SMACNA: Sheet Metal and Air Conditioning Contractors National Association.
UL: Underwriters Laboratories, Inc.

B. All workmanship, material, and equipment shall be in accordance with all local, state, and federal codes, ordinances and regulations.

C. All work shall comply and be constructed in accordance with 2015 International Mechanical codes.

D. All mechanical work shall be performed by, or under the direct supervision, of a Master Mechanical Contractor, holding an active license with the Texas Department of Licensing and Regulation for the performance of mechanical work in the State of Texas. The mechanical contractor shall submit a copy of the license of the person performing this requirement to the Texas Parks and Wildlife Department prior to the commencement of work. The acceptance of this submittal shall be documented to the contractor prior to the commencement of work.
1.3 QUALITY ASSURANCE

A. Quality Assurance in accordance with TPWD Division 1 - Section 01 00 00 - Special Conditions Section 1.10 Quality Assurance and UGC Article 8.

1.4 DEFINITIONS

A. “Contract Documents” shall refer to the complete package of Plans, Specifications, addenda, and special conditions used as a basis for the General Construction Contract for this project including but not limited to all General and Special Conditions, all Architectural and Engineering Divisions of Specifications and all Architectural and Engineering Plans.

B. “Owner” means the entity specified in the General Construction Contract as Owner.

C. "Contractor" means the entity contracting with the Owner for the performance of work.

D. “Work” means all of the Contractor’s obligations under the Contract.

E. “Provide” shall mean furnished and installed, complete and ready for intended use by Contractor, except as otherwise noted.

F. “Furnish” shall mean purchase only by Contractor; installation by others, except as otherwise noted.

G. “Install” shall mean Contractor to set up for use, erect or construct only; purchase by others, except as otherwise noted.

H. “Demolish” and “Remove” shall mean Contractor to disassemble, take away from site, and properly dispose of items as indicated or implied. Contractor shall patch remaining systems to match existing.

I. "Directed" means "directed by Owner’s representative". This shall not imply that Architect's or Engineer's responsibility extends into the Contractor's area of construction supervision.

J. Where the words "similar" or "typical" are used, they shall be used in their general sense and shall not be interpreted as meaning identical. Details shall be worked out in relation to their location and connections to other parts of work.

K. Items such as but not limited to access doors, sleeves, cleanouts, trap-primmers, roof flashings, pipe supports, or balancing dampers that are to be installed repetitiously and are noted on the Plans as "typical" shall be installed at every location required by Specifications, codes, or good practice, whether specifically shown on Plans or not.

L. Where the terms "or equal" and "or approved equal" are used they shall be defined as "approved as equal by Owner’s representative".

1.5 CONTRACTOR'S RESPONSIBILITY

A. It shall be the responsibility of the Contractor to carefully examine all of the Contract Documents and to comply with them in every respect. Should there be omissions or discrepancies in the
documents notify the Owner’s representative prior to the bid date so a written clarification can be issued.

1. Coordinate exact electrical requirements of all mechanical equipment prior to submittal review and make all modifications necessary for full compatibility with the final electrical installation.

B. It shall be the responsibility of the Contractor to review all Divisions of the Contract Documents with respect to mechanical work that will be required by other divisions. Contractor shall thoroughly review all aspects of Mechanical Bid Proposal prior to bidding for the purpose of clearly defining the scope of Mechanical Bid Proposal with that of all other trades.

C. It shall be the responsibility of the Contractor to provide all equipment, materials, and labor, whether specifically indicated on Plans or called for in Specifications or not, which are necessary for the proper installation and function of the mechanical systems for this project.

D. It shall be the responsibility of the Contractor to carefully examine conditions of the project site and to check the work of other divisions that might affect the mechanical work. Include all costs of demolition, cutting, patching, and repairing of existing elements in bid proposal.
   1. Visit the proposed project site prior to bid and carefully investigate existing streets, parking lots, paved areas, sidewalks, buildings, structures, and landscaping.

E. It shall be the responsibility of the Contractor to coordinate work performed under the Mechanical Division of the Contract Documents with work performed under other divisions so as not to delay or damage any part of this installation.

F. It shall be the responsibility of the Contractor to coordinate the location of chases, openings, sleeves, flashings and the like required for the work covered by the Mechanical Division of the Contract Documents. Do so in sufficient time for proper coordination with general construction, or assume the responsibility for required cutting and patching. No cutting of structural members shall be performed without approval of the Owner’s representative.

G. It shall be the responsibility of the Mechanical Division to include minor details necessary for proper installation and operation of materials, equipment, or fixtures as if specified or shown in Contract Documents.

H. It shall be the responsibility of the Contractor to install materials, equipment, and fixtures according to code requirements, manufacturer’s recommendations or as required in Contract Documents, whichever is more stringent.

1.6 ADDITIONAL COMPENSATION

A. Failure to examine or to comply with Contract Documents shall not relieve Contractor of responsibility for the work or be used as basis for additional compensation.

B. No additional compensation will be awarded for conflict with Architectural, Structural, Electrical, or Mechanical components in installation of prefabricated materials or equipment.
   1. Ductwork shall be fabricated from field measurements. Adjust duct sizes as necessary to fit space available. Contractor shall advise Owner’s representative of any discrepancies prior to fabrication.
C. No compensation will be awarded to the Contractor for minor relocations or deviations from plans. Changes in contract price will be allowed only for additions to or changes to original design intent and then only with written approval of the Owner’s representative.

D. Omission of Architectural, Civil, Structural, Electrical, or other pertinent details from Mechanical Contract Documents shall not be used as basis for additional compensation.

E. No compensation will be awarded to the Contractor for failure to coordinate exact electrical requirements with electrical division prior to ordering equipment.

1.7 SUPERVISION, LABOR, AND WORKMANSHIP

A. Contractor shall provide proper supervision of mechanics and subcontractors performing work under this Division. Labor shall be performed by skilled mechanics experienced in their particular trade. Duct and equipment shall be installed square and plumb, with accessibility for proper operation and service. Any item that does not present a neat and workmanlike appearance shall be replaced or corrected at the direction of the Owner’s representative and without additional cost to the Owner or Design Professionals.

1.8 FEES AND PERMITS

A. Contractor shall obtain and pay for all fees and permits required for the completion of the Work, including but not limited to construction permits; federal and state inspection fees, connections to utilities, meter and tap fees, capitalization charges, temporary service charges, and any other associated fees or charges.

1.9 PROJECT/SITE CONDITIONS

A. Install Work in locations shown on Drawings, unless prevented by Project conditions.

B. These Specifications and the accompanying Drawings are intended to describe and illustrate systems which will not interfere with the structures, which will fit into available spaces, and which will ensure complete and satisfactorily operating installations. Coordinate the proper fitting of the material and apparatus into the available spaces without interfering with other building components. Prepare installation drawings at all locations where possible conflicts of HVAC, Plumbing, Fire Protection, Electrical, Structural, or Architectural components may occur. The installation drawings shall be submitted to the Owner’s representative prior to commencing the Work. They should illustrate the installation of work in relation to other portions of the Work. Interferences with other portions of work, or the building structure, shall be corrected before the work proceeds. Should changes become necessary on account of failure to comply with these stipulations, make such necessary changes.

1.10 PRE-INSTALLATION CONFERENCE

A. Contractor shall convene a pre-installation conference one (1) week prior to commencing work of this Division and in conjunction with work of other divisions and notify Owner’s representative of date and time of meeting.

B. Require attendance of parties directly affecting work of Division 23 and 26.

C. Review installation procedures and coordination required with related work.
D. Establish “right of way” and routes for conduit, wiring, cable trays, piping, ductwork, and similar elements in the available space above ceilings and vertical chases.

E. Coordinate exact plumbing, fire protection, electrical, and service access requirements of all HVAC equipment and fixtures. Coordinate exact HVAC and service access requirements of all plumbing, fire protection and electrical equipment. Advise Owner’s representative of any requirements that will be necessary in addition to requirements on Contract Documents.

1.11 GENERAL REQUIREMENTS

A. Protection of Rough Work: All openings of every description shall be securely capped or otherwise protected against debris or other foreign material entering the system until such time as the equipment is permanently attached.

B. Cleaning and Adjusting: At the completion of the work all parts of the installation shall be thoroughly cleaned. All dampers and controls shall be adjusted for proper operation. Upon completion of the work, the Contractor shall leave the building and project site in a neat condition.

C. Defective work: If inspection or testing show defects, such defective work or materials shall be replaced and inspection and test repeated. All repairs to piping shall be made with new material. No caulking of screwed joints will be acceptable.

D. Dielectric Connection: Where dissimilar metals are connected, provide approved dielectric connector to protect against dielectric corrosion.

E. Surveys and Measurements: Carefully survey project site prior to bidding and installation. Dimensions, both horizontal and vertical, shall be derived from Architectural, Civil, and Structural plans. Do not "scale" plans; that is do not measure plans with Architect's or Engineer's scale and base installation dimensions on such measurements.

F. Horizontal and vertical measurements shall be based on established benchmarks. Work shall agree with established lines and levels. Field verify measurements at project site. Check correctness of same as related to work prior to fabrication of shop made items and ordering of factory-built items.

G. Notify Owner’s representative of discrepancies between plans and actual field conditions that will prevent the following of good practice or affect the intent of plans and Specifications. Do not proceed with installation until instructions are received from Owner's representative.

H. The accompanying plans show diagrammatically the sizes and location of the various equipment items and the sizes of the major interconnecting piping and ductwork, without showing exact details as to elevations, offsets, control lines, and other installation details. The Contractor shall carefully lay out his work to conform to the site conditions, to avoid obstructions and provide proper grading of lines. Exact locations of outlets, apparatus, and connections thereto shall be determined by reference to the accompanying Plans, to all detail drawings, equipment drawings, rough-in drawings, etc., by measurements at the building, and in cooperation with other divisions, and in all cases shall be subject to the approval of the Owner’s representative. Minor relocations necessitated by the conditions at the site or directed by the Owner’s representative shall be made without any additional cost to the Owner.
I. All work shall be run parallel or perpendicular to the lines of the building unless otherwise noted on the Drawings.

J. It is the intent of the Contract Documents to provide an installation complete in every respect. In the event that additional details or special construction may be required for work indicated or specified in this Section or work specified in other Sections, it shall be the responsibility of the Contractor to provide same as well as to provide material and equipment usually furnished with such systems or required to complete the installation, whether mentioned or not.

K. Should a discrepancy exist between the mechanical Drawings and the mechanical Specifications it is the Contractor's responsibility to include that portion or portions of the more expensive item in bid proposal. Final approval and/or directive can then be forwarded to the Contractor during the submittal process.

1.12 FIXTURE AND EQUIPMENT SIZES AND REQUIREMENTS

A. Space allocations in machinery spaces are based on equipment scheduled in each case. Should the Contractor offer equipment of another make that requires more space in any critical dimension, the Contractor shall submit, together with other submittal data on the equipment, prints of drawings indicating how the equipment may be installed, indicating room for servicing and revisions in piping or ducting and any other details necessary for the Owner's representative to form a judgment as to the suitability of the substitute material, as to performance, suitability for the space and other variables.

B. Duties of certain equipment items, horsepower of driving motors and electrical characteristics are scheduled for equipment items of a particular make in each case. Should any substitute material be accepted which has other requirements that would involve allied equipment or the work of others, the Contractor shall be responsible for all modifications required at no change in contract price.

1.13 SUBMITTALS

A. Submit in timely manner for review, brochures describing all materials, equipment, fixtures, and specially fabricated structures proposed for use in the performance of the work on this Project.
   1. Items to be submitted shall include, but shall not be limited to, ductwork, fittings, materials, hangers, special supports, equipment, controls, coordination and ductwork fabrication drawings, etc.
   2. Contractors Coordination Drawings: The Contractor shall prepare a complete set of coordination drawings indicating the equipment actually purchased and the exact routing for ductwork. This requirement for coordination drawings shall not be construed as authorization for the Contractor to make any unauthorized changes to the Contract Drawings. All Design Drawing space allocations shall be maintained, such as ceiling height, chase walls, equipment room size, and the like, unless proper written authorization is received from the Architect to change them.

B. Submit in accordance with TPWD Division 1 - Section 01 00 00 – Special Conditions Section 1.09 Submittals and UGC Article 8.

C. Submit manufacturer's data or shop drawings where required by a Section covering a particular system and/or piece of equipment. The manufacturer's data of shop drawings shall include, but not be limited to, giving full information as to dimensions, weight, materials, motor sizes,
electrical characteristics, wiring diagrams, capacities and all information pertinent to adequacy of items. Contractor is responsible for the timely preparation and submission of $\frac{1}{4}'' = 1'-0''$ ductwork shop drawings indicating all items necessary for complete coordination and fabrication/installation. Contractor is also responsible for the timely preparation and submission of $\frac{1}{2}''-1'-0''$ shop drawings indicating all HVAC equipment, piping, and ductwork in mechanical room areas and or critical areas that mandate a thorough review of the systems. Engineer will review these drawings for compliance and offer comments and or suggestions.

D. Information shall be presented so that line-by-line comparison may be made with Contract Documents. Deviation from Contract Documents shall be enumerated on a separate sheet and so entitled. Data of general nature will not be acceptable.

E. Each submittal will be reviewed for compliance with general requirements of design and arrangement only; it is not a Contract Document and acknowledgment of compliance does not remove the Contractor of responsibility for performance of the work in compliance with all provisions and requirements of the Contract Documents. Job measurements and the coordination of all the dimensions for proper fit of all parts of the work and performance of all equipment supplies to meet Specification requirements are and remain specific responsibilities of the Contractor.

F. Each submittal shall be neatly organized with information arranged in order of specification section. Submit HVAC divisions independently with a maximum of three (3) separate packages, as example, major equipment, materials, and controls. Each brochure shall be neatly organized (i.e. separate tabs for each section with a corresponding Table of Contents) into a single binder or electronic PDF file to include all proposed equipment in a single submission for each package. In each brochure or electronic file provide cover sheet identifying project name and location, Architect, Engineer, General Contractor, and Mechanical Contractor. Include Contractor's addresses and phone numbers. Provide adequate space for Architect's and Engineer's stamps. Contractor shall include and sign the following statement of compliance on the cover sheet:

I hereby certify that this shop drawing and/or brochure has been checked prior to submittal and that it complies in all respects with the requirements of the Contract Documents for this project.

(Company Name)
Signed
Date

Submittals forwarded without compliance statement and signature in each brochure will not be reviewed. Contractor will bear the risk of all delays, as if no submittal had been delivered.

G. Contractor’s statement of compliance shall constitute a representation to the Owner’s representative that Contractor has either determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data or assumes full responsibility for doing so, and that Contractor has reviewed or coordinated each submittal with the requirements of the work and the Contract Documents.

H. Engineer’s review of submittals does not relieve Contractor of his responsibility for deviations from Contract Documents or errors and omissions except when acceptance of the specific deviation is given in writing.
I. Engineer’s review and approval is only for conformance with the design concept of the project and for compliance with the information given in the Contract.
   1. The review shall not extend to means, methods, sequences, techniques, or procedures of construction or to safety precautions or programs incident thereto.
   2. The review shall not extend to review of quantities, dimensions, weight or gauges, fabrication processes or coordination with the work of other trades.

J. The shop drawings are not intended to cover detailed quantitative lists of heating specialties, air distribution devices and similar items. It is the Contractor's responsibility to procure the proper quantities required to comply with the established requirements.

K. Coordinate exact electrical requirements of HVAC equipment with Electrical Division prior to submittal of brochures.

L. Submit brochures in sufficient time and of proper format so as to avoid delays or changes in construction. Failure to comply shall render Contractor liable for expenses of delays occasioned by failure to provide necessary information or drawings. Owner’s representative reserves the right to contact manufacturer directly to secure proper data and detail when deemed necessary. Contractor shall be liable for costs incurred by such action.

M. Any shop drawings prepared to illustrate how equipment, piping, ducts, and the like are to be fitted into available spaces will be examined under the assumption that the Contractor has verified all the conditions, and obtaining any approval thereon shall not relieve the Contractor of responsibility in the event the material cannot be installed as shown on those drawings.

N. Any material or equipment installed without the Owner representative's prior approval shall, if so directed by the Owner's representative, be removed and replaced with approved material or equipment at the Contractor's expense.

O. Any dimensional changes or rerouting of piping or ductwork shall necessitate submittal or shop drawings of the system under consideration prior to fabrication or erection of material. Drawings will be utilized by the Owner's representative to evaluate the effect of the proposed changes on equipment performance.

P. Test Reports: The Contractor shall submit to the Owner's representative all test reports in accordance with details specifically called for in the various Sections of the Specifications in this Division.

1.14 COMMISSIONING OF HVAC SYSTEMS

A. Upon completion of the HVAC installation, Contractor shall test, balance, adjust, and operate all individual components of the HVAC system. Demonstrate that the installation is functioning in all modes of operation as a complete and integrated HVAC system and is performing in accordance with the Contract Documents. Owner’s personnel shall be trained in the operation and maintenance of the system. All operating schedules, parameters, and set-points shall be entered into the Automatic Temperature Control system.

1.15 OPERATION OF HVAC SYSTEMS

A. It is the intent of the HVAC system design to operate HVAC systems continuously, 24 hours a day, 365 days a year, as described in Section 23 09 93 – Equipment Control Sequence of Operation.
1.16 OPERATION AND MAINTENANCE INSTRUCTIONS

A. Upon completion of work, provide three (3) sets of complete operations and maintenance instructions of mechanical equipment, neatly bound in 3 ring binders. Provide each binder with the name of Owner, Architect/Engineer, Contractor, and Title. During the construction period, accumulate the following for inclusion in the Operating and Maintenance Manuals:

1. Tabulation of equipment by manufacturer, model number, and serial number.
2. All warranties and guarantees and manufacturer's directions on equipment and material covered by the Contractor.
3. Approved fixture brochures, wiring diagrams, and control diagrams.
5. Operating instructions for all mechanical equipment and systems. Operating instructions shall include maintenance and seasonal changeover procedures.
6. Recommended maintenance procedures.
7. Repair parts list of all major items and equipment including name, address, and telephone number of local supplier or agent.
8. Manufacturer's letter certifying that the equipment has been installed per manufacturer’s installation manuals.
9. Contractor’s one (1) year warranty letter including start and finish dates.

B. Operation and Maintenance instructions shall be submitted and approved prior to instruction of Owner's personnel in the various systems operation and maintenance.

1.17 UTILITIES

A. The Contract Documents reflect the general location, size, and manner of routing for all utilities known to be required on this project. It shall be the responsibility of the Contractor to visit the site, meet with the local Utility Company personnel in order to coordinate and confirm the exact requirements for all utilities. The bid submitted by the Contractor shall include costs for all such coordination work as well as any and all utility company charges and/or fees.

1.18 BUILDING CONSTRUCTION AND LAYOUT OF WORK

A. The Contract Documents are diagrammatic in character and cannot show every connection in detail or every line or conduit its exact location. These details are subject to the requirements of ordinances and also Structural and Architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases unless specifically noted or indicated to be exposed. Work shall be installed to avoid crippling of structural members; therefore, inserts to accommodate hangers shall be set before concrete is poured, and proper openings through floor, walls, beams, etc. shall be provided as hereinafter specified or as otherwise indicated or required before concrete is poured. All work shall be run parallel or perpendicular to the lines of the building unless otherwise noted.

1.19 RECORD DRAWINGS

A. As part of the required mechanical work, a complete set of record drawings shall be made up and delivered to the Owner's representative.
B. The drawings shall reflect the following:
1. All mechanical work installed exactly in accordance with the original design.
2. All mechanical work installed as a modification or addition to the original design.
3. The dimensional information necessary to delineate the exact location of all ductwork and piping runs which are so concealed as to be untraceable by inspection through the regular means of access established for inspection and maintenance. Where shop drawings have been prepared and approved, the record drawings shall be cross referenced to the respective shop drawings. In this case dimensions need not be shown on the record drawings.

C. Record drawings shall include the updating of all equipment schedules.

D. The record drawings shall be of a reproducible type as directed.

1.20 WARRANTY

A. All materials and equipment, to be furnished and installed under this Division of the Specifications shall be warranted to meet the specified performance requirements and to be free of defects in materials and workmanship for a period of one year after Final Acceptance regardless of equipment start-up date. Coordinate with manufacturer to extend warranty as required by project conditions and construction schedule. The Contractor to the complete satisfaction of the Owner’s representative shall remedy deficiencies caused by other than normal usage, without cost to the Owner or Design Professionals.

B. If there is any indication that the equipment does not meet the specified quantities, the Contractor shall, at his expense, institute a program to demonstrate the adequacy of the installation. This program shall include all necessary testing and testing equipment. Should the Contractor not have the equipment or technical skill to perform the tests, it shall be his responsibility to employ recognized experts to perform the tests and shall provide certified laboratory tests, certified factory reports and work sheets, or other certified data to support results of any tests required.

1.21 BILLINGS

A. Contractor shall provide a schedule of values of the mechanical work with each payment application. Provide a line item for labor and materials for each section of specifications. Provide additional breakdown where requested by Owner’s Representative.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. Coordinate exact electrical requirements of mechanical equipment prior to submittal and purchase. Equipment that is not compatible with electrical installation will be removed and replaced at no expense to the Owner or Design Professionals.

2.2 MATERIALS

A. Unless otherwise specified, provide only new, first grade equipment and materials which comply with requirements of this Specification and applicable Standards.
B. Furnish, if required, satisfactory evidence of kind and quality of materials proposed for use.

C. Similar items of material and equipment shall be product of same manufacturer.

2.3 SUBSTITUTIONS

A. The Specifications indicate a standard of quality for materials. Manufacturer’s names and catalog numbers are used to designate materials or equipment to establish grade and quality. Where several manufacturers are named, the bid shall be based on those named manufacturer’s products. Where only one manufacturer is named, unless stated otherwise, manufacturers of equal quality products will be considered as substitutions only if submitted at least 5 days before the bid date and when in compliance with all criteria set forth within Section 2.3:

1. Contractor is responsible for all coordination and additional costs which may be required for the work to be completed on time with no additional cost to the Owner or Design Professionals.

2. Contractor to verify during submittal that the product works dimensionally within the intent of the design.
   a. The ability to service components shall not be compromised.
   b. Any additional coordination due to interference with other elements of the project will be the responsibility of the Contractor with no additional cost to the Owner or Design Professionals.

3. Comply with Uniform General Conditions.

B. It is fully the Contractor’s responsibility to assemble and submit sufficient technical information to fully illustrate that the material or equipment proposed for substitution is equal or superior as the Architect or Engineer is under no obligation to perform the service for the Contractor. The proposal shall be accompanied by manufacturer’s complete engineering data, specification sheet, and a sample, if practical or if requested. In no event shall a proposal for substitution be cause for delay of work.

C. Substitutions and deviations shall be clearly marked, indicated, or otherwise called to attention of the Owner’s representative in the submittal documents. Failure to indicate substituted materials and/or equipment or deviations from Contract Documents shall be construed as a representation that contractual obligations have not been meet and the submittal shall be rejected without further review.

D. Engineer reserves the right to accept or reject proposed substitutions and it is understood that his judgment shall be final.

2.4 ELECTRICAL MOTORS

A. All motors furnished under any of the several Sections of these Specifications shall be of recognized manufacturer, of adequate capacity for the loads involved, and wound for the electrical characteristics indicated on the Drawings or specified herein. Verify all job site voltages and power source available before installation of any motor or controls. All motors shall conform to the standards of manufacture and performance of the National Electrical Manufacturers Association (NEMA) as shown in their latest publication. All motors shall be furnished with open-frame, unless otherwise noted, or required by NEC for the service conditions encountered.
B. Unless otherwise noted, fractional motors rated at less than 1/2 horsepower shall be single phase, the motors rated at 1/2 horsepower or larger shall be three phase. Single phase motors shall be arranged for across-the-line starting. Motors exposed to weather shall be totally enclosed and weatherproof. Single phase motors shall be capacitor start, induction run type and shall be furnished with motor controller with pilot light where scheduled or indicated.

C. All motors shall be of the same manufacturer unless they are an integral part of the piece of equipment to which they are attached.

2.5 MOTOR CONTROLLERS AND ELECTRIC INTERLOCKS

A. Except where otherwise specified or as included as an integral part of the normal and customary mechanical equipment, each starter shall be furnished by other divisions complete with the required control power transformers and auxiliary contacts necessary for control interlocks and wired by a licensed electrician in accordance to governing codes.

B. In Fractional horsepower 120v-single phase fans, a motor rated manual starter/disconnect with on-off snap switch type with soldered ratchet overload protection shall be furnished by the Contractor furnishing the fans and wired by a licensed electrician in accordance to governing codes.

C. When interlocking of equipment is required all wiring in excess of 50 volts to be provided by a licensed master electrician and coordinated by the Contractor. All other wiring 50 volts or less or as required by the controls/energy management system shall be fully coordinated by the Contractor to provide and assure a complete and fully operational system. All conduit for controls and or power wiring shall be in accordance with Division 26 requirements, and installed by licensed electrician and coordinated by the Contractor.

D. Except for such items that are normally wired up to their point of manufacture and so delivered and unless specifically noted to the contrary herein, the Contractor shall do all electric wiring of every character for interlocking, pilot, and control in accordance with methods and materials described within Division 26 of these Specifications. This includes conduits and mounting of all electrical devices.

E. Furnishing of complete wiring diagrams showing proper control and interlock wiring shall be work under the trade supplying the equipment. Diagrams shall be based on the approved equipment for this project and shall be complete integral drawings, not a series of manufacturers’ individual diagrams.

F. The electrical design and drawings are based on the equipment scheduled and shown on the mechanical Drawings and should any mechanical equipment requiring changes to the electrical design be approved, the required electrical changes shall be made at no cost to the Owner.

2.6 CONTROL POWER AND EQUIPMENT POWER FOR CONTROLS

A. Control power, whether it be DDC, 24 volts, or 120 volts, should be delivered to each piece of mechanical equipment and/or control panels whether or not it is specifically indicated on the Contract Drawings.

B. All wiring and conduit for controls and power wiring shall be in accordance with Division 26 requirements, installed by licensed electrician and coordinated by the Contractor.
C. It is the Contractor’s responsibility to include in his or her bid all costs in connection with control wiring, and/or power, whether or not it is specifically indicated. Regardless of how large in nature or how incidental, no additional compensation will be approved by the Owner’s representative or Design Professionals concerning a failure on the Contractor’s part to include these costs in bid proposal or a failure on the Contractor’s part to properly coordinate these important functions.

D. All exposed control wiring to be installed in raceways. All other wiring to be installed neatly and inconspicuously per local code requirements. If local code allows, control wiring above accessible ceiling spaces may be run with plenum rated cable (without conduit). All conduits outdoors shall be installed per Division 26 requirements.

PART 3 - EXECUTION

3.1 PRODUCT HANDLING, RECEIVING, INSPECTION, AND STORAGE

A. Handling and Receiving: The Contractor shall receive and handle all materials and equipment with care so as not to cause damage. Use padded or strap slings, etc. as appropriate for the items being handled. Lift materials and equipment by lift points provided or recommended by the manufacturer.

B. Inspection: The Contractor shall upon receipt, inspect all materials and equipment for defects, damage, and compliance with the Specifications. When materials and equipment are received in acceptable condition, assume full responsibility for its storage, handling, and installation. Materials and equipment found to be incomplete or damaged shall be reported to the Carrier and Owner's representative immediately, within a maximum of three (3) days, for its replacement.

C. Identification: Upon receipt of all materials and equipment, the Contractor shall identify and tag, stencil, or otherwise permanently identify all materials and equipment with the appropriate equipment number.

D. Storage: Materials and equipment, which cannot be installed immediately after delivery, shall be stored in a safe, dry location provided by the Contractor. Materials and equipment damaged or stolen while in storage shall be replaced by the Contractor at no cost to the Owner.

3.2 COORDINATION WITH OTHER DIVISIONS AND OWNER

A. General: Cooperate to fullest extent with other Divisions and Owner to the end that all work shall be executed economically without delay and that it will not interfere with their operations.

B. Progress Schedule: Contractor shall inform himself of progress schedules of all Divisions and shall work in accordance with schedules for completion of work.

C. Examine work of other trades that comes in contact with or is covered by this work. Do not attach to, cover, or finish against any defective work, or install work of this Division in a manner which will prevent other trades from properly installing their work. Consult all Drawings, Specifications, and details of other Divisions of the work.

D. Do not install equipment with electrical characteristics that are not compatible with the electrical installation.
3.3 EQUIPMENT ACCESSORY REQUIREMENT

A. It shall be the Contractor's responsibility to assure all packaged equipment ancillary devices shall be completely wired, piped, and calibrated. All systems shall be commissioned for acceptance by the Owner.

3.4 INSTALLATION

A. Space and Equipment Arrangement:
   1. All equipment shall be installed in a manner to permit access to parts requiring service and to comply with code-mandated and manufacturer required clearances. Contractor shall notify Owner's representative prior to installation of any equipment where said clearances cannot be maintained for further direction.
   2. Any large piece of apparatus which is to be installed in any space in the building, and which is too large to permit access through stairways, doorways, or shafts shall be brought to the job and placed in the space before the enclosing structure is completed. Following placement in the space, such apparatus shall be thoroughly and completely protected from damage as hereinbefore specified.

B. Materials and equipment installed under this Contract shall be new in every respect, and installed in a first-class manner in accordance with the manufacturer's recommendations and applicable codes and standards.

C. The Contractor shall plan and coordinate his Work to provide all equipment and materials necessary to provide the Owner with a neat, functional, and serviceable installation.

D. The Contractor shall protect all work, materials, and equipment against damage until Final Acceptance by the Owner's representative. Replace, or repair to the satisfaction of the Owner's representative, any work, materials, or equipment that becomes damaged prior to Final Acceptance.

E. The Contractor shall make a detailed inspection of the work area and adjoining construction prior to beginning installation of any materials or equipment. Verify governing dimensions and other permissible dimensional tolerances. The Contractor shall report in writing to the Owner's representative unsatisfactory conditions encountered; do not begin installation until conditions are correct. Beginning installation signifies acceptance of conditions.

3.5 CUTTING AND PATCHING

A. This Contractor shall coordinate with the General Contractor all necessary cutting and drilling of walls, floor, ceilings, etc. for the installation of new work or for modifications to the existing work, but no structural work shall be cut unless specifically approved by the Owner's representative. Patching and painting of surfaces as required shall be by the Contractor, unless specified hereinafter.

B. Cutting and patching or repairing of work in place, made necessary by the negligence of the Contractor or anyone employed by him, shall be paid for by the Contractor.
3.6 EXISTING FACILITIES

A. The Contractor shall be responsible for loss or damage to the existing facilities as used by him and his workmen, and shall be responsible for repairing or replacing such loss or damage. The Contractor shall send proper notices and receive written permission from the Owner’s representative to enter existing areas. The Contractor before beginning work in existing areas shall make necessary arrangements and perform other services required for the care, protection, and in-service maintenance of all electrical, communication, plumbing, heating, air conditioning, and ventilating services for new and existing facilities. The Contractor shall erect temporary barricades with necessary safety devices, as required to protect personnel from injury, removing all such temporary protection upon completion of the work.

3.7 INSPECTIONS

A. Contractor shall arrange for all inspections required by local building officials and state agencies. Correct deficiencies required to comply with codes and standards and to receive certificate of occupancy. Upon completion of this project, submit written evidence of compliance with the above to Owner’s representative. Final acceptance will not be issued and the warranty date will not be established until such compliance is demonstrated.

3.8 SYSTEMS START-UP

A. Upon completion of the installation of the work, start-up all mechanical systems and test, balance and adjust systems until they are fully operational and functioning as intended by Engineer.

B. Do not start-up or operate HVAC systems until construction of building envelope is complete and system components will not be subjected to damage from dirt, dust, construction debris, and weather. Provide temporary caps on ductwork to prevent entry of debris. Where adequate protection is not provided, all systems shall be cleaned or replaced to the satisfaction of the Owner.

3.9 FINAL CONSTRUCTION REVIEW

A. Schedule: Upon completion of the Contract, there shall be a final construction review of the completed installation. Prior to this walk through, all work under this Division shall have been completed, tested, balanced and adjusted in final operating condition and the test report shall have been submitted to and approved by the Owner’s representative.

B. Personnel: A qualified person representing the Contractor must be present at this final construction review to demonstrate the system and prove the performance of the equipment.

C. The building mechanical system shall have been in operation for a minimum of fifteen (15) days after Test and Balance work is complete prior to this review.

3.10 CERTIFICATIONS

A. Before receiving final payment, the Contractor shall certify that all equipment furnished and all work done is in compliance with all applicable codes mentioned in these Specifications and with manufacturer’s requirements.

END OF SECTION 23 05 00
SECTION 23 05 29 – HVAC HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes duct and equipment supports, hangers, sleeves and sealing of work to adjacent construction.

1.2 SUBMITTALS

A. Section 23 05 00 – Mechanical General Conditions: Submittal Procedures.

B. Submit in accordance with TPWD Division 1 - Section 01 00 00 – Special Conditions Section 1.09 Submittals and UGC Article 8.

C. Shop Drawings: Indicate system layout with location and detail of trapeze hangers.

D. Product Data: Submit manufacturers catalog data including load capacity.

E. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.

F. Manufacturer's Installation Instructions: Submit special procedures and assembly of components.

1.3 QUALITY ASSURANCE

A. Perform Work in accordance with code for piping support and in conformance with NFPA 13 and 14 for support of sprinkler piping and standpipes.

B. Perform Work in accordance with AWS D1.1 for welding hanger and support attachments to building structure.

C. Quality Assurance in accordance with TPWD Division 1 - Section 01 00 00 - Special Conditions Section 1.10 Quality Assurance and UGC Article 8.

PART 2 - PRODUCTS

2.1 ACCESSORIES

A. Hanger Rods: Hot dipped galvanized mild steel threaded both ends, threaded on one end, or continuous threaded.

2.2 PROTECTION OF HANGERS

A. Steel hangers, hanger rod, and appurtenances shall be hot dipped galvanized.
2.3 SLEEVES

A. Manufacturers:
   1. Pro Set.
   2. Substitutions: Section 23 05 00 – Mechanical General Conditions.

B. Sleeves for Round Ductwork: Galvanized steel.

C. Sleeves for Rectangular Ductwork: Galvanized steel.

D. Stuffing or Fire-stopping Insulation: Glass fiber type, non-combustible.

E. Sealant: Acrylic in non-fire rated application.

2.4 FIRE STOP SYSTEMS

A. Manufacturers:
   1. 3m Model 2000.
   2. Spec Seal Model 100.
   3. Hilti.
   4. Substitutions: Section 23 05 00 – Mechanical General Conditions.

B. General Purpose Fire Stopping Sealant: Water based, non-slumping, premixed sealant with intumescent properties, rated for 3 hours in accordance with ASTM E814 and UL 1479.

C. General Purpose Vibration Resistant Fire Stopping Sealant: Silicone based, non-slumping, premixed sealant with intumescent properties, vibration and moisture resistant, rated for 3 hours in accordance with ASTM E814 and UL 1479.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturers instructions.

3.2 FLASHING

A. Provide curbs for mechanical roof installations 14 inches minimum high above roofing surface. Flash and counter-flash with sheet metal; seal watertight. Attach counterflashing mechanical equipment and lap base flashing on roof curbs. Flatten and solder joints.

3.3 SLEEVES

A. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with stuffing or fire stopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

B. Install chrome plated steel escutcheons at finished surfaces.

END OF SECTION 23 05 29
SECTION 23 05 53 – HVAC IDENTIFICATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes nameplates.

1.2 SUBMITTALS

A. Section 23 05 00 – Mechanical General Conditions: Submittal Procedures.

1.3 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.4 QUALITY ASSURANCE

A. Materials: Flame spread/smoke developed rating of 25/50 or less in accordance with ASTM E84, NFPA 255, UL 723.

B. Maintain one copy of each document on site.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years documented experience.

PART 2 - PRODUCTS

2.1 NAMEPLATES

A. Manufacturers:

1. Brady.

2. Seton.

3. LEM.

4. Substitutions: Section 23 05 00 – Mechanical General Conditions.

B. Product Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.

PART 3 - EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.
3.2 INSTALLATION

A. Install identifying devices after completion of coverings and painting.

B. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.

C. Equipment: Identify exhaust fans, control panels, radiant heaters, thermostats and other mechanical equipment with plastic nameplates. Air devices do not require mechanical identification.

D. Identify control panels and major control components outside panels with plastic nameplates.

E. Thermostats, nameplate shall include thermostat number and information as follows. Coordinate all set points with Owner prior to Substantial Completion:
   1. T1: Exhaust Fan Stage 2 Recommended Set Point 80 deg. F.
   2. T2: Ceiling Fan Recommended Set Point 80 deg. F.
   3. T3: Space Heating Recommended Set Point 65 deg. F.
   4. T4: Freeze Protection Recommended Set Point 38 deg. F.

F. Provide ceiling tacks to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION 23 05 53
SECTION 23 05 58 – HVAC ACCESS DOORS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install access doors as required or shown for access to equipment, dampers and other equipment requiring maintenance, adjustment or operation.

PART 2 - PRODUCTS

2.1 NON-FIRE RATED ACCESS DOORS

A. Furnish Inryco/Milcor, Acudor, Elmdor, or equal with 16 gauge frames, 14-gauge panels and 22-gauge casing head. Provide continuous concealed hinges and flush screwdriver cam lock. Use Style K access doors for plastered surfaces, Style M for masonry or gypboard surfaces. Use Style AP for acoustical plaster ceiling, with 18-gague panel and all-galvanized construction.

2.2 FIRE RATED ACCESS DOORS

A. Furnish Inryco/Milcor, Acudor, Elmdor, or equal, UL listed, 1-1/2 hour Label “B”, access doors with 16-gauge steel frames, and 20-gauge insulated sandwich-type door panel. Provide door with continuous concealed hinge and automatic closing and latching mechanism.

2.3 FINISHED AREAS

A. Provide stainless steel access doors where located in finished areas that are accessible to the general public such as but not limited to Toilet Rooms, Offices, Corridors, and Classrooms.

PART 3 - EXECUTION

3.1 Access doors specified in Division 23 will be installed by other Divisions. Not all required access doors are shown. Coordinate with the Contractor to locate access doors for ease of operation and maintenance of concealed equipment.

3.2 Installation shall be in accordance with the manufacturer’s printed instructions.

3.3 Access doors shall be of sufficient size to perform all necessary service and maintenance tasks.

END OF SECTION 23 05 58
PART 1 - GENERAL

1.1 SUMMARY

A. Perform all work required to prepare the building HVAC systems for testing, adjusting and Balancing indicated by the contract as follows:
   1. Responsibilities of Project Construction Manager.
   2. Preparation for balancing of air systems.

B. The General Contractor shall secure the services for Testing, Adjusting and Balancing. The scope of the TAB work is indicated to draw the attention of the Contractor to the coordination, adjustment, and system modification required under the project work to complete the requirements for Final TAB. The Contractor in his original bid shall allow for the costs required to cover all work that may be required in the TAB phases as defined herein and as may be necessary for the completion of the TAB work as defined by the TAB firm.

1.2 RELATED SECTIONS

A. Division 22 Plumbing.
B. Division 23 Heating, Ventilation and Air Conditioning.
C. Division 26 Electrical.

1.3 REFERENCES


1.4 DOCUMENTS

A. The TAB firm shall, as a requirement of the TAB contract, arrange with the Architect to compile one set of mechanical specifications, all pertinent change orders, and one complete set of drawings less the structural sheets.

B. Approved submittals data on equipment installed, and related changes as required to accomplish the test procedures outlined in Sections 1.6 through 1.10 of this Specification will be available through the Architect.
1.5 QUALITY ASSURANCE

A. Perform total system balance in accordance with AABC National Standards for Field Measurement and Instrumentation, Total System Balance, ANSI/ ASHRAE 111 or NEBB Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.

B. Quality Assurance in accordance with TPWD Division 1 - Section 01 00 00 - Special Conditions Section 1.10 Quality Assurance and UGC Article 8.

1.6 QUALIFICATIONS

A. Agency: Company specializing in the testing, adjusting, and balancing of systems specified in this Section with minimum three (3) years documented experience certified by AABC.

B. Perform Work under supervision of AABC Certified Test and Balance Engineer or NEBB Certified Testing, Balancing and Adjusting Supervisor.

1.7 RESPONSIBILITIES OF THE TAB FIRM

A. The TAB personnel shall check, adjust, and balance the components of the ventilation system to achieve the optimum noise and airflow results in the building while maintaining efficient and economical operation. This shall be performed after all components are installed and operating as provided in the Contract Documents. It is the responsibility of the Mechanical Contractor to place the equipment into service.

B. The TAB firm personnel on the project shall act as the liaison between the Owner, Architect and Construction manager. The following observations and tests shall be performed by the TAB firm:

1. Consult with the Architect and his consultants during the design phase to address matters affecting the work of this section.
2. During construction, review all HVAC submittals such as control diagrams, equipment, etc., that pertain to commissioning work and the ability to balance the system.
3. Allow for a fixed number of trips to the project site, over and above those required for testing and balancing for inspection of installation of sheet metal work, temperature controls and other components of the HVAC system during construction. These inspections shall be made prior and/or at the above the ceiling inspection. Commentary shall be provided to the Owner of each observation.

C. During the balancing process, as abnormalities and malfunctions of equipment or components are discovered by the TAB personnel, the Architect shall be advised in writing so that the condition can be corrected by the Mechanical Contractor. The written document must be understandable and legible. Data from malfunctioning equipment shall not be recorded in the Final TAB Report. The TAB firm shall not instruct or direct the contractor in any of the work, but will make such reports as necessary to the Owner.

D. Change speed of direct drive units to proper speed to bring units to design criteria. Report actual speed at fan (low/medium/high).

E. Shall plug all test holes.
F. Examination:
1. Prior to commencing the testing, adjusting and balancing of environmental system(s), verify the following conditions:
   a. Systems are started and operating in a safe and normal condition.
   b. Verify no existing airflow blockages/obstructions are present.
   c. Temperature control systems are installed, complete, and operable.
   d. Manual dampers are operable and fully open.
   e. Thermal overload protection is in place for fans and other equipment.
   f. Duct and fan systems are clean.
   g. Fans are rotating correctly.
   h. Access doors are closed and duct end caps are in place.
   i. Air outlets are installed and connected.
2. If deficiencies are evident, submit Deficiency Report to Architect. Do not begin testing, adjusting, and balancing of environmental system until deficiencies have been remedied.

G. Adjusting:
1. Recorded data shall represent actual measured or observed conditions.
2. Permanently mark setting of valves, dampers, and other adjustment devices allowing for settings to be restored. Set and lock memory stops.
3. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

1.8 FINAL AIR BALANCE

A. General: When systems are complete and ready for operation, the TAB consultant will perform a final air balance for all air systems and record the results. The exhaust air volume for each exhaust fan and the exhaust air volume for each distribution device shall be adjusted to within +10% of the value shown on the drawings. Fan volumes shall be adjusted by changing fan speed and adjusting volume dampers associated with the unit. Air distribution device volume shall be adjusted using the duct damper or device OBD for duct connected devices. Air distribution devices shall be balanced with air patterns as specified. Duct volume dampers shall be adjusted to provide air volume to branch ducts where such dampers are shown. The general scope of balancing by the TAB consultant will include:
1. Blower Speed: Measure RPM at each fan or blower to design requirements.
2. Ampere Readings: Measure and record full load amps for motors.
3. Static Pressure: Static gains or losses shall be measured across each supply fan, cooling coil, heating coil, return air fan, air handling unit filter and exhaust fan. Readings shall be measured and recorded for this report at the furthest air device or terminal unit from the air handler supplying that device.
4. Equipment Air Flow: Adjust and record exhaust air flows at each EF.
5. Pitot Tube Traverses: For use in future troubleshooting by maintenance Personnel, all exhaust ducts shall have their air velocity and volume measured and recorded by the traverse method. Locations of these traverse tests stations shall be described on the sheet containing the data. All traverse points shall be marked on drawing and submitted in final Test and Balance Report. All traverse points shall be labeled with stickers with the unit number, duct size, duct area, design CFM, design velocity, actual velocity, actual CFM and actual static pressure.

1.9 TESTING OF TEMPERATURE CONTROLS SYSTEMS
A. The TAB consultant shall:
1. Work with the HVAC Contractor to ensure the most effective total system operation within the design limitations, and to obtain mutual understanding of intended control performance.
2. Verify that all control devices are properly connected.
3. Verify that all controlled devices are operated by the intended controller.
4. Observe the calibration of all controllers.
5. Observe the locations of all thermostats and sensors for potential erratic operation from outside influences such as sunlight, drafts or cold walls.
6. Observe the location of all sensors to determine whether their position will allow them to sense only the intended temperatures or motion. HVAC Contractor shall relocate as deemed necessary by the TAB consultant. (Relocate thermostats only if new location will have better control of the system. MEP consultant will make final decision).
7. Verify that the sequence of operation for any control mode is in accordance with approved shop drawings and specifications.
8. Verify that all controller set points meet design intent.
9. Check all dampers for free travel.
10. Verify the operation of the interlock systems.

B. A systematic listing of the above testing and verification shall be included in the final TAB Report.

1.10 REPORTS

A. The activities described in this section shall culminate in a report to be provided in Quadruplicate individually bound to the Owner. TAB consultant shall provide two flash drive copies of the report. Data shall be presented in a neat and workmanlike manner. Include in the data the date tested, personnel testing, weather conditions, nameplate record of test instrument and list all measurements taken after all corrections are made to the system. Record all failures and corrective action taken to remedy incorrect situation. The intent of the final report is to provide a reference of actual operating conditions for the Owner’s operations personnel.

B. During TAB work the Owner can ask the contractor to provide actual readings for different areas if problems occur in some areas. Copies of the filed notes would be acceptable.

C. The TAB consultant shall submit preliminary TAB reports within four (4) weeks after substantial completion. Preliminary report shall include all the information required of the final report and may be copies of the field notes in a binder. Preliminary report shall also indicate all deficiencies noted. Final test and balance reports shall be submitted to the Owner within four weeks of completion of all deficiencies. If any deficiencies are not corrected within two months of substantial completion, the TAB consultant shall submit the final TAB report with the deficiencies noted. Once the deficiencies are corrected, the TAB consultant shall submit addenda to the Final Report.

D. All measurements and recorded readings (of air, electricity, etc.) that appear in the reports must have been made on-site by permanently employed technicians or engineers of the TAB firm.
E. At the option of the Architect, all data sheets tabulated each day by TAB personnel shall be submitted for initial review by the engineer. Those work sheets so initialed, or copies hereof, shall be presented as a supplement to the final TAB Report.

F. Submit Reports on forms approved by the Owner and Engineer and include the following information at a minimum:

1. Title Page:
   a. Company Name.
   b. Company Address.
   c. Company Telephone Number.
   d. Project Name.
   e. Project Address.
   f. Project Manager.
   g. Project Engineer.
   h. Project Construction Manager.
   i. Project Identification Number.

2. Instrument List:
   b. Manufacturer.
   c. Model and Serial Number.
   d. Range.
   e. Calibration Date.
   f. What test instrument was used for.

3. Fan Data (Include Design Versus Actual Readings):
   a. Identification/Location.
   b. Manufacturer.
   c. Model and Serial Number.
   d. Air Flow, specified and actual.
   e. Total Static Pressure (total external), specified and actual.
   f. Inlet Pressure.
   g. Discharge Pressure.
   h. Fan RPM.
   i. Total Traverse.
   j. Amps and Volts.

4. Electric Motors:
   a. Manufacturer.
   b. HP/BHP.
   c. Phase, voltage, amperage, nameplate, Hz, frame.
   d. RPM.
   e. Service Factor.

5. Duct Traverse:
   a. System/Zone Branch.
   b. Duct Size.
   c. Area.
   d. Design Velocity.
   e. Design air flow.
   f. Test velocity.
   g. Test air flow.
   h. Duct Static pressure.
   i. Air temperature.
j. Air correction factor.

6. Air Distribution Test Sheet:
   a. Manufacturer.
   b. Model Number.
   c. Air Terminal Number.
   d. Room Number/Location.
   e. Terminal Type.
   f. Terminal Number.
   g. Area Factor.
   h. Design Velocity.
   i. Design Air Flow.
   j. Test (Final) Velocity.
   k. Test (Final) Air Flow.
   l. Diffuser Mark.

7. Electric Infrared Heater (Design versus Actual):
   a. Manufacturer.
   b. Identification.
   c. Location.
   d. Model Number.
   e. Design KW.
   f. Stages/Control.
   g. Voltage, phase, amperage.
   h. Test voltage, amperage (each phase).

8. Control Verification Indicating Date Performed and any abnormalities identified:
   a. Point Location/Description.
   b. Actual readout.
   c. Interlocks.
   d. Safeties.
   e. Alarms.
   f. Sequences of Operation.

NOTE: Owner personnel training by manufacturer’s technicians for equipment and controls shall not commence until all TAB issues are resolved and a FINAL TAB report is received and approved by the Engineer.

G. The final, completed TAB report shall be submitted to the Engineer for approval, and to the Owner, TPWD, prior to substantial completion. The project will not be considered substantially complete until the Engineer and the Owner have stated that the systems are operating as designed.

1.11 AFTER OWNER OCCUPANCY

A. After Owner has occupied and is using the building, make two additional inspections of the system at 1 month intervals to:
   1. Check correct operation of equipment and verify by letter to the engineer on each trip. Include a list of any corrections made in the letter.

1.12 ADDITIONAL TESTING
A. Within 90 days of completing testing, adjusting, and balancing, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial testing, adjusting, and balancing procedures were not performed during near-peak summer and winter conditions, perform additional inspections, testing, and adjusting during near-peak summer and winter conditions. Owner shall provide 30 days notice to TAB firm. TAB firm shall coordinate seasonal inspection and TAB work at the convenience of the Owner.

END OF SECTION 23 05 93
SECTION 23 07 00 – HVAC INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes ductwork duct liner.

1.2 SUBMITTALS

A. Section 23 05 00 – Mechanical General Conditions: Submittal Procedures.

B. Submit in accordance with TPWD Division 1 - Section 01 00 00 – Special Conditions Section 1.09 Submittals and UGC Article 8.

C. Product Data: Submit product description, thermal characteristics, and list of materials and thickness for each service, and location.

1.3 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Applicator: Company specializing in performing Work of this section whose primary business is insulation with minimum three years documented experience.

C. Quality Assurance in accordance with TPWD Division 1 - Section 01 00 00 - Special Conditions Section 1.10 Quality Assurance and UGC Article 8.

1.4 QUALITY ASSURANCE

A. Materials: Flame spread/smoke developed rating of 25/50 or less in accordance with ASTM E84, NFPA 225, and UL 723.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer’s identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.

B. Maintain temperature during and after installation for minimum period of 24 hours.
1.7 REGULATORY COMPLIANCE


PART 2 - PRODUCTS

2.1 LONG FIBER TEXTILE OR ROTARY DUCT LINER, FLEXIBLE

A. Manufacturers:
   2. CertainTeed ToughGard R Duct Liner.

B. Insulation: ASTM C1071 Type I flexible, noncombustible blanket.
   1. K Value: ASTM C177, 0.27 at 75 degrees F.
   2. Maximum service temperature: 250 degrees F.
   3. Density: Minimum 1.5 lb/cu ft.
   4. Noise Reduction Criteria: 0.80.
   5. Maximum Velocity on Coated Air Side: 6,000 ft/min.
   6. Minimum Thickness and/or R-Value: Refer to Part 3 Schedules.

C. Adhesive:
   1. Manufacturers:
      a. Foster Model 81-90.
      b. Minnesota Mining Model EC104.
      c. Substitutions: Section 23 05 00 - Mechanical General Conditions.
      d. Waterproof, ASTM E162 fire-retardant type.

D. Biocide: Coat liner with EPA-registered anti-microbial agent that will not support the growth of fungus or bacteria.


2.2 GENERAL SEALANT

A. Manufacturers/Product.
   1. Fosters Products Co 95-90.
   2. Rector Seal/Air-Lock 181.
   3. Design Polymerics/DP 1020.

B. Non-hardening, Non-flammable; water-based; fiber reinforced; mildew, water and UV resistant; compatible with mating materials; UL Listed 181A or 181B; liquid used alone or with tape or heavy mastic.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify equipment and duct work have been tested before applying insulation materials.

B. Verify surfaces are clean and dry, with foreign material removed.
3.2 INSTALLATION

A. Install in accordance with NAIMA National Insulation Standards and Manufacturers instructions.

B. It shall be the responsibility of the contractor to ensure that an effective insulation and vapor seal is achieved on all cold surfaces which will eliminate any sweating or condensation on any cold surfaces installed by the contractor.

C. Equipment Connections: Seal duct and piping at point of connection to equipment to maintain vapor barrier.

D. Continue insulation through penetrations of building assemblies or portions of assemblies having fire resistance rating of one hour or less. Provide intumescent firestopping when continuing insulation through assembly. Finish at supports, protrusions, and interruptions. Refer to Architectural for penetrations of assemblies with fire resistance rating greater than one hour.

E. Factory Insulated Equipment: Do not insulate, except when indicated on drawings, or other sections of specifications.

F. Duct Liner Application:
   1. Adhere insulation with adhesive for 100 percent coverage.
   2. Secure insulation with mechanical liner fasteners. SMACNA Standards for spacing.
   4. Seal liner surface penetrations with adhesive.
   5. Duct dimensions indicated are net inside dimensions required for airflow. Increase duct size to allow for insulation thickness.

G. Install according to manufacturer’s recommended stretch out chart and to manufacturer’s installation instructions where more stringent than herein.

3.3 SCHEDULES

Provide minimum thickness as follows:


END OF SECTION 23 07 00
SECTION 23 09 23 – EQUIPMENT CONTROLS COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

A. Control system shall be provided to control HVAC equipment. The following specification shall assist in the coordination between trades.

1.2 SCOPE OF WORK

A. HVAC Contractor:
   1. Contractor shall provide and mount all thermostats and space temperature probes. Contractor shall wire temperature probes and complete installation.
   2. Contractor shall provide exhaust fan speed controller in enclosure panel provided by Electrical Contractor at location indicated on drawings. Electrical Contractor shall make all low voltage and high voltage line and load side connections to controller.
   3. Radiant Heaters: Contractor shall provide and mount all thermostats and space temperature probes. Contractor shall wire temperature probes and complete installation.
   4. Ceiling Fans: Contractor shall provide and mount all thermostats and space temperature probes. Contractor shall wire temperature probes and complete installation.

B. Electrical Contractor:
   1. Conduits and Raceways: Electrical Contractor shall provide junction boxes and conduit in walls with pull strings for all wall mounted temperature sensors, occupancy sensors and relay panels. HVAC Contractor shall provide new thermostats/sensors, probes and probe wiring.
   2. Electrical Contractor shall provide 120-vac power to relay control panel.
   3. Electrical Contractor shall provide occupancy sensors and relays/contactors.
   4. Electrical Contractor shall make all high voltage line and load side connections to relays, contactors, exhaust fans, heaters, ceiling fans and controllers.

END OF SECTION 23 09 23
SECTION 23 09 93 – EQUIPMENT SEQUENCE OF OPERATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. HVAC equipment Sequence of Operations for the Lake Corpus Christi State Park Restroom Replacement Project.

PART 2 - EQUIPMENT SEQUENCE OF OPERATIONS

2.1 ENERGY MANAGEMENT SYSTEM (EMS)

A. System shall energize and de-energize each component of the HVAC system individually.

B. The HVAC system shall operate 24 hours a day, 7 days a week.

2.2 TESTING AND CALIBRATION

A. After completion of installation, all controls shall be tested and calibrated to operate as required in this specification.

B. Upon request by the Engineers’ representative, demonstration of proper control system operation shall be provided prior to final job acceptance.

2.3 GENERAL

A. Indoor Conditions - Heating: 68 degrees F. (adj.)

B. Space Temperature Controllers:
   1. Provide wall mounted thermostat controllers with remote space temperature probes for exhaust fans, heaters and ceiling fans.
   2. Thermostats: Johnson Controls Model A19ABC-35C mechanical temperature controller or equal with 20-foot remote sensor probe.

C. Air Balance:
   1. Test, Adjust, and Balance services shall be provided by General Contractor through sub-contract with licensed TAB firm. HVAC Contractor shall not include the cost of TAB in bid proposal. HVAC Contractor shall coordinate work with TAB Contractor as if they were their own direct sub-contractor.
   2. HVAC Contractor shall update system setpoints as needed with TAB Contractor.
   3. TAB Contractor shall include coordination setpoints on final TAB reports.
   4. Refer to Specification 23 05 93 Testing, Adjusting and Balancing for coordination requirements.

2.4 EXHAUST FANS

A. Each system shall consist of a unit with a two-speed exhaust fan. Refer to Specification 23 09 23 Equipment Controls Coordination for additional requirements. Electrical Contractor shall
provide high voltage line and load connections through fan relays and controllers to associated exhaust fan as required.

B. All fans shall operate as indicated by notes on fan equipment schedules.

C. Exhaust Fans:
   1. Occupied Mode:
      a. Occupied Mode shall start based on motion sensed by either occupancy sensor in main restroom or Family Restroom.
      b. When fan is commanded On through occupancy sensor, thermostat T1 shall energize and fan shall start at Speed 1 Minimum Exhaust Airflow.
      c. If space temperature exceeds temperature set point, 80 deg. F. (adj.), fan shall modulate to Speed 2 Maximum Exhaust Airflow.
      d. Fan speed controller auxiliary contact shall close and energize ceiling fan thermostat T2.

2.5 RADIANT HEATERS

A. Each system shall consist of electric radiant heaters and wall thermostat. Refer to Specification 23 09 23 Equipment Controls Coordination for additional requirements. Electrical Contractor shall provide high voltage line and load connections through relays to associated heaters as required.

B. Heaters:
   1. Occupied Mode:
      a. Occupied Mode shall start based on motion sensed by occupancy sensor and energize thermostat T3 (main restroom and Family Restroom).
      b. If space temperature falls below space heating set point, 68 deg. F. (adj.), thermostat T3 shall energize heater.
      c. Freeze Protection Override: If space temperature drops below freeze protection temperature set point, 38 deg. F. (adj), thermostat T4 (main restroom and Family Restroom) shall override occupancy sensor and energize heaters.

PART 3 - EXECUTION

NOT USED.

END OF SECTION 23 09 93
SECTION 23 31 13 - DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes metal ductwork and duct cleaning.

1.2 PERFORMANCE REQUIREMENTS

A. No variation of duct configuration or sizes other than those of equivalent or lower loss coefficient is permitted except by written permission. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE.

B. Seal ductwork in accordance with ASHRAE 90.1-2013 and International Energy Conservation Code - 2015 standards and as described herein.

1.3 SUBMITTALS

A. Section 23 05 00 – Mechanical General Conditions: Submittal Procedures.

B. Submit in accordance with TPWD Division 1 - Section 01 00 00 – Special Conditions Section 1.09 Submittals and UGC Article 8.

C. Coordination Drawings: Indicate duct fittings, gages, sizes, welds, and configuration for all systems.

D. Product Data: Submit data for duct materials duct liner and duct connectors.

E. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA HVAC Air Duct Leakage Test Manual.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with SMACNA - HVAC Duct Construction Standards - Metal and flexible.

B. Construct ductwork to NFPA 90A NFPA 90B and NFPA 96 standards.

C. Materials: Flame spread / smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255, UL 723.

D. Quality Assurance in accordance with TPWD Division 1 - Section 01 00 00 - Special Conditions Section 1.10 Quality Assurance and UGC Article 8.
1.6 QUALIFICATIONS

A. Installer: Company specializing in performing Work of this section with minimum three (3) years documented experience.

1.7 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 - PRODUCTS

2.1 DUCT MATERIALS


B. Stainless Steel Sleeves: ASTM A167, Type 316.

C. Fasteners: Rivets, bolts, or sheet metal screws.

D. Hanger Rod: ASTM A36; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

E. Sealant:
   1. Manufacturers / Product:
      a. Rector Seal / Air-Lock 181.
      b. Design Polymeric / DP 1020.
   2. Non-hardening, Non-flammable; water-based; fiber reinforced; mildew, water and U.V. resistant; compatible with mating materials; U.L. listed 181A or 181B; liquid used alone or with tape or heavy mastic.

F. General Purpose Fire Stopping Sealant (Refer to Architectural Sections):
   1. Manufacturers:
      a. 3M Model 2000.
      b. Spec Seal Model 100.
      c. Hilti.
   2. Water based, nonslumping, premixed sealant with intumescent properties, rated for 3 hours per ASTM E814 and UL 1479.

2.2 DUCTWORK FABRICATION

A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated on Drawings. Furnish duct material, reinforcing, and sealing for operating pressures indicated. Furnish gauges as indicated on Minimum Sheetmetal Gauges Schedule in this specification section.

B. Construct T's, bends, and elbows with minimum radius 1-1/2 times centerline duct width. Where not possible and where rectangular elbows are used, provide airfoil turning vanes. Where acoustical lining is indicated, furnish turning vanes of perforated metal with glass fiber insulation.
C. Round ductwork in supply and constant volume supply, return, outside air and exhaust systems shall be constructed with grooved seam pipe lock flat lock longitudinal seams (Refer to SMACNA 1997 Figure 3-1). Snap-lock seams are not acceptable.

D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

E. Fabricate continuously welded round duct fittings two gages heavier than duct gages indicated in SMACNA Standard. Minimum 4 inch cemented slip joint, brazed or electric welded. Prime coat welded joints.

F. Provide standard 45-degree lateral wye takeoffs. When space does not allow 45-degree lateral wye takeoff, use 90-degree conical tee connections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify sizes of equipment connections before fabricating transitions.

3.2 INSTALLATION

A. Duct sizes shown on plans are inside clear dimensions. For lined ducts, maintain sizes inside lining.


C. Field verify all measurements and dimensions prior to fabrication of any ductwork. Notify engineer where duct sizes require modifications. No additional compensation will be awarded for modifications to fit field conditions.

D. Minor changes in duct routing and dimensions to avoid structural members and other obstructions will be allowed. Major departures from duct layout will require approval of the Owner’s Representative.

E. Duct materials or prefabricated ductwork stored or installed at site shall be protected from weather, dust and moisture. Damaged duct shall be removed and replaced at the contractor's expense.

F. During construction, install temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

G. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

H. Use double nuts and lock washers on threaded rod supports.

I. Permanently seal openings in ducts where probes for TAB instruments are inserted.
J. Firestopping: Seal around all duct penetrations through fire barriers with fire stopping sealant. Provide fire dampers and smoke dampers as shown on plans.

3.3 SEALING OF DUCTWORK

A. Seal ductwork, as a minimum, in accordance with ASHRAE 90.1-2013 and IECC 2015 requirements, and as required herein. All exhaust duct shall be sealed as Class B, regardless of static pressure classification of system.
1. Exhaust air: Seal all transverse joints, longitudinal seams and duct connections.
2. Pressure-sensitive tape shall not be used as the primary sealant.

3.4 VERIFICATION OF MINIMUM GAUGES

A. Contractor shall be required to cut samples of materials from installed ductwork at five locations as designated by Engineer prior to installation of insulation. Samples will be provided to Engineer for verification that gauges are in compliance with SMACNA standards and with minimum gauges as specified herein, refer to Minimum Sheetmetal Gauges Schedule. If any sample is found not to be in compliance with contract documents, ductwork shall be replaced and an additional set of five samples shall be provided until it is determined that all ductwork is in compliance. Contractor shall patch ductwork where samples are taken. All ductwork found to be non-compliant shall be removed and replaced by Contractor at no expense to the Owner or Design Professionals.

3.5 CLEANING

A. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient airflow, clean one half of system completely before proceeding to other half. Protect equipment with potential to be harmed by excessive dirt with temporary filters, or bypass during cleaning.

3.6 SCHEDULES

A. **DUCTWORK MATERIAL SCHEDULE**

<table>
<thead>
<tr>
<th>AIR SYSTEM</th>
<th>MATERIAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Exhaust</td>
<td>Galvanized Steel</td>
</tr>
</tbody>
</table>

B. **DUCTWORK PRESSURE CLASS SCHEDULE**

<table>
<thead>
<tr>
<th>AIR SYSTEM</th>
<th>PRESSURE CLASS</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>2 inch wg</td>
</tr>
</tbody>
</table>
C. **MINIMUM SHEET METAL GAUGES**

<table>
<thead>
<tr>
<th>Maximum Rectangular Duct Size Inches</th>
<th>U.S. Standard Gauges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 12</td>
<td>24</td>
</tr>
<tr>
<td>13 – 30</td>
<td>22</td>
</tr>
<tr>
<td>31 – 48</td>
<td>22</td>
</tr>
<tr>
<td>49 – 54</td>
<td>20</td>
</tr>
<tr>
<td>55 and above</td>
<td>18</td>
</tr>
</tbody>
</table>

** Ductwork must be reinforced in accordance with pressure class and SMACNA standard requirements.

<table>
<thead>
<tr>
<th>Maximum Round Duct Size Inches</th>
<th>U.S. Standard Gauges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 14</td>
<td>24</td>
</tr>
<tr>
<td>15 – 26</td>
<td>22</td>
</tr>
<tr>
<td>27 – 36</td>
<td>22</td>
</tr>
<tr>
<td>37 – 50</td>
<td>20</td>
</tr>
<tr>
<td>51 and above</td>
<td>18</td>
</tr>
</tbody>
</table>

** Minimum duct gauges are selected for medium pressure spiral duct up to 10” inches static pressure and low pressure long seam up to 2” inches static pressure.

END OF SECTION 23 31 13
SECTION 23 33 01 – DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY
   A. Section includes back-draft dampers, duct access doors, volume control dampers and duct test holes.

1.2 SUBMITTALS
   A. Section 23 05 00 – Mechanical General Conditions: Submittal Procedures.
   B. Submit in accordance with TPWD Division 1 - Section 01 00 00 – Special Conditions Section 1.09 Submittals and UGC Article 8.
   C. Manufacturer's Installation Instructions: Submit for Fire and Combination Smoke and Fire Dampers.
   D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.3 CLOSEOUT SUBMITTALS
   A. Project Record Documents: Record actual locations of access doors.
   B. Operation and Maintenance Data: Submit for Combination Smoke and Fire Dampers.

1.4 QUALIFICATIONS
   A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING
   A. Protect dampers from damage to operating linkages and blades.

1.6 FIELD MEASUREMENTS
   A. Verify field measurements prior to fabrication.

1.7 WARRANTY
   A. Furnish one (1) year manufacturer warranty for duct accessories.

PART 2 - PRODUCTS

2.1 DUCT ACCESS DOORS
   A. Manufacturers:
      1. Ruskin Model ADC/H series.
2. Flexmaster.
4. Philips.
5. Safe-Air.

B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated on Drawings.

C. 2 inch w.g. and less: Rigid and close fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, furnish double wall door with 1” insulation.
1. Less Than 12 inches square, secure with sash locks.
2. Up to 18 inches Square: Furnish two hinges and two sash locks.
3. Up to 24 x 48 inches: Three hinges and two compression latches with outside and inside handles.
4. Larger Sizes: Furnish additional hinge.
5. Access panels with sheet metal screw fasteners are not acceptable.
6. Ruskin AD series.

2.2 VOLUME CONTROL DAMPERS

A. Manufacturers:
1. Ruskin Model MD35, MDRS 25.
2. Greenheck.
3. Philips.
4. Safe-Air.

B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated on Drawings.

C. Multi-Blade Damper: Opposed blade pattern. Frame to be 16 gauge galvanized steel hat channel. Blades shall be single skin of 16 gauge galvanized steel with three longitudinal grooves for reinforcement. Maximum blade width of 8 inches. Linkage concealed in frame. ½ inch hex axle.

D. Round Damper: Fabricate of 20 gauge galvanized steel with 14 gauge butterfly damper blade, neoprene seal and stainless steel sleeve bearing.

E. End Bearings: Furnish end bearings. On multiple blade dampers, furnish oil-impregnated nylon or sintered bronze bearings. Furnish closed end bearings on ducts having pressure classification over 2 inches wg.

F. Quadrants:
1. Furnish locking, indicating quadrant regulators on single and multi-blade dampers.
2. On insulated ducts mount quadrant regulators on standoff mounting brackets, bases, or adapters.
3. Where rod lengths exceed 30 inches furnish regulator at both ends.
4. On dampers concealed above inaccessible ceiling, provide concealed damper regulators as manufactured by Young Regulator, Model 315, 927, 1200. In finished areas where appearance of instrument port is unacceptable, provide remote cable control as manufactured by Young Regulator, Model Bowden Cable Control.
G. Velocity and pressure rating of damper to match duct system characteristics at installed location.

2.3 FLEXIBLE DUCT CONNECTIONS

A. Manufacturers:
   1. Durodyne Model Therma Fab for indoor application, Durolon for outdoor application.
   2. Vent Fab.
   3. Elgen.

B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated on Drawings.

C. Connector, indoors: Fabric crimped into metal edging strip.
   1. Fabric: UL listed fire-retardant (500 deg. F. continuous) silicon rubber coated woven glass fiber fabric conforming to NFPA 90A, minimum density 17 oz per sq yd.
   3. Metal: 3 inch wide, 24 gage galvanized steel.

D. Metal: 3 inch wide, 24 gage galvanized steel.

2.4 DUCT TEST HOLES

A. Temporary Test Holes: Cut or drill in ducts. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Furnish extended neck fittings to clear insulation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to Section 23 31 13 for duct construction and pressure class.

B. Install back-draft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated on Drawings.

C. Install duct access doors for inspection and cleaning before and after fire dampers, automatic dampers, and as indicated on Drawings. Install minimum 8 x 8 inch size for hand access, 24 x 24 inch size for shoulder access, and as indicated on Drawings. Review locations prior to fabrication.

D. Install duct test holes where indicated on Drawings and required for testing and balancing purposes.

E. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment and supported by vibration isolators.
F. Install balancing dampers a minimum of two equivalent duct diameters from duct takeoff.

END OF SECTION 23 33 01
SECTION 23 34 23 - FANS

PART 1 - GENERAL

1.1 SCOPE

A. This Section provides for the furnishing and installation of centrifugal fans, with all supplemental equipment.

1.2 APPLICABLE PROVISIONS

A. Refer to Section 23 05 00 – Mechanical General Conditions.

1.3 PERFORMANCE

A. Provide fan type, arrangement, rotation, capacity, size, motor horsepower, and motor voltage as shown. Fan capacities and characteristics are scheduled on the Drawings.

B. Rate fans according to appropriate Air Moving and Conditioning Association, Inc. (AMCA), approved test codes and procedures. Supply fans with sound ratings below the maximums permitted by AMCA standards. All fans provided must be licensed to bear the Certified Ratings Seal.

C. Statically and dynamically balance all fans.

1.4 SUBMITTALS

A. Section 23 05 05 – Submittal Procedures.

B. Submit in accordance with TPWD Division 1 - Section 01 00 00 – Special Conditions Section 1.09 Submittals and UGC Article 8.

C. Submit product data on all fans, including cut sheets, fan curve, sound data, performance data, and accessories provided.

D. On products required to have a paint finish, submit a detailed cut sheet of paint properties.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Centrifugal Fans:
   1. Loren Cook (Basis of Design).
   2. Greenheck.
   3. Acme.
   4. ILG.

2.2 SUPPLEMENTAL EQUIPMENT

A. Safety Disconnect Switch: Furnish a factory-wired, safety disconnect switch on each unit.
2.3 SQUARE IN-LINE CENTRIFUGAL FANS:

A. Fan shall be duct mounted, direct driven centrifugal square inline. Fan shall be listed by Underwriters Laboratories (UL 705). Fan shall bear the AMCA certified ratings seal for sound and air performance.

B. The fan shall be of bolted construction utilizing corrosion resistant fasteners. Housing shall be minimum 18-gauge steel with integral duct collars. Bolted access doors shall be provided on three sides, sealed with closed cell neoprene gasketing. Heavy duty motor plate shall be provided to support motor and wheel with vibration isolators. Housing shall be pre-drilled to accommodate universal mounting feet for vertical or horizontal installation. Unit shall bear an engraved aluminum nameplate with manufacture’s data.

C. Wheel shall be centrifugal backward inclined, non-overloading flat blade type, constructed of 100% aluminum, including a cast aluminum hub. Wheel hub shall be keyed and securely attached to the fan motor shaft. Wheel shall be balanced in accordance with AMCA Standard 204-96, Balance Quality and Vibration Levels for Fans.

D. All steel fan components shall be coated with a minimum 2 mil thick baked powder finish. Paint must exceed 1,000 hour salt spray under ASTM B117 test method.

E. Motor shall be electronically commutated permanent magnet type rated for continuous duty and furnished with internally mounted speed controller. Unit shall be capable for remote control through 0-10 vdc signal or local manual adjustment. Motor shall be provided to operate at electrical power listed on equipment schedules.

F. Accessories:
   1. Insulated housing.
   2. Electrical disconnect switch.
   4. Hanger rod support brackets.
   5. EC Motor speed controller: Variable Speed with two speed control, Cook VF2SC or equal.

PART 3 - EXECUTION

3.1 EXECUTION

A. Install fans according to the manufacturer’s instructions, design details and at the locations shown on the Drawings.

B. Provide flexible connection at inlet and outlet.

END OF SECTION 23 34 23
SECTION 23 37 13 - AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Registers/Grilles.

1.2 RELATED SECTIONS

A. Section 23 05 00 Mechanical General Conditions
B. Section 23 31 13 - Ducts.
C. Section 23 33 01 - Duct Accessories.
D. Section 23 05 93 – Testing, Adjusting, and Balancing.
E. All Divisions of Contract Documents.

1.3 REFERENCES

B. AMCA 500 - Test Method for Louvers, Dampers, and Shutters.
C. ARI 650 - Air Outlets and Inlets.
E. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.
F. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

1.4 SUBMITTALS

A. Section 23 05 05 – Submittal Procedures.
B. Submit in accordance with TPWD Division 1 - Section 01 00 00 – Special Conditions Section 1.09 Submittals and UGC Article 8.
C. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

1.5 PROJECT RECORD DOCUMENTS

A. Section 23 05 05 – Submittal Procedures.
B. Record actual locations of air outlets and inlets.

1.6 QUALITY ASSURANCE

A. Test and rate air outlet and inlet performance in accordance with ADC Equipment Test Code 1062 and ASHRAE 70.

B. Test and rate louver performance in accordance with AMCA 500.

C. Quality Assurance in accordance with TPWD Division 1 - Section 01 00 00 - Special Conditions Section 1.10 Quality Assurance and UGC Article 8.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience.

PART 2 - PRODUCTS

2.1 EXHAUST REGISTERS/GRILLES

A. Manufacturers:
   1. Titus Model 350RL-SS or as shown on Plans.
   2. Other acceptable manufacturers offering equivalent products:
      a. Metalaire.
      b. Krueger.
      c. Price.

B. Type: Streamlined blades, 3/4 inch (19 mm) minimum depth ¾ inch (19mm) maximum spacing, with blades set at 45 degrees to horizontal face.

C. Frame: 1-1/4 inch margin with borders for lay-in or surface mount as noted on scheduled.

D. Fabrication: 316 Stainless steel frames and blades with factory off-white enamel finish. Coordinate finish with Architect prior to ordering.

E. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face where not on drawings as “OBVD”.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate work of this Section with other affected work.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.

C. Install diffusers to ductwork with air tight connection.

D. Provide balancing dampers on duct take-off to diffusers and grilles and registers, despite whether dampers are specified as part of the diffuser or grille and register assembly.

E. Paint ductwork visible behind air outlets and inlets matte black.

END OF SECTION 23 37 13
SECTION 23 82 40 - HEATERS

PART 1 - GENERAL

1.1 SCOPE

A. This Section provides for the furnishing and installation of electric radiant heaters with all supplemental equipment.

1.2 APPLICABLE PROVISIONS

A. Refer to Section 23 05 00 – Mechanical General Conditions.

1.3 SUBMITTALS

A. Submit product data on all fans, including cut sheets, fan curve, sound data, performance data, and accessories provided.

B. Submit in accordance with TPWD Division 1 - Section 010000 – Special Conditions Section 1.09 Submittals and UGC Article 8.

C. On products required to have a paint finish, submit a detailed cut sheet of paint properties.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Radiant Heaters:
   1. TPI Corp. Model FSA (Basis of Design)
   2. Infratech.
   4. Redd-i.
   5. Space-Ray.

2.2 SUPPLEMENTAL EQUIPMENT

A. Provide all miscellaneous appurtenances required for a complete and functional installation.

2.3 INFRA-RED HEATERS

A. Description: Heaters shall be bracket surface mounted, electric infra-red heaters.

B. Construction:
   1. Heavy duty single flat plate emitter heating element. Medium wave operating at 78.5% radiant efficiency with a 25,000-hour life expectancy
   2. Extruded Aluminum housing providing a 60-deg. symmetrical heating pattern.
   3. Inset mounting brackets.

C. Controls: System shall operate on 120 volts.
D. Warranty: The manufacturer shall provide a published warranty covering the heater for a period of three (3) years.

E. Certifications:
1. High Intensity Infra-Red Heaters shall be Designed Certified by CSA, approved by Underwriter’s Laboratories, Inc. (UL), comply with current Occupational Safety and Health Act (OSHA) requirements, and be accepted by Factory Insurance Association (FIA) and Mutual Fire Insurance Companies (FM).
2. High Intensity Infra-Red Heaters must be CSA Design Certified to operate at the designated heating rating.
3. ETL C/US listed for indoor or protected outdoor applications.
4. The manufacturer shall have a minimum of 30 years of manufacturing experience producing high intensity infra-red heaters.

PART 3 - EXECUTION

3.1 Install heaters according to the manufacturer’s recommended instructions and in the locations shown on the Drawings. Maintain all clearances required by the manufacturer.

3.2 Comply with manufacturer's product data, including technical bulletins, product catalog installation instructions.

3.3 Examine areas to receive heaters. Notify the Engineer of conditions that would adversely affect installation or subsequent utilization and maintenance of heaters. Do not proceed with installation until unsatisfactory conditions are corrected.

3.4 Adjust heaters to function properly.

3.5 Clean as recommended by manufacturer. Do not use material or methods which may damage finish surface or surrounding construction.

3.6 Protect installed product and finished surfaces from damage during construction

3.7 Protect installed heaters to ensure that, except for normal weathering, heaters will not be damaged at time of substantial completion.

END OF SECTION 23 82 40
SECTION 26 00 00 - ELECTRICAL SPECIFICATIONS

1.1 GENERAL

A. Section 20 00 00 is a part of these Electrical Specifications for Lake Corpus Christi State Park Restroom Replacement Project, Texas Parks and Wildlife Department.

1.2 SCOPE

A. Work to be accomplished under these Specifications includes the furnishing of all labor, materials, and equipment required for the complete installation as described herein and as indicated on the Drawings.

B. Work is to be completed from point of service to each outlet indicated on Drawings and/or specified herein with all accessory construction as may be required to make the installation of each piece of equipment complete and ready for normal service. In general, this work consists of the following:
   1. A system of power and control connections to the heating equipment as indicated on the Drawings.
   2. A system of power and control connections to the ventilation equipment as indicated on the Drawings.
   3. New underground service feeder from existing overhead electric service.
   4. A system of conduits, junction boxes, pull boxes, outlet boxes with plates, wiring devices, load centers, enclosed circuit breakers, lighting fixtures, control devices, conductors, time clocks, and related items for the power and lighting system.

C. Installation of this work, including all materials and labor shall be first class in every respect and in exact accordance with these Specifications and accompanying Drawings. It is intended that Specifications and accompanying Drawings shall include everything requisite and necessary for proper installation of electric wiring, even though every item may not be particularly mentioned in detail.

1.3 ELECTRICAL SERVICE

A. Contractor shall furnish the secondary feeder complete from the switchgear rack to Panel “P” as indicated on the Drawings.

B. Contractor shall furnish the secondary trench, conduit with pullcord and trench backfill for secondary conductors by AEP from the new AEP secondary dip pole to the switchgear rack. Refer to drawing details and notes for conduit termination requirements to be coordinated by the contractor with AEP.

C. Metering will be coordinated and provided in accordance with power company requirements.

D. The existing service utilization voltage is solidly grounded, 120/240 volt, single-phase, 3-wire nominal.

E. Contractor shall furnish all new service equipment and materials as indicated on the Drawings and as required for electrical service extensions to new equipment.
1.4 TEMPORARY POWER AND LIGHTING

A. Contractor shall provide all necessary wiring, service switches, poles, ground fault protection equipment, etc., required for temporary power and lighting during construction of the building.

1.5 GROUNDING

A. The entire electrical system shall be grounded in accordance with Article 250 of the National Electrical Code, and as hereinafter specified.

B. Main service entrance ground shall be as indicated on Drawings.

C. Driven ground rods shall be provided where required and/or where indicated on the Drawings. Ground rods shall be minimum 3/4” x 10’-0” Copper-weld or equal. All ground wiring shall have adequate mechanical protection, and be exothermically welded to rods.

D. The grounding system shall be tested at the completion of the project to ensure the resistance does not exceed 25 ohms. Testing shall be performed utilizing a ground resistance test instrument equal to AEMC Model #3710 or a fall-of potential test. Ground resistance testing shall be witnessed by a representative of TPWD. If the grounding system exceeds 25 ohms, the contractor shall provide additional means to reduce the resistance to 25 ohms or less.

E. Grounding electrode and equipment conductors with a “green” colored insulated jacket shall be provided and installed in all raceways, whether non-metallic or metallic.

F. Equipment shall have an effective equipment ground in accordance with the National Electrical Code.

1.6 CONDUIT AND TUBING

A. Conduit size shall be 1/2” unless otherwise indicated on the Drawings or otherwise specified.

B. Conduit installed underground or in concrete slabs shall be Schedule 40 rigid polyvinyl chloride (PVC) conduit as manufactured by Carlon or approved equal, installed in accordance with National Electrical Code, and as indicated on Drawings. All PVC conduit shall have Underwriters Laboratory, Inc. approval for direct burial underground without concrete encasement. All PVC plastic conduit must be installed in accordance with manufacturer’s recommendations and in strict accordance with the applicable sections of these Specifications.

C. Conduit installed above grade in damp or wet locations shall be rigid hot-dip galvanized conduit as manufactured by Republic, Allied, Triangle, Wheatland, Western, or an approved equal, with screwed couplings and fittings. All fittings used shall be hot-dip galvanized.

D. Fittings and connections involving dissimilar metals will not be allowed in damp or wet locations.

E. All conduit in furred ceiling spaces, interior masonry, or stud partitions and dry locations shall be galvanized thinwall (EMT) as manufactured by Allied, American or Wheatland with die-cast aluminum watertight, insulated throat type compression fittings. Indentor type or set screw type connectors and fittings will not be accepted. All conduit installed in finished spaces shall be concealed unless otherwise specifically indicated on the Drawings.
F. MC type cable is not permissible for use. Other types of cable shall not be utilized for any purpose.

G. Flexible metal conduit shall not be used for any purpose except as hereinafter specified and as specifically indicated on the Drawings. All flexible metal conduit shall be installed in strict accordance with Articles 348 and 350 of the National Electrical Code. Non-metallic flexible conduit will not be acceptable for any purpose.
   1. Connections to mechanical and plumbing equipment shall be made with flexible metal conduit. Length of weatherproof flexible metal conduit for this application shall not exceed 6'-0".
   2. Flexible metal conduit may be used for light fixture connections. Length of flexible conduit for this application shall not exceed 6'-0".
   3. Where flexible conduit is used for connections to equipment in damp or wet locations, conduit shall be liquid tight flexible metal conduit with approved fittings.

1.7 INSTALLATION AND ROUTING OF CONDUITS

A. All conduit shall be run in the straightest possible path.

B. Not more than three (3) 90 degree bends will be permitted in any one (1) conduit run and no run shall be longer than allowed by the National Electrical Code without the installation of pull boxes. There shall not be any pull boxes or junction boxes installed in inaccessible space.

C. Exposed conduit shall be run in straight lines, at right angles to, or parallel with walls, beams, columns, or decks, and shall be supported at maximum of 6'-0" by malleable conduit straps or suitable clamps on hangers to provide a rigid installation. PVC conduit shall not be run exposed for any application.

D. In no case shall conduit be fastened to other pipe or equipment or so installed as to prevent the ready removal of other pipes or equipment for repairs.

E. All Schedule 40 steel conduit ends are to have a minimum of five full threads. No threadless connectors are to be used. All conduit shall be reamed after cutting and threading and before installation; runs shall be straight and true; elbows, offsets, and bends shall be uniform and symmetrical. All conduit after installation and prior to completion of project shall be capped to prevent entrance of moisture and foreign objects. Conduit shall be swabbed before installation of wire. PVC conduit joints shall be made in accordance with manufacturer's recommendations.

F. Elbows in PVC conduit below grade shall be Schedule 80 PVC.

G. Provision shall be made for expansion and contraction of all conduit as hereinafter specified.

H. Underground PVC conduit shall not be extended above grade. PVC shall be transitioned to Schedule 40 rigid galvanized conduit at level of finished grade or slab for all exterior applications and in damp or wet locations. PVC shall be transitioned to aluminum EMT at slab level for all interior applications in dry locations.

I. All underground conduits shall have a minimum cover from top of conduit to finished grade of at least 24".

J. Provide 4" wide yellow warning tape 1'-0" above all underground conduit exterior to building lines.
K. All steel (vertical rise) conduits and fittings shall be wrapped with 3M pipe wrap. Successive winds of pipe wrap shall be overlapped at least 1". Vertical rise conduit shall be wrapped to at least 6" above finished grade or slab.
1.8 CONDUIT AND FITTING SUBMITTAL

A. The Contractor shall complete the following table and submit for approval prior to acquisition of conduit and conduit fittings.

B. A copy of the following table (submitted and approved) shall be retained on site in the possession of the on-site electrical foreman until the certificate of substantial completion is executed.

<table>
<thead>
<tr>
<th>Location / Environment</th>
<th>Conduit Type and Schedule</th>
<th>Coupling Material and Type</th>
<th>Terminal Adapter Material/Type</th>
<th>Elbow Material / Type</th>
<th>Expansion Fitting Material</th>
<th>Condulet Material</th>
<th>Maximum Allowance Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interior/Dry Locations</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
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<tr>
<td>Under Cover/Damp Locations</td>
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<td>NA</td>
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<tr>
<td>Exterior/Wet Locations</td>
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<td>Flexible Conduit Dry Locations</td>
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<tr>
<td>Flexible Conduit Damp and Wet Locations</td>
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<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

SUBMITTED BY CONTRACTOR DATE: ________________________________

ENGINEER APPROVAL: ________________________________ DATE: ________________
1.9 EXPANSION JOINTS

A. Provision for expansion and shifting of conduits shall be provided where conduit rises from underground or crosses a building expansion joint.

B. Conduits which are freely suspended in space and crossing a building expansion joint shall be considered as having sufficient freedom for any expansion or movement on interior of building.

C. Steel conduit connected to conduit which rises from below grade and terminating in a panelboard, cabinet, switch, or other fixed device shall have diecast expansion fitting installed above grade.

D. All underground conduit which rises up through the floor slab shall pass through a pipe sleeve in the floor to allow any movement between the underground conduit and structural members of the building.

1.10 CONCRETE

A. All concrete encasements and caps shall be ready mix type transit mix and shall be continuously agitated until poured. Concrete shall be minimum 2,500 pound strength after 30 days.

1.11 HANGERS AND SUPPORTS

A. Contractor shall provide all hangers and supports for supporting all conduit, gutters, cabinets, and equipment of all types. All hangers and supports shall be secure and of a type appropriate in design, application, and dimensions for the particular application.

B. Perforated hanger strap and wire will not be acceptable for any supporting purpose.

1.12 PAINTING

A. Electrical Contractor shall touch-up or refinish if so directed by the Architect any panels, fixtures, and other equipment furnished with a factory finish which shall become damaged in shipment or installation.

1.13 CONDUCTORS

A. All wiring and cables shall be insulated soft-drawn annealed 98% conductivity copper and shall be new. Voltage rating of wire and cable operating on voltages in excess of 50 volts shall be 600 volts A.C. For circuits operating on voltage less than 50 volts, the voltage rating shall be not less than 300 volts A.C.

B. It is permissible to utilize aluminum conductors for panel feeders and services of #3/0 THHN or larger. Attention is directed that all wire sizes and corresponding conduit sizes indicated on the drawings are based upon copper conductors. In the event that the contractor proposes to utilize aluminum conductors as permitted by this paragraph, the contractor must submit the proposed wire size and conduit size required to provide ampacity rating for approval prior to acquisition of wire and conduit. Aluminum conductors as manufactured by American and Southwire will be acceptable.
C. All wire No. 10 AWG and smaller shall be solid and wire of larger size shall be stranded unless otherwise specified herein. Stranded wire will not be permitted for termination at wiring devices rated 20 amperes or less.

D. Power feeder and branch circuit wire and cables shall have insulation Type THHN unless indicated otherwise on Drawings. Standard wire size shall be No. 12 AWG copper and this size shall be used except where other sizes are indicated on the Drawings, otherwise specified herein, or otherwise required by the Code. On any run 100 feet in length or longer, No. 10 AWG copper shall be used in place of No. 12. Feeder cables shall be identified by suitable tags where they pass through pull boxes. Conductors as manufactured by Cablec, Capitol, American Insulated, Houston Wire and Cable, Southwire, and Okonite will be acceptable.

E. All wire for special systems and special conditions shall be as specified and/or as indicated on the Drawings.

1.14 WIRE PULLING LUBRICANTS
A. Contractor shall use Ideal “CableEase” or approved equal wire pulling lubricants for all wire installation. Soaps or other substitute material having electrical conduction properties are not acceptable.

1.15 COLOR-CODING AND TAGGING
A. All wiring furnished shall be color-coded. Conductors No. 10 AWG and smaller shall have insulation colored as follows. Conductors larger than No. 10 AWG may be black with tape manufactured for this application and colored as follows. All such conductors shall be color-code taped at all junctions and terminations.
   1. 120/240 volt, single phase: Red and Black.
   2. Switched legs: Phase color with white tracer.

B. All control wiring shall be color-coded, and the same color shall be used for the same circuit throughout the system, and a different color shall be used for each separate control function.

C. Identification shall be accomplished by means of Brady "Quick-Labels" or approved equal attached permanently to all wire requiring identification in addition to the color-coding. Acceptable manufacturers: Thomas and Betts, Ideal.

1.16 INSULATION OF SPLICES AND CABLE TERMINATION
A. All connections for conductors No. 8 and larger must be made by means of a compression type connector UL listed and specifically approved for the purpose for which it is used. Such connectors shall be Polaris or equal insulated NSI type lug blocks. Wire No. 10 and smaller may be connected with U.L. listed wire nuts in lieu of compression connections.

1.17 OUTLET AND SWITCH BOXES
A. All boxes shall be galvanized and shall be set with covers plumb and square with the finished surface. Boxes in chase spaces may be surface and conduits may be exposed. All boxes in all other spaces shall be flush and conduits shall be concealed.
B. Boxes set in concrete block, structural tile, brick, plywood, formica, or other field installed surfaces shall be square cut masonry boxes, and shall have standard square type corners.

C. All boxes shall be securely attached to the structural members.

D. Junction boxes and pull boxes shall be furnished where indicated on the Drawings, or as required by the National Electrical Code. Boxes shall be of code gauge galvanized steel, and shall have removable screw cover. Flush boxes shall be used on all walls and ceilings where conduits are concealed. Where conduits are exposed, surface type boxes shall be used.

E. Any boxes not installed in a workmanlike manner shall be removed by contractor, wall repaired, and box reset.

F. Boxes and conduit fittings for outdoor work shall be cast metal, watertight, and have gasketed coverplates.

1.18 LOCATION OF OUTLET BOXES

A. Contractor shall determine from the complete dimensioned Architectural Drawings, the electrical details and Drawings, and from other contractors, the locations of all pieces of equipment prior to locating any outlet boxes or devices.

B. All outlet boxes, devices, etc., shall be located so as to be clear of equipment, permanent fixtures, building trim, etc. If the exact location of any equipment is not clearly defined, the contractor shall request direction from the Architect prior to locating the facilities for the equipment.

C. Locations of services for equipment connections shall be determined accurately from certified shop drawings on equipment to be served, or from actual measurements of the equipment itself.

D. All wall outlets for equipment on panel walls shall be located symmetrically with the pattern established by the panels. Determine exact location for all boxes from the Architect before installation.

E. Final lighting fixture locations shall be as approved by the Architect.

F. Outlet boxes for receptacles and light switches shall be mounted with long axis of the box vertical unless otherwise indicated on the Drawings.

G. Size and location outlet boxes for special and/or recessed equipment shall be obtained from the equipment manufacturer supplying the equipment.
1.19 HEIGHT OF OUTLETS

A. The following table shall act as a general guide to aid the contractor in locating elevations of outlet boxes where such elevations are not specifically indicated on the Drawings.

<table>
<thead>
<tr>
<th>OUTLET</th>
<th>LOCATION</th>
<th>ABOVE FLOOR TO TOP OF BOX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Convenience Receptacles</td>
<td>Walls in general</td>
<td>18” or as directed by Architect</td>
</tr>
<tr>
<td>Switches</td>
<td>Walls</td>
<td>48” on strike of door</td>
</tr>
</tbody>
</table>

B. The exact location of all outlets shall be as approved by the Architect who reserves the right to change the position of any outlet by a distance of five feet in any direction, from the position indicated on the Drawings before work is roughed-in, without extra charge. Outlet heights are indicated in these Specifications as a guide. Regardless of heights indicated, the contractor is ultimately responsible for confirming that all final outlet locations are in compliance with the requirements of Texas Architectural Barriers Act and Title III Provisions of the Americans with Disabilities Act.

1.20 WIRING DEVICES

A. Wiring devices, or approved equal, as scheduled and/or indicated on the Drawings shall be furnished and installed. All receptacles shall be grounding type, and shall be polarized in accordance with the latest standards of the National Electrical Code.

1.21 COVERPLATES

A. All coverplates for switches, and receptacles, except as hereinafter specified, shall be satin finish, Type 316 stainless steel, smooth with matching screws.

B. All coverplates shall have matching screws.

C. Coverplates for exterior wiring devices and wiring devices in damp or wet locations shall be rain-tight while-in-use type die cast covers.

1.22 DISCONNECT SWITCHES

A. All disconnect switches shall be Square D Type GD for 240 volt use, quick-make quick-break type safety switches with cover interlocked door.

B. All switches on exterior of building and in damp or wet locations shall be in NEMA 3R enclosures.

C. All motors and fixed equipment connections shall have disconnects as required by the National Electrical Code.

D. All disconnect switches shall have the load served by the switch identified by 1/8” thick white thermoplastic with black (3/4” stroke) sunken letter nameplate screwed or riveted to outside cover of the switch.
E. Disconnect switches as manufactured by Eaton and Siemens will be acceptable.

1.23 LOAD CENTERS

A. Contractor shall furnish the load centers as indicated on Drawings, and riser diagram. Load centers shall be complete with door and trim. Branch circuits shall be equipped with plug-on type automatic circuit breakers for each circuit. Load centers shall bear the Underwriter's Laboratories, Inc., seal of approval. Load centers shall have tin plated copper bussing with capacity as indicated. Lugs shall be UL listed to accept solid or stranded copper and aluminum conductors.

B. Load centers shall be Square D Type QO with QO circuit breakers or equal for 120/240 volt use. Multi-pole breakers shall be one handle common trip.

C. Branch circuits as indicated on the Drawings shall be connected to the corresponding breaker number of the load centers insofar as possible. Each circuit bearing load shall be identified on a typewritten directory card inside the door of the load center. Spare circuit breakers and spaces shall be hand written in pencil on directory card.

D. Load Center by Eaton and Siemens will be acceptable.

1.24 LIGHTING FIXTURES

A. Lighting fixtures as hereinafter specified and as indicated on the Drawings shall be furnished and installed by the contractor. Installation details and scheduled information indicated on the Drawings describe the requirements of each fixture type and shall apply where applicable.

B. Supports of adequate capacity and rigidity shall be provided for all fixtures. Also, refer to "Hanger and Supports" Section of these Specifications.

C. Continuous row mounting shall be provided as indicated on the Drawings, with the necessary connectors, joining strips, etc., to form a neat compact joint and to maintain a straight line of fixtures.

D. Sealed nickel cadmium high temperature emergency battery units shall be factory installed in fixtures so indicated by scheduled information on the Drawings. Minimum initial illumination of light source shall be 600 lumens. Minimum illumination after 90 minutes of discharge shall be 450 lumens. Maximum full recharge time after 90 minutes discharge shall be 24 hours. Battery unit in standard configuration shall have integral test switch, red LED charge power indicator, constant current charger, high efficiency inverter, and automatic transfer switch for automatic transfer to battery unit upon loss of normal power, and return transfer to normal power upon restoration of normal power. Nickel cadmium battery, charger, inverter, and transfer switch shall be concealed interior to battery unit hosing. LED indicator shall be fixture mounted and shall be visible for inspection from below fixture without removal or opening of fixture parts. Test switch shall be fixture mounted and shall be accessible from below fixture by means of opening fixture door. Battery unit shall be finished in enamel and shall bear the UL seal of approval and battery unit replacement wiring diagram. Fixtures with emergency battery packs shall have unswitched power to battery unit.

E. Contractor shall test all fixtures containing emergency battery packs and submit a report indicating the time and date emergency fixtures were tested, the name of personnel who performed the test,
and the results of the test. The test report shall be included within the Operation and Maintenance manual submittal.

F. LED light engines and drivers shall be factory installed for all fixtures.

G. Values of life expectancy, input power, output frequency, power factor, and total harmonic distortion for LED drivers and light engines shall be equal to the values of drivers and light engines selected by scheduled information on the Drawings.

H. Locations and elevations indicated on the Drawings for exterior wall pack fixtures are intended to serve as a general guide. Contractor shall verify the exact location and elevation of all such fixtures with the Architect prior to the installation of rough-in for same.

I. All directional distribution type fixtures with narrow x long type distribution shall be mounted such that long axis of distribution is parallel with long axis of area to be illuminated.

J. Where wall mounted emergency fixtures (other than exit signage) are located in exposed structure areas, such fixtures shall be located 1'-0" below lowest structural roof members. Where such fixtures are located in areas with ceilings, fixture elevation shall be 6" below ceilings. Where such fixtures are located in spaces which have multi-level ceiling heights and/or structure, all fixtures shall be located at the same elevation (6" below) which shall be established by the lowest ceiling or structural member elevation.

K. Data furnished on lighting fixtures shall indicate specifically by manufacturer their compliance with the above special requirements where applicable. If this information is not provided, the data cannot be accepted.

L. Substitutions may be offered by the contractor, provided the substitute fixture is equal to the specified fixture in performance, physical appearance, mechanical features and efficiency.

1.25 CONTROL EQUIPMENT, WIRING, AND CONNECTIONS

A. Electrical Contractor shall provide all control wiring, all control terminations, control enclosure and control devices required for heating and ventilation equipment furnished and installed by the HVAC Contractor. The HVAC contractor shall furnish and install the line voltage thermostats with remote sensors. The Electrical contractor shall furnish the required line and load conductors to HVAC installed line voltage thermostats. Refer to the drawings for specific requirements.

1.26 WIRING OF MOTORS

A. All motors specified under other divisions of the Specifications will be furnished by the respective contractor. Electrical shall provide power and control terminations to motors as indicated on the drawings.

1.27 CIRCUITING

A. Contractor shall connect all wires so as to provide the arrangement of circuits indicated on the Drawings.
1.28 IDENTIFICATION AND LABELING OF DISTRIBUTION GEAR

A. Contractor shall furnish white thermoplastic (1/8” thick) with black sunken letters (3/4” stroke) for all load centers, timeclocks, and disconnect switches. Labels shall be permanently attached to service side of all such gear.

B. Identification and labeling of individual branch circuit devices shall be provided as hereinafter specified.

1.29 SPACES AND SPARES

A. Where spaces are indicated on the Drawings for load centers, all such spaces shall be completely equipped provisions such that future installation of overcurrent devices requires no accessory apparatus.

B. Where spares are indicated on the Drawings for load centers, all such spares shall be completely equipped and line side connected devices, such that future use of same requires load side connection only.

1.30 CONNECTIONS TO EQUIPMENT SPECIFIED ELSEWHERE OR BY THE OWNER

A. Certain equipment will be furnished by the Owner or other contractors on the job which will require electrical services and connections by the Electrical. Contractor shall refer to the "Disconnects", and "Control Equipment, Wiring, and Connections", "Wiring of Motors", and the "Location of Outlet Boxes" Sections of these Specifications.

B. HVAC equipment such as radiant heaters units, ventilation equipment, etc., shall be furnished and installed by the HVAC Contractor. Electrical services indicated on the Drawings are based on the requirements of specified HVAC equipment. Attention is directed that in the event the HVAC Contractor furnishes equipment other than specified, changes may be required to accommodate the electrical load and quantity of electrical connections for such furnished equipment. Electrical Contractor must coordinate changes resulting from differences between the specified and furnished HVAC equipment and advise the HVAC Contractor of any additional costs. HVAC Contractor shall be responsible for paying all costs involved as a result of the changes.

C. Electric water heaters, fixture motion sensors, and other equipment will be furnished and installed by the Plumbing Contractor. Electrical shall provide electrical connections in accordance with vendor furnished drawings.

1.31 ELECTRIC HAND DRYERS

A. Contractor shall furnish and install where indicated on Drawings. Hand Dryers shall be surface mounted, grey polycarbonate. Electrical characteristics shall be 115 volts, single phase, 60 Hertz, 20 ampere rated overcurrent protection. Electric hand dryers shall be World Dryer SLIMDRI Model No. L-972 or approved equal.

1.32 ACCESSORY CONSTRUCTION APPARATUS

A. It is the intention that these Specifications shall provide a complete installation, except as herein specifically excepted. All accessory construction and apparatus necessary or advantageous in the operation or testing of the work shall be included. Omission of specific references to any part of the
work necessary for such complete installation shall not be interpreted as relieving the contractor
from furnishing such work.

1.33 TESTS/DEMONSTRATION

A. The service entrance feeder shall be "Meggered" for faults in accordance with methods approved by
I.E.E.E. and National Electrical Code. The test shall be performed using a 500 Volt DC megger
tester. The feeder resistance shall not exceed 50 megohms.

B. A demonstration shall be performed in the presence of a representative of the Architect and TPWD.
Equipment installed and/or connected by the contractor shall be put through their normal operating
paces and all such equipment shall be required to operate to the satisfaction of the Architect and
TPWD on completion of the job.

1.34 INSTRUCTIONS

A. Contractor shall provide for instructing an employee or employees of the Owner in the operation
and maintenance of the systems. Duplicate sets of manufacturer's certified drawings, specifications,
operating instructions, maintenance manuals, and maintenance instructions on all equipment
furnished by contractor shall be furnished to the Owner.

1.35 WORKMANSHIP AND INSTALLATION

A. Contractor shall have his choice as to the location of conduits, pull boxes, etc., except for locations
set by dimensions on Drawings, provided his choices do not interfere with piping, fixtures, and
equipment installed by other contractors working on the same project, and do not interfere with the
characteristic features of the building. In cases of such interference, the Architect will determine
the locations of the interfering items.

B. Contractor shall make such progress in his work that he will not delay the work of other trades
unduly.

C. Contractor shall provide service to all using connections.

D. Cutting of any structural member, regardless of material, shall be kept at a minimum. Contractor
shall pay for repairing damage to such members.

E. All electrical fixtures and fittings of all types shall be properly supported to construction.

END OF SECTION 26 00 00
SECTION 31 00 00 - SITE EARTHWORK

PART 1 - GENERAL
1.1 SUMMARY
A. Furnish all labor, materials, equipment and incidentals as shown, specified and necessary to complete the work of site preparation, erosion control, surface drainage, ground water control, construction of compacted fills, excavations, trenching, installation and removal of sheeting and bracing, backfilling and final site grading.
B. This Section includes providing backfill materials for all trenches including select backfill, backfill, fill, granular embedment, and the satisfactory disposal of surplus and unacceptable materials.
C. No classification of excavated materials will be made. Excavation includes all materials regardless of type, character, composition, moisture, or condition thereof.
D. The Contractor shall perform all earthwork as specified in this Section. All trenching shall conform to the requirements of Section 31 50 00 – Excavation Support and Protection.

1.2 RELATED SECTIONS
A. Section 31 23 13 – Subgrade Preparation
B. Section 31 50 00 – Excavation Support and Protection

1.3 REFERENCE STANDARDS
A. The contractor shall comply with applicable provisions and recommendations of the following:
   d. ASTM D421 – Standard Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants.
   f. ASTM D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
   g. ASTM D1140 – Standard Test Methods for Amount of Material in Soils Finer than No. 200 (75-μm) Sieve.
   h. ASTM D1556 – Standard Test Method for Density and Unit Weight of Soil In-Place by the Sand-Cone Method.
   i. ASTM D1557 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
   m. ASTM D6938 – Standard Test Method for In Place Density and Water Content of Soil and Soil Aggregate by Nuclear Methods (Shallow Depth).
2. OSHA: Occupational Safety & Health Administration, 200 Constitution Ave., NW, Washington DC 20210
3. TxDOT: Texas Department of Transportation, 125 E 11th St, Austin, Texas 78701
      1) Item 160 – Topsoil.
      2) Item 164 – Seeding for Erosion Control
   b. Tex-104-E – Determining Liquid Limits of Soils
   c. Tex-106-E – Calculating the Plasticity Index of Soils
d. Tex-110-E – Particle Size Analysis of Soils.


1.4 SUBMITTALS
A. Submit in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.09 SUBMITTALS and UGC Article 8.
B. Test Reports
1. The testing laboratory shall submit copies of the following reports directly to the Engineer, with copy to the Contractor:
   a. Field Density Tests
   b. Optimum Moisture – maximum density curve for each soil used as backfill.
C. Samples of all select backfill, backfill, fill, granular embedment, pit run sand, and drain gravel, shall be submitted by the Contractor to the Testing Laboratory. Samples of the proposed material shall be submitted to least fourteen (14) days in advance of its anticipated use. Each material sample shall be submitted to the Testing Laboratory in three (3) five-gallon containers.

1.5 QUALITY ASSURANCE
A. QUALITY ASSURANCE in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.10 QUALITY ASSURANCE AND UGC Article 8.
B. Testing Services
1. General:
   a. Testing of materials, testing of moisture content during placement and compaction of fill materials, and of compaction requirements for compliance with technical requirements of the Specifications shall be performed by a testing laboratory. See Division 1 of Specifications.
2. Testing Services Include:
   a. Test the Contractor’s proposed materials in the laboratory and/or field for compliance the Specifications.
   b. Perform field moisture content and density tests to assure that the specified compaction of backfill material has been obtained.
   c. Report all test results to the Engineer and the Contractor.
C. Earthwork – perform sampling and testing as specified in this Section and Section 01 45 00 – Quality Control.
1. Perform one moisture-density (Proctor) test per soil type subgrade, backfill, fill and base materials.
2. Perform one Atterberg limits test per soil type subgrade, backfill, fill and base materials.
3. Perform one percent finer than #200 sieve test per soil type subgrade, backfill, fill and base materials.
4. In building areas refer to structural plans, notes, and specifications for requirements.
5. In pavement areas provide:
   a. One moisture-density test per 5,000 square feet of surface area on the subgrade soil.
   b. One moisture-density test per 5,000 square feet of surface area for each compacted six inch (6") thickness of fill.
6. Failures in tested areas shall be re-tested until passed at the expense of the Contractor.
D. Trench Backfill: Establish level of compaction effort by frequent testing of initial lifts. Provide not less than one (1) test per lift per 500 linear feet of trench.
1. Make random tests of subsequent lifts of backfill. Frequency of tests shall be adequate to guarantee proper compaction. In no case shall there be less than one (1) test per lift per 500 linear feet of trench.
2. Failures in tested areas shall be re-tested until passed at the expense of the Contractor.

1.6 SITE CONDITIONS
A. Refer to Division 1 Specifications for information pertaining to availability of subsurface investigations.

B. Contractor is referred to the Special Conditions and to other applicable sections of these Specifications in regard to protection of existing improvements and property shown to remain, as well as the proper barricading of all work areas.

C. Erosion Protection: Provide erosion control as shown on the plans and maintain for the duration of the project. Provide routine maintenance as required to maintain integrity of erosion and sedimentation protection measures and remove any accumulations of mud or debris which would jeopardize the integrity of control measures. Refer to plans for details.

D. Dust Control: The Contractor shall exercise care during site clearing operations to confine dust to the immediate work area and shall employ dust control measures to the satisfaction of the Owner to ensure adequate dust control throughout site clearing operations.

E. Street Conditions:
   1. The Contractor shall be required to remove mud or debris from existing adjacent streets scheduled to remain in service throughout his contract period.
   2. The Contractor shall be responsible and protect the Owner from damage during haul operations. Any damage shall be repaired at the Contractor's expense.

F. The use of explosives will not be permitted.

G. Burning is prohibited.

H. All traffic during construction shall confine their limits to an established “traffic route” submitted by the Contractor and reviewed by the Engineer.

1.7 COORDINATION

A. The Contractor shall expedite placement of compacted fill and embankments at the earliest practical time.

1.8 LEGALLY PERMITTED LANDFILL CERTIFICATION

A. The Contractor shall dispose of all materials in a legally permitted landfill, permitted to accept construction waste, as determined by the Texas Department of Health, Municipal Solid Waste Management Regulation.

B. The Contractor shall be required to provide written evidence of the permitted landfill prior to commencement of site clearing operations.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Backfill Materials
   1. Materials for use as backfill shall be acceptable materials obtained from excavations on site; if material is obtained from off-site sources, their gradation shall not be more than 15% passing the No. 200 standard sieve as measured by ASTM D1140, and whose Plasticity Index (PI) is not in excess of 20 percent (20%) as determined by ASTM D4318. The material shall contain no vegetative matter.
   2. All material to be used as backfill shall be tested and verified by the Testing Laboratory.

B. Fill Material
   1. Materials for use as fill shall be acceptable materials obtained from excavations on site; if material is obtained from off-site sources, their gradation shall not be more than 35% passing the No. 200 standard sieve as measured by ASTM D1140, and whose Plasticity Index (PI) is not in excess of 20 percent (20%) as determined by ASTM D4318. The material shall contain no vegetative matter.
   2. All material to be used as fill shall be tested and verified by the Testing Laboratory.

C. Select Backfill
   1. Obtain select fill from a source that meets the requirements of the Geotechnical Report. In general, select fill shall consist of non-expansive (inert) soils such as a low plasticity clayey soil, clayey gravel, crushed base material or caliche. Caliche used as select fill shall have a Plasticity Index (PI) between seven percent (7%) and twelve percent (12%).
   2. Select fill for building areas shall meet the requirements of the Structural drawings and Section 03 30 00.
   3. The select fill materials shall be free of organic debris and shall not contain stones larger than three (3) inches in maximum dimension.
4. Select fill shall be defined as Grade 1, Grade 2, or Grade 3, adhering to the following physical requirements:
   a. Clayey gravel materials shall be classified as crushed or uncrushed gravel.
   b. Crushed base materials shall be produced from oversized quarried aggregate, sized by crushing and produced from a naturally occurring single source. Crushed gravel or uncrushed gravel shall not be submitted as crushed base material. No blending of sources and/or additive materials will be allowed.
   c. Select fill shall meet the following physical requirements:

<table>
<thead>
<tr>
<th>Property</th>
<th>Test</th>
<th>Grade 1</th>
<th>Grade 2</th>
<th>Grade 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Master Gradation Sieve Size (% retained)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-1/2 in.</td>
<td>Tex-110-E</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1-3/4 in.</td>
<td>Tex-110-E</td>
<td>0-10</td>
<td>0-10</td>
<td>0-10</td>
</tr>
<tr>
<td>7/8 in.</td>
<td>Tex-110-E</td>
<td>10-35</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3/8 in.</td>
<td>Tex-110-E</td>
<td>30-50</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>No. 4</td>
<td>Tex-110-E</td>
<td>45-65</td>
<td>45-75</td>
<td>45-75</td>
</tr>
<tr>
<td>No. 40</td>
<td>Tex-110-E</td>
<td>70-85</td>
<td>60-85</td>
<td>50-85</td>
</tr>
<tr>
<td>Liquid Limit, % max.</td>
<td>Tex-104-E</td>
<td>35</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Plasticity Index, max.</td>
<td>Tex-106-E</td>
<td>10</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Wet Ball Mill, % max.</td>
<td>Tex-116-E</td>
<td>40</td>
<td>45</td>
<td>-</td>
</tr>
<tr>
<td>Wet Ball Mill, % max. increase passing the No. 40 sieve</td>
<td>Tex-116-E</td>
<td>20</td>
<td>20</td>
<td>-</td>
</tr>
<tr>
<td>Classification</td>
<td>Tex-117-E</td>
<td>1.0</td>
<td>1.1-2.3</td>
<td>-</td>
</tr>
<tr>
<td>Min. Compressive Strength, psi</td>
<td>Tex-117-E</td>
<td>45</td>
<td>35</td>
<td>-</td>
</tr>
<tr>
<td>Lateral Pressure 0 psi</td>
<td>Tex-117-E</td>
<td>175</td>
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<td>-</td>
</tr>
<tr>
<td>Lateral Pressure 15 psi</td>
<td>Tex-117-E</td>
<td>175</td>
<td>175</td>
<td>-</td>
</tr>
</tbody>
</table>

5. All material for select backfill must be tested and accepted by the Testing Laboratory.
6. No select backfill shall be placed without authorization.

D. Granular Embedment Material:
   1. Granular embedment shall be as shown on the plans.

E. Trench Plugs:
   1. Clay meeting the requirements of ASTM D2487 Classification of CL or CH and with at least 60 percent fines (passing No. 200 sieve) and a Plasticity Index of 15 or greater.
   2. Flowable Fill
   3. On-site silty sand soils processed with 20 pounds of bentonite clay per cubic yard.

F. Herbicide
   1. Comply with Federal Insecticide, Fungicide, and Rodenticide Act (Title 7, U.S.C. Section 136) for requirements on Contractor’s licensing, certification and record keeping.

G. Topsoil
   1. Topsoil shall meet the requirements of TxDOT Item 160.

H. Tree Wound Paint
   1. Bituminous based paint of standard manufacture specially formulated for tree wounds.

I. Tracer Wire for Nonmetallic Piping
   1. Tracer wire shall be minimum 12 gauge (AWG) single strand, insulated copper wire with high molecular weight polyethylene (HMWPE) insulation, specifically manufactured for direct burial applications.
   2. Provide tracer wire in sufficient length to be continuous over each separate run of non-metallic pipe.
   3. All spliced or repaired wire connections in the tracer wire system shall be made using approved connectors.

J. Warning Tape
   1. Detectable underground aluminum warning tape shall be minimum 3 inches wide, minimum 5 mils thick. Tape to be color coded according to American Public Works Association (APWA) Uniform Color Codes.

PART 3 - EXECUTION
100% Construction Documents
12.04.2020
3.1 PROTECTION

A. Roads and Walks
   1. Keep roads and walks free of dirt and debris at all times.

B. Trees, Shrubs
   1. Protection shall be in accordance with project plans.

C. Utility Lines
   1. All existing utility locations shown on plans are approximate, based on information provided by utility service providers and field surveys. Utilities were not uncovered to determine precise locations, except as noted on the plans. The contractor shall verify the location of underground utilities and drainage structures at least forty-eight (48) hours prior to construction, whether shown on the plans or not, and shall protect same during construction.
   2. Protect existing utility lines that are not identified to be removed. Notify the ODR immediately of damage to or an encounter with an unknown existing utility line. The Contractor shall be responsible for the repairs of damage to existing utility lines that are indicated or made known to the Contractor prior to start of clearing and grubbing operations. When utility lines which are to be removed are encountered within the area of operations, the Contractor shall notify the ODR in ample time to minimize interruption of the service.

3.2 SITE PREPARATION

A. Do not begin operations until limits of clearing and grubbing have been identified and staked out by the Contractor and approved by the Owner’s Designated Representative.

B. All areas of proposed construction shall be stripped of existing vegetation, concrete, asphalt and base, and six inches (6") of topsoil. Except as noted on the plans. Topsoil is to be stockpiled for reuse on the project, as noted below.

C. Clear and grub all existing trees and understory where indicated on the drawings.
   1. A certified arborist shall perform all pruning. Contractor shall submit proof of qualifications and three (3) current references to Owner’s Designated Representative for approval prior to commencing pruning.
   2. Remove all dead trees and tree limbs or trees that have substantial structural or cosmetic damage.
   3. Remove all climbing vines to a height of thirty feet (30’) above the ground. Grub out vine roots.
   4. Remove all broken limbs and vines on trees that could fall and pose a hazard to pedestrians.
   5. Spray all Poison Ivy with two (2) applications of a contact herbicide labeled for such use. After a complete kill has been achieved, grub out all plants and roots. Do not burn any part of Poison Ivy plants.
   6. Remove briars and other vines and brambles where these plants have grown up into trees.
   7. Remove logs and stumps higher than four inches (4") above grade and other debris from this area. Backfill holes in accordance with this Section.
   8. Trim tree limbs to allow five feet (5’) clearance above ground.
   9. Remove any trash or man-made debris from this area.
   10. All material generated by pruning and clearing operations shall be disposed of legally off-site.

D. General Stripping of Existing Weeds and Grasses:
   1. The area within the work limits shown shall be stripped of lawns and vegetation under the direction of the Owner’s Designated Representative.
   2. Method of removal shall remove a minimum amount of topsoil and shall be even so as to not generally change the overall grading.
   3. Remove and dispose of all products of stripping from the site. Do not allow material to accumulate at locations in or about the work areas.

E. Stripping and Removal of Existing Sod:
1. All areas designated shall be stripped of existing sod to a depth of two and one-half inches (2 ½"), or as deep as necessary to remove the majority of roots.

2. Sod shall be stripped by acceptable means and materials. Products of stripping operations shall be removed from the project area and be legally disposed of.

F. Stripping and Stockpiling of Existing Topsoil:

1. Strip from all disturbed areas all suitable topsoil. Strip to a depth of four inches (4") or as necessary to remove all topsoil. Do not strip topsoil when conditions are muddy and avoid admixture with subsoil.

2. Strip no topsoil where grades require only slight change.

3. Stockpile the topsoil in areas designated on the Drawings or as agreed upon with the Owner. Stockpiled topsoil shall be free from trash and other related material and shall be protected during the duration of the Contract.

4. Stripped and stockpiled topsoil not used for landscape fill or for planting operations shall be removed from the site and be legally disposed of.

G. Any depressions created by site preparation operations shall be filled as directed below.

3.3 DEWATERING

A. The Contractor shall provide and maintain adequate dewatering equipment to remove and dispose of all surface and ground water entering excavations, trenches, or other parts of the Work. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the structure to be built, or the pipe is installed therein, and backfill operations have been completed.

1. The different working areas on the site shall be kept free of surface water at all times. The Contractor shall install drainage ditches and dikes and shall perform all pumping and other necessary work to divert or remove rainfall and all other accumulations of surface water from the excavations and fill areas. The diversion and removal of surface water shall be performed in a manner that will prevent the accumulation of water behind temporary structures or at any other locations within the construction area where it may be detrimental.

2. Water used for working or processing, resulting from dewatering operations, or containing oils or sediments that will reduce the quality of the water downstream of the point of discharge shall not be directly discharged. Such waters shall be diverted through a settling basin or filter before being discharged.

3. The Contractor will be held responsible for the condition of any pipe, conduit or channel which he may use for drainage purposes and all such pipes, conduits or channels shall be left clean and free of sediment.

B. The Contractor shall provide, install and operate sufficient trenches, sumps, pumps, hose, piping, wellpoints, deep wells, etc., necessary to depress and maintain the ground water level below the base of the excavations during all stages of construction operations. The ground water table shall be lowered in advance of excavation and maintained two feet (2') below the lowest subgrade excavation made until structure has sufficient strength and weight to withstand horizontal and vertical soil and water pressures from natural ground water. The system must be operated on a 24-hour basis and standby pumping facilities and personnel shall be provided to maintain the continued effectiveness of the system. If, in the opinion of the Engineer, the water levels are not being lowered or maintained as required by these Specifications, the Contractor shall install additional or alternate dewatering devices as necessary, at no additional cost to the Owner.

1. Elements of the system shall be located so as to allow a continuous dewatering operation without interfering with the construction of the permanent work. Where portions of the dewatering system are located in the area of permanent construction, the Contractor shall submit details of the methods he proposes to construct the permanent work in this location for the review of the Engineer. Control of groundwater shall continue until the permanent construction provides sufficient dead load to withstand the hydrostatic uplift of the normal groundwater, until concrete has attained sufficient strength to withstand earth and hydrostatic loads, until all waterproofing work below normal groundwater level has been completed, and until pipelines are properly jointed.
2. Dispose of all water removed from the excavation in such a manner so as not to endanger any portion of the work under construction or completed. Convey water from the excavations in a closed conduit. Do not use trench excavations as temporary drainage ditches. Before discontinuing dewatering operations, or permanently permitting the rise of the groundwater level, computations shall be made to show that any pipeline or structure affected by the water level rise is protected by backfill or other means to sustain uplift. Use a safety factor of 1.25 when making these computations.

3. Dewatering operations shall not be discontinued without the prior authorizations of the Engineer.

3.4 GRADING
   A. The site shall be prepared and shaped in conformity with the lines and grades as shown on the plans and the recommendations contained in the Geotechnical Report.

3.5 EXCAVATION
   A. General
      1. The Contractor shall excavate and backfill, in advance of the construction, test pits to determine conditions or location of the existing utilities. The Contractor shall perform all work required in connection with excavating, stockpiling, maintaining, sheeting, shoring, backfilling and replacing pavement for the test pits.
      2. The Contractor shall be responsible for the definite location of each facility constructed by others involved within the area of his excavation for work under this contract. Care shall be exercised during such location work to avoid damaging and/or disrupting the affected facility. The Contractor shall be responsible for repairing, at his expense, damage to any structure, piping, or utility caused by his work.
      3. Excavation of every description and of whatever substance encountered within the limits of disturbance of the project shall be performed to the lines and grades indicated on the Drawings. All excavation shall be performed in the manner and sequence as required by the work.
         a. Excavation work shall be performed in a safe and proper manner with appropriate precautions being taken against all hazards. Excavations shall provide adequate working space and clearances for the work to be performed therein and for installation and removal of concrete forms. In no case shall excavation faces be undercut for extended footings.
         b. Exposed soil after excavations have been made shall be protected against detrimental damage and change in condition from physical disturbance and rain. Wherever possible, concrete footings shall be done the same day the excavation is made. If this is not done, the footing excavations shall be properly protected.
      4. All excavated materials that meet the requirements for backfill shall be stockpiled within the site, but not less the twenty-five feet (25') from the surface borders of any excavation, for use as backfill, or for providing final site grades. All excavated materials which are not considered suitable for fill, and any surplus or excavated material which is not required for fill shall be disposed of off the site by the Contractor. Upon completion of the fill, all on-site waste and disposal areas shall be cleaned and the debris removed from the site.
      5. Materials deposited off the site shall be transported and placed in accordance with all applicable rules and regulations of all authorities having jurisdiction thereof. No surplus or unacceptable excavated materials of any kind shall be deposited in any stream or water course on dumped on public property.

   B. Excavations for Structures
      1. Excavations for construction of structures shall be carefully made to the depths indicated or required. Bottoms for footings and slabs shall be level, clean, dry and clear of loose material and the lower sections true to size.
      2. Subgrade preparation for structures shall meet the requirements of the Structural Drawings and Notes.
      3. Footings and slab excavations shall be verified by the Testing Laboratory, and reviewed by the Engineer, before concrete is placed thereon.
4. In excavations for structures where, in the opinion of the Testing Laboratory, the ground, not affected by high water level, is spongy or otherwise unsuitable for the contemplated foundation, the Contractor will be required to remove such unsuitable earth and replace it with suitable material in accordance with the requirements of the Structural Drawings and Notes.

5. Excavations for structures which have been carried below the depths indicated shall be refilled to the proper grade with select backfill material properly compacted in accordance with the Structural Drawings and Notes.

6. All structure excavations shall be hand-trimmed to permit the placing of full widths and lengths of footings on horizontal beds. Rounded and undercut edges will not be permitted.

7. Excavation shall be extended a minimum of two feet (2') on each side of structures, footings, etc., unless otherwise shown or specified.

C. Excavations for Pavements

1. Pavement excavation shall consist of excavations for all site pedestrian and vehicular pavements, in conformity with the typical sections shown on the Drawings, and to the lines and grades established by the Engineer and shown on the Drawings, by the removal of existing material or addition of acceptable material.

2. All unstable or otherwise objectionable material shall be removed from the subgrade and replaced with acceptable material.

3. All holes, ruts, and depressions shall be filled with select fill material.

4. Subgrade preparation shall comply with the requirement of Section 31 12 13 – Subgrade Preparation.

D. Trench Excavations

1. Reference Section 31 50 00 – Excavation Support and Protection.

2. Trenches shall be excavated to a width that will provide adequate working space and clearances for proper pipe installation, jointing and embedment.

3. Where pipe elevations are not shown on the Drawings, trenches shall be excavated to a depth sufficient to provide a minimum cover of three feet (3') over the top of the pipe, unless otherwise shown or specified.

4. Where necessary to reduce earth load on pipe trench banks to prevent sliding or caving, banks may be cut back on slopes that shall not extend lower than twelve inches (12") above the top of the pipe.

5. Except where otherwise required, pipe trenches shall be excavated six inches (6") below or 1/8 of the outside diameter of the pipe, whichever is greater, the underside of the pipe to provide for the installation of granular embedment material.

6. Over depth excavations shall be backfilled with select backfill material compacted to 95 percent (95%) of maximum density, as determined by ASTM D698 at a moisture content between optimum and optimum +4%.

7. Whenever subgrade material that is incapable of properly supporting the pipe is encountered, the subgrade material shall be removed to the depth required and the trench backfilled to the proper grade with select backfill material compacted to 95 percent (95%) of maximum density, as determined by ASTM D698 at a moisture content between optimum and optimum +4%.

8. Bell holes shall provide adequate clearance for tools and methods used in installing pipe. No part of any bell or coupling should be in contact with the trench bottom, trench walls, or granular embedment when the pipe is jointed.

9. Where existing piping constructed by others cross the new pipeline trench, the existing piping or ductbank shall be adequately supported and protected from damage due to construction. All methods of supporting and maintaining these facilities shall be subject to review by the Engineer and/or the Testing Laboratory.

3.6 UNAUTHORIZED EXCAVATION

A. All excavation outside the lines and grades shown, and which is not in conformance with the plans and specifications as determined by the Testing Laboratory, together with the removal and disposal of the associated material shall be at the Contractor’s expense.
B. The unauthorized excavation shall be fill with select backfill and compacted as specified by the Testing Laboratory by the Contractor at his expense.

3.7 PLACEMENT OF FILL AND BACKFILL

A. General

1. All select backfill, backfill and fill required for structures and trenches and required to provide the finished grades shown and as described herein shall be furnished, placed and compacted by the Contractor.

2. Backfill excavations as promptly as work permits, but not until completion of the following:
   a. Observation by the Engineer of construction below finish grade.
   b. Observation, testing and recording of locations of underground piping and ductwork.
   d. Removal of shoring and bracing, and backfilling of voids with satisfactory materials.
   e. Removal of trash and debris.
   f. Backfill against foundation walls only after review by the Engineer. Do not damage waterproofing when placing backfill.

3. Fill containing organic materials or other unacceptable material shall be removed and replaced with acceptable fill material.

B. Placement of Select Backfill, Backfill, and Fill Materials

1. Material shall be placed to the grades shown on the Drawings. The lift thickness and compaction moisture content range given herein are approximate. These values will be finally determined from the laboratory test results on the fill materials.

2. All material shall be placed in horizontal loose lifts not exceeding nine inches (9") in thickness and shall be mixed and spread in a manner assuring uniform lift thickness after placing. Each lift shall be compacted by not less than two complete coverages of the specified compactor. Select backfill shall be placed to the underside of all concrete slabs. The fill material shall extend a minimum of two feet (2') outside the face of each structure and be twelve inches (12") below finished grade. The maximum slope of select backfill to the subgrade shall be one vertical to one and one-half horizontal.

3. Backfill around and outside of structures and over select backfill shall be deposited in layers not to exceed nine inches (9") in uncompacted thickness and mechanically compacted, using platform type tampers. Compaction of structural backfill, by rolling will be permitted provided the desired compaction is obtained and damage to the structure is prevented. Compaction of select backfill and/or backfill by inundation with water will not be permitted. All materials shall be deposited as specified herein and as shown on the Drawings.

4. All material shall be placed at a moisture content that falls in the range of laboratory optimum moisture content and laboratory optimum +4%. It shall be compacted to a density of 95 percent (95%) of the maximum laboratory dry density for that material as determined by ASTM D698. The Contractor shall provide equipment capable of adding measured amounts of water to the material to bring it to a condition within the range of the required moisture content. The Contractor shall provide equipment capable of discing, aerating, and mixing the soil to insure reasonable uniformity of moisture content throughout the material and to reduce the moisture content of the material by air drying if necessary. If the subgrade material must be moisture conditioned before compaction, the material shall be sufficiently mixed or worked on the subgrade to insure a uniform moisture content throughout the lift of material to be compacted. Materials at moisture content in excess of the specified limit shall be dried by aeration or stockpiled for drying.

5. No material shall be placed when free water is standing on the surface of the area where the material is to be placed. No compaction of material will be permitted with free water on any portion of the material to be compacted. No material shall be placed or compacted in a frozen condition or on top of frozen material. Any material containing
organic materials or other unacceptable material previously described shall be removed and replaced with acceptable material prior to compaction.

6. Each lift of compacted material shall be compacted by the designated number of coverages of all portions of the surface of each lift by a smooth-drum vibratory roller for granular material having a static weight not less than 5,500 pounds, a sheepsfoot roller for cohesive material exerting a pressure of 250 psi on the surface of the feet, or equivalent equipment, prior to commencement of the work. One coverage is defined as the condition obtained when all portions of the surface of the backfill material have been subjected to the direct contact of the compactor. The compactor shall be operated at a forward speed not exceeding 40 feet per minute.

7. Compaction shall be performed with equipment suitable for the type of material being placed. The contractor shall select equipment that is capable of providing the minimum density required by these Specifications. The gross weight of compacting equipment shall not exceed 7,000 pounds within a distance of ten feet (10') from the wall of any existing structure or completed structure under this contract. Equipment shall be provided that is capable of compacting in restricted areas next to structures and around piping. The effectiveness of the equipment selected by the Contractor shall be tested at the commencement of compacted material work by construction of a small section of material within the area where material is to be placed. If tests on this section of backfill show that the specified compaction is not obtained, the Contractor shall increase the amount of coverages, decrease the lift thicknesses or obtain a different type of compactor.

8. Particular care shall be taken to compact structure backfill that will be beneath pipes, roads, or other surface construction or structures. In addition, wherever a trench passes through structure backfill, the structure backfill shall be placed and compacted to an elevation twelve inches (12") above the top of the pipe before the trench is excavated. Compacted areas, in each case, shall be adequate to support the item to be constructed or placed thereon.

9. The compaction requirements specified are predicated on the use of normal materials and compaction equipment. In order to establish criteria for the placement of a controlled fill so that it will have compressibility and strength characteristics compatible with the proposed structural loadings, a series of laboratory compaction and/or compressive strength tests will be performed on the samples of materials submitted by the Contractor. From the results of the laboratory tests, the final values of the required percent compaction, the allowable compaction moisture content range, and the maximum permissible lift thickness will be established for the fill material and construction equipment proposed.

10. The requirements of this Section apply for the placement and compaction of all fill materials.

C. Backfill in Pipe trenches

1. Pipeline trenches may be backfilled prior to pressure testing, but no structure shall be constructed over any pipeline until it has been tested.

2. All pipe larger than six inches (6") in diameter shall be placed on granular embedment material. Pipe six inches (6") in diameter and smaller shall be placed in bedding zone of granular embedment material unless the trench bottom has been graded to provide uniform and continuous support of the installed pipe.

3. Backfill is divided into three (3) separate zones: (a) bedding, the material in trench bottom in direct contact with the bottom of the pipe; (b) initial backfill, the backfill zone extending from the surface of the bedding to a point one foot (1') above the top of the pipe; and (c) secondary backfill, the backfill zone extending from the initial backfill surface to the top of the trench. Placement of materials for each of the zones shall be as described herein.

   a. Bedding
      
      1) When unacceptable materials such as water, silt, muck, trash or debris, or rock boulder or coarse gravel (particle size greater than 1 ¾ inch) exist at the...
bearing level or for pipes with a nominal inner diameter greater than six inches (6"), a bedding of granular embedment material shall be used.

2) Unstable materials shall be removed at the direction of the Engineer and replaced to a minimum depth of four inches (4") or one-eighth (1/8) of the outside diameter of the pipe, whichever is greater, with granular embedment material. This material shall extend up to the sides of the pipe sufficient to embed the lower quadrant of the pipe. If stability is not accomplished by using the above procedure, the Engineer may require additional granular embedment.

3) Granular embedment shall be spread and graded to provide a uniform and continuous bedding zone beneath the pipe at all points between bell holes or pipe joints. It will be permissible to slightly disturb the finished subgrade surface to withdraw pipe slings or other lifting tackle. After each pipe has been graded, aligned, and shoved home, sufficient pipe embedment material shall be deposited and compacted under and around each side of the pipe and back of the bell or end thereof to hold the pipe in proper position and alignment during subsequent pipe jointing and embedment operations. Embedment material shall be deposited and compacted uniformly and simultaneously on each side of the pipe to prevent lateral displacement.

4) Each layer of embedment material shall be compacted by at least two complete coverages of all portions of the surface of each lift using adequate compaction equipment. One coverage is defined as the conditions reached when all portions of the lift fill have been subjected to the direct contact of the compacting surface of the compactor.

5) The method of compaction and the equipment used shall be appropriate for the material to be compacted and shall not transmit damaging shocks to the pipe.

b. Initial Backfill

1) Select Initial Backfill: Where pipe is to be laid in a rock cut or where rock in boulder ledges or coarse gravel (particle size larger than 1 ¾ inch) formations exist in the initial backfill zone, or where trench walls or conditions are unstable or where the pipe to be laid is flexible pipe, select initial backfill material shall conform to the requirements of Granular Embedment. For conduits less than twenty-four inches (24") in diameter select initial backfill material shall be placed in two (2) lifts. The first lift shall be spread uniformly and simultaneously on each side and under the shoulders of the pipe to the mid-point or spring line of the pipe. The first lift of select initial backfill shall be inspected and approved prior to placement of the second lift. The second lift of select initial backfill material shall extend from the spring line of the pipe to a depth sufficient to produce a compacted depth of material a minimum of one foot (1') above the top of the pipe. The second lift shall be evenly spread in a similar manner as the first lift. For conduits twenty-four (24") in diameter and larger, select initial backfill material shall be evenly and simultaneously spread alongside, under the shoulders or haunches of the pipe and over the pipe in twelve-inch (12") lifts to a point sufficient to produce a compacted depth of material a minimum of one foot (1') above the top of the pipe.

2) Optional Select Initial Backfill: Where the pipe to be laid is Flexible Pipe or where unstable materials exist at the pipe bearing level or the initial backfill zone, in lieu of the material specified above, an optional select backfill may be used by the Contractor where rock, in ledge, boulder, or coarse gravel (particle size larger than 1 ¾" inch) formations are not present in the bedding or initial backfill zone of the trench and where water is not present at the pipe bearing level. Optional Select Initial Backfill shall be clean, well graded gravels, crushed screenings or sand with 100% passing a ½" sieve, 95% to 100% passing a ¼" sieve. The plasticity index shall not be more than 12.
when tested in accordance with the ASTM D4318. Optional select initial backfill shall be placed around the pipe and to the defined limit for initial backfill above. Sand and other materials as may be required by the Engineer shall be thoroughly compacted. Minimum thickness of completed optional select initial backfill shall be one foot (1') above the top of the pipe.

3) Natural Initial Backfill: Where the pipe to be laid is rigid pipe and where stable materials and laying conditions exist at the pipe bearing level and initial backfill zone and existing excavated materials are acceptable to the Engineer, such excavated natural materials may be utilized as initial backfill material.

c. Secondary Backfill

1) Secondary backfill shall generally consist of materials removed from the trench and shall be free of trash brush and other debris. No rock or stones having any dimension larger than one half of the trench width, or eight inches (8"), unless otherwise approved, at the largest dimension, whichever is less, shall be used in the secondary backfilling zone. In special cases where excessive width and/or depth of the trench permit, and only with approval of the Engineer, larger rocks up to twelve inches (12") in diameter may be incorporated into the backfill provided that the surrounding compactable soil may be properly and adequately compacted. Material for backfill shall be placed in uniform layers not more than nine inches (9") in depth (loose measurement) and shall be compacted to the density specified herein.

2) The initial lift of secondary backfill shall be a maximum of nine inches (9") in loose thickness. Consideration should be given to keeping the initial lift of secondary backfill as close as possible to the maximum nine inches (9") thickness to reduce the possibility of damage resulting from the compaction operations. This initial lift of secondary backfill material shall be compacted to a minimum of 95 percent of the laboratory determined maximum dry density (ASTM D698) using suitable compaction equipment. The backfill material shall be wetted or dried in such a manner as to provide uniform moisture content near the optimum moisture content identified by laboratory testing. Moisture contents in excess of 5 percent above or below the optimum laboratory moisture content are considered unacceptable and will require adjustment as necessary.

3) Moisture density tests will be performed by a geotechnical engineer at periodic intervals on the top of the initial lift of backfill to determine the degree of compaction. If these test results indicate marginal compaction has been obtained near the surface of this lift, the Contractor will be given the option of applying more compactive effort or excavating a portion of the upper fill materials to allow access for moisture-density testing near the bottom of the lift. Any materials determined to be under compacted will require additional work by the Contractor to meet the above compaction requirements.

4) After the initial lift of secondary backfill has been properly compacted as evidenced by moisture-density tests, subsequent lifts of secondary backfill material shall be placed and compacted in accordance with the above Specification. All subsequent lifts of secondary backfill shall be placed in loose lifts not to exceed twelve inches (12") in thickness and compacted in accordance with the above Specifications. Succeeding lifts of supplemental backfill may be placed only after completion of adequate moisture-density tests on backfill material already in place.

5) Due to the rather large vertical displacement of backfill material, experienced by using thick lifts, it is anticipated that, in some areas, the final lift of backfill material could be approximately one foot (1') thick. Compaction of this last lift of backfill material may be accomplished in the manner described above,
4. Clay Plugs
   a. A clay plug shall be installed on all utility trenches before they enter the building or go under a foundation.
   b. The plug must be installed a distance of one (1) foot from the foundation.

D. Compaction Density Requirements

1. The degree of compaction required for all types of fills shall be listed below. Material shall be moistened or aerated as necessary to provide the moisture content specified below:

<table>
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<tr>
<th>Uncompacted Material/Location</th>
<th>Standard/Location</th>
<th>Maximum Required Density</th>
<th>Loose Lift Thickness</th>
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<tr>
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<td>12 inches</td>
</tr>
<tr>
<td>Backfill/Around Structures</td>
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<tr>
<td>All Other Backfill</td>
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<td>95%</td>
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<tr>
<td>Fill/Roadway Embankment</td>
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<tr>
<td>Fill/Pipe Trenches</td>
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<td>12 inches</td>
</tr>
<tr>
<td>Pipe Trenches</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. The Testing Laboratory shall perform tests necessary to provide data for selection of fill material and control of placement water content.

3. The Testing Laboratory will perform field density tests at the completion of each lift to insure that the specified density is being obtained. Number of tests shall be determined by the Testing Laboratory.

4. If the tests indicate unsatisfactory compaction, the Contractor shall provide the additional compaction necessary to obtain the specified degree of compaction. All additional compaction work shall be performed by the Contractor at no additional cost to the Owner until the specified compaction is obtained. The work shall include complete removal of unacceptable (as determined by the Testing Laboratory) fill areas and replacement and re-compaction until acceptable fill is provided.

E. Pit Run Sand Placement: Pit run sand shall be placed and compacted to the limits shown on the Drawings.

F. Drainage Gravel: Drain gravel shall be compacted in maximum twelve inch (12") lifts with a minimum of two passes of a hand operated vibratory plate compactor weighing between 150 and 500 pounds.

G. Replacement of Unacceptable Excavated Materials: In cases where over-excavation for the replacement of unacceptable soil materials is required, the excavation shall be backfilled to the required subgrade with select backfill material and thoroughly compacted to 95 percent (95%) of ASTM D698, at a moisture content between optimum and optimum +4%, in layers not thicker than twelve inches (12"). Sides of the excavations shall be sloped in accordance to the maximum inclinations specified for each structure location.

3.8 FINAL GRADING AND EMBANKMENTS

A. To the extent available, backfill material from excavations shall be placed in accordance with this Section to final grades with a maximum compacted depth of six inches (6").

B. After other outside work has been finished, and backfilling and embankments completed and settled, all areas on the site of the work which are to be graded shall be brought to a subgrade suitable with the indicated elevations, slopes, and grades with suitable excess excavation material. Final grades shall be within 0.1 foot of the finished grades shown on the Drawings.

C. Final stabilization of non-paved areas shall comply with the requirements of TxDOT Item 164.

3.9 DISPOSITION OF SURPLUS MATERIAL
A. All surplus materials shall be removed from the Owner’s property and be disposed of in a legal manner.

3.10 PROTECTION OF UTILITIES AND PROPERTY
   A. The Contractor is referred to other portions of this Section, the Special Conditions and other Sections and/or Divisions within these Specifications for requirements concerning the protection of utilities, property and existing trees.
   B. Locate and identify all above and below grade utilities in advance of any excavation operations and/or activities. Stake and flag locations. Maintain and protect existing utilities thus identified. Notify A/E or Owner’s Representative if concealed conditions affect work.

END OF SECTION 31 00 00
SECTION 31 11 00 - CLEARING AND GRUBBING

PART 1 - GENERAL

1.1 GENERAL DOCUMENTS
A. The Terms and Conditions of the Contract, including Supplementary and Special Conditions of the Contract, and the Drawings apply to this Section.

1.2 SUMMARY
A. Section Includes:
   1. Protection of 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. Site Preparation.
   7. Erosion protection, noise and dust control.

1.3 RELATED WORK
A. Related work of other sections includes but is not limited to:
   1. TPDES Storm Water Pollution Prevention Plan
   2. Section 02 41 00 – Site Demolition
   3. Section 31 00 00 – Site Earthwork

1.4 DEFINITIONS
A. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
B. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.
C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of subsoil and weeds, roots, toxic materials, or other non-soil material.
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 as indicated on the Tree Protection Plan.
F. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.5 CONDITIONS
A. Contractor is referred to the Special Conditions and to other applicable sections of these Specifications in regard to protection of existing improvements and property shown to remain, as well as the proper barricading of all work areas.
B. 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.
   3. The Contractor shall be required to remove mud or debris from existing adjacent streets scheduled to remain in service throughout his contract period.
   4. The Contractor shall be responsible and protect the Owner from damage during haul operations. Any damage shall be repaired at the Contractor’s expense.
C. Erosion Protection: Provide erosion control as shown on the plans and maintain for the duration of the project. Provide routine maintenance as required to maintain integrity of erosion and sedimentation protection measures and remove any...
accumulations of mud or debris which would jeopardize the integrity of control measures. Refer to plans for details.

D. Dust Control: The Contractor shall exercise care during site clearing operations to confine dust to the immediate work area and shall employ dust control measures to the satisfaction of the Owner to ensure adequate dust control throughout site clearing operations.

E. The use of explosives will not be permitted.

1.6 SALVAGE OF MATERIALS

A. Contractor to deliver to the Owner all items that are specified to be salvaged and retained by the Owner (as applicable and shown on the Drawings). Owner’s Designated Representative shall direct Contractor in the field of where to deliver the salvaged material. The Contractor has salvage rights for all other existing materials, parts, or accessories scheduled for demolition.

B. All items specified to be removed or required to be removed because of conflicts with proposed improvements shall be removed from the Owner’s property in a timely manner.

1.7 LEGALLY PERMITTED LANDFILL – CERTIFICATION

A. The Contractor shall dispose of all materials in a legally permitted landfill, permitted to accept construction waste, as determined by the Texas Department of Health, Municipal Solid Waste Management Regulation.

B. The Contractor shall be required to provide written evidence of the permitted landfill prior to commencement of site clearing operations.

1.8 DEMOLITION

A. Removal of Miscellaneous Items: Contractor shall remove all other miscellaneous items not identified elsewhere, for the purposes of carrying out the Work, and dispose of in accordance with Item 1.6 of this Section.

1.9 REFERENCES

A. OSHA Excavation and Trench Safety Standards.


1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to store at the site, and handle in a manner which will maintain the materials in their original manufactured or fabricated condition until ready for use.

PART 2 - PRODUCTS

2.1 TREE WOUND PAINT

A. Bituminous based paint of standard manufacture specially formulated for tree wounds.

2.2 HERBICIDE

A. Comply with Federal Insecticide, Fungicide, and Rodenticide Act (Title 7 U.S.C. Section 136) for requirements on contractor’s licensing, certification and record keeping. Contact the command Pest Control Coordinator prior to starting work.

PART 3 - EXECUTION

3.1 PROTECTION

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

B. Roads and Walks

1. Keep roads and walks free of dirt and debris at all times.

C. Trees and Shrubs

1. Trees and vegetation to be left standing shall be protected from damage incident to clearing, grubbing, and construction operations by the ejection of barriers or by such other means as the circumstances require.

D. Utility Lines
1. All existing utility locations shown on plans are approximate, based on information provided by utility service providers and field surveys. Utilities were not uncovered to determine precise locations, except as noted on the plans. The contractor shall verify the location of underground utilities and drainage structures at least forty-eight (48) hours prior to construction, whether shown on the plans or not, and shall protect same during construction.

2. Protect existing utility lines that are not identified to be removed. Notify the Owner’s Designated Representative immediately of damage to or an encounter with an unknown existing utility line. The Contractor shall be responsible for the repairs of damage to existing utility lines that are indicated or made known to the Contractor prior to start of clearing and grubbing operations. When utility lines which are to be removed are encountered within the area of operations, the Contractor shall notify the Owner’s Designated Representative in ample time to minimize interruption of the service.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL
   A. Install erosion and sedimentation controls prior to commencing operations that disturb soil.

3.3 TREE AND PLANT PROTECTION
   A. Protect trees and plants as described in the Drawings.
   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 SITE CLEARING AND GRUBBING
   A. All areas of proposed construction shall be stripped of existing vegetation, concrete, asphalt and six inches (6") of topsoil, except as noted on the plans. Topsoil is to be stockpiled for reuse on the project, as directed below. The exposed subgrade shall be proof rolled with at least a 15-ton pneumatic roller to detect weak soil support areas. These areas will be removed and replaced according to the following:
      1. Areas not designated for new improvements shall be reshaped and filled to finished grade, less topsoil requirement.
      2. Areas designated for new improvements shall be reshaped and filled to subgrade with material meeting requirements for select fill material.
         a. Place lifts of select fill in thin, loose layers not exceeding eight inches in thickness to the desired rough grade and compact to a minimum of 95% of the maximum density defined by ASTM D698.
         b. Maintain moisture within a range of optimum -1% to optimum +3%.
         c. Conduct in-place density tests at a rate of one test per 3,000 square feet for every lift with a minimum of 2 tests per lift.
         d. For select fill placed above the existing groundline, extend the lateral limits of the fill at least 5 feet beyond the perimeter of the building area, transitioning back to the existing groundline on a 3:1 (horizontal/vertical) slope.
   B. Take all measures necessary to protect trees to remain from construction damage and keep them healthy during the construction process. This includes trees inside construction fences and adjacent to any construction activities.
   C. Clear and grub all existing trees and understory where indicated on the drawings.
      1. Remove all dead trees and tree limbs or trees that have substantial structural or cosmetic damage.
      2. Remove all climbing vines to a height of 30' above the ground. Grub out vine roots.
      3. Remove all broken limbs and vines on trees that could fall and pose a hazard to pedestrians.
      4. Spray all Poison Ivy with two (2) applications of a contact herbicide labeled for such use. After a complete kill has been achieved, grub out all plants and roots. Do not burn any part of Poison Ivy plants.
5. Remove brambles and other vines where these plants have grown up into trees.
6. Remove old fences and fence posts. In cases where wire penetrates existing trees to remain the wire shall be trimmed back flush with the tree bark.
7. Remove logs and stumps higher than four inches (4") above grade and other debris from this area. Backfill holes in accordance with Section 31 00 00 – Site Earthwork.
8. Trim tree limbs to allow five feet (5’) clearance above ground.
9. Remove any trash or man-made debris from this area.
10. All material generated by the pruning and clearing process shall be disposed of legally off-site.

D. Perform these operations under the direction of the licensed arborist.
E. Do not begin operations until limits of clearing and grubbing have been identified and staked out by the contractor and approved by the Owner’s Designated Representative.
F. Do no damage to existing plant material, utilities, and/or pavements designated to remain as indicated on the drawings.
G. Fill any depression caused by clearing and grubbing operations; removing any improvements, over or underground, as necessary to facilitate new construction.
H. Disposal will be done legally; no burning is permitted on University property.
I. A certified arborist shall perform all pruning. Contractor shall submit proof of qualifications and three current references to A/E and Owner for approval prior to commencing any pruning.

3.5 GENERAL STRIPPING OF EXISTING WEEDS AND GRASSES:
A. The area within the work limits shown shall be stripped of lawns and vegetation under the direction of the Owner’s Designated Representative.
B. Method of removal shall remove a minimum amount of topsoil and shall be even so as to not generally change the overall grading.
C. Remove and dispose of all products of stripping from the site. Do not allow material to accumulate at locations in or about the work areas.

3.6 STRIPPING AND REMOVAL OF EXISTING SOD:
A. All areas designated shall be stripped of existing sod to a depth of two and one-half (2 1/2") inches, or as deep as necessary to remove the majority of roots.
B. Sod shall be stripped by acceptable means and materials. Products of stripping operations shall be removed from the site and legally disposed of.

3.7 STRIPPING AND STOCKPILING OF TOPSOIL:
A. Remove sod and grass before stripping topsoil.
B. Strip topsoil to a depth of six (6") inches or as necessary to remove all topsoil. Strip topsoil not in a muddy condition and avoid admixtures of subsoil.
C. Strip no soil where grades require only a slight change. Stockpile the topsoil in areas designated on the Drawings or as agreed upon with the Owner. Stockpiled topsoil shall be free from trash and other related material and shall be protected during the duration of the Contract.
D. Stripped and stockpiled topsoil not used for landscape fill or for planting operations shall be removed from the site and legally disposed of.

3.8 DISPOSAL OF MATERIALS
A. Non-saleable Materials
   1. Logs, stumps, roots, brush, rotten wood, and other refuse from the clearing and grubbing operations, shall be disposed of outside the limits of Owner controlled land at the Contractor’s responsibility, except when otherwise directed in writing. Such directive will state the conditions covering the disposal of such products and will also state the areas in which they may be placed.
SECTION 31 13 11 – TEMPORARY TREE PROTECTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to work of this section.

1.02 DESCRIPTION OF WORK:

A. Extent: Furnish all labor, material, equipment, tools, and incidentals necessary for the installation of Tree Protection measures as shown on the Drawings and as specified in this Section.
   1. The work includes pruning and replacements of vegetation indicated to be protected on the Drawings that are affected by temporary or permanent construction.

B. Related work includes but is not limited to:
   1. Site Clearing
   2. Demolition
   3. Earthwork and Grading
   4. Soil Preparation
   5. Landscape Planting

PART 2 - PRODUCTS

2.01 PLANT PROTECTION DEVICES:

A. Install minimum protective devices consisting of orange plastic construction fencing and “T” posts at the drip line plus one foot as detailed on drawings, of all trees within the limits of construction. At tight locations where the protection fencing will restrict the proposed construction, subject to approval by the Owner's Representative, alternative protective devices consisting of a fence a minimum of 1 foot radius for each inch caliper (thickness) from the tree to be protected or wrapping the tree trunk with two (2) inch thick wood stock from ground line to eight (8) feet above will be allowed. Maintain protective devices in good order for the duration of the construction period. Additional protective devices or barriers, required by the Owner's Representative during the course of construction, may be added to the work by field order. Protective devices so added are to be installed immediately and shall be maintained in good condition until construction is concluded. Protective devices are further defined to include references in the specifications, or notes on the drawings as to construction limits, or other such notes that indicate the area or right-of-way in which the Contractor must work.

PART 3 - EXECUTION

3.01 EQUIPMENT AND MATERIAL STORAGE:

A. Where trees are adjacent to construction and are not scheduled to be removed:
   1. Contractor shall protect them from unnecessary cutting, breaking, skinning, or bruising of roots and bark by use of boxing or fencing.
2. No stockpiling of excavated or construction materials or vehicle parking area shall be allowed within drip lines.

3. Foot and vehicular traffic within drip lines shall be minimized.

4. If it is or becomes necessary to remove or damage vegetation contrary to protection requirements, the Contractor shall make written request to and obtain approval from the Owner prior to beginning the work in conformance with 3.04 below.

3.02 BURNING:

A. Fires are prohibited.

3.03 REPARATION FOR DAMAGES:

A. Contractor is liable for all unauthorized vegetation damages and shall bear all costs or subsequent appraisal and restoration.

1. Appraisal: The Owner may request that unauthorized damage be appraised by a horticulturist, botanist, arborist, or forester from the Owner's staff who shall appraise damage values under the latest edition of Guidelines for Established Values of Trees and Plants, published by the Council of Tree and Landscape Appraisers, 232 Southern Building, Washington, D.C. 20005.

2. Restoration: Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner acceptable to the Owner. In the case of more serious damage, the Owner may require the Contractor to employ an arborist to repair damages to trees and shrubs, or replace trees that cannot be repaired and restored to full growth status, as determined by the arborist.

3.04 PLANT PRUNING AND LIMB REMOVAL:

Plant protection requirements cited above shall include authorized pruning and cutting of limbs and major roots. The Contractor is cautioned not to cut, prune or otherwise remove plant parts without prior approval and guidance by the Owner. All cutting or pruning that may be required by construction shall be approved prior to beginning such work and shall be accomplished by a Certified Arborist to be employed by the Contractor at the Contractor's expense.

END OF SECTION 31 12 11
SECTION 31 23 13 - SUBGRADE PREPARATION

PART 1 - GENERAL
1.1 RELATED DOCUMENTS
   A. The Terms and Conditions of the Contract, including Supplementary and Special Conditions of the Contract, and the Drawings apply to this Section.

1.2 SUMMARY
   A. Section includes furnishing all labor, materials, and equipment necessary for completing all subgrade preparation operations for pavement, drainage facilities and other improvements shown on the drawings associated with this project.

1.3 RELATED SECTIONS
   A. Section 31 00 00 – Site Earthwork

1.4 DEFINITIONS
   A. Prepared Ground Surface – Ground surface after completion of site clearing, scalping of sod, stripping of topsoil, excavation to grade, and scarification and compaction of subgrade.
   B. Subgrade – Layer of existing soil after completion of clearing, grubbing, scalping to topsoil prior to placement of fill, structural fill, roadway structure or base for floor slab.
   C. Proof Rolling – Testing of subgrade to identify areas that will not support the future loading without excessive settlement, and locate areas of instability

1.5 REFERENCE STANDARDS
   A. The contractor shall comply with applicable provisions and recommendations of the following:
         a. ASTM D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft$^3$ (600 kN-m/m$^3$)).
         b. ASTM D6938 – Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
      2. Geotechnical Report.

1.6 SUBMITTALS
   A. Submit in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.09 SUBMITTALS and UGC Article 8.
   B. Provide certifications and laboratory analysis results for all fill materials proposed for use on the project, indicating conformity to the specifications and source of materials.
   C. Perform, document and report the following quality control tests at the designated frequency in accordance with Section 01 45 00.
      1. Submit two (2) copies of test reports of the moisture-density and compaction results for review.
      2. Comply with Submittal requirements outlined in Sections 01 33 00 and 01 45 00.

1.7 SITE CONDITIONS
   A. Environmental Requirements: Prepare subgrade when unfrozen and free of ice and snow.

1.8 SEQUENCING AND SCHEDULING
   A. Complete applicable work as specified in Section 31 00 00 – Site Earthwork prior to subgrade preparation.

PART 2 - PRODUCTS
2.1 EQUIPMENT
   A. Proof Rolling Equipment
      1. The proof rolling equipment shall consist of not less than four pneumatic tired wheels, running on axles carrying not more than two wheels, and mounted in a rigid frame and provided with loading platform or body suitable for ballast loading. All wheels shall be arranged so that they will carry approximately equal loads when operating on uneven surfaces.
      2. The proof roller under working conditions shall have a rolling width of from 8 feet to 10 feet, and shall be so designed that, by ballast loading, the gross load may be varied uniformly from 25 tons to 50 tons. The tires shall be capable of operating under the
various loads with variable air pressure up to 150 pounds per square inch. Tires shall be practically full of liquid. (Tires shall be considered as being practically full when liquid will flow from the valve stem of a fully inflated tire with the stem in the uppermost position). The operating load and tire pressure shall be within the range of the manufacturer’s chart. The Contractor shall furnish the A/E charts or tabulations showing the contact areas and contact pressures for the full range of tire inflation pressures and for the full range of loadings for the particular tires furnished.

3. The proof roller shall be towed by a suitable crawler type tractor or rubber tired tractor of adequate tractive capacity, or may be of the self-propelled type. A proof roller unit shall consist of either a self-propelled roller or combination of roller and towing tractor

4. There shall be a sufficient quantity of ballast available to load the equipment to a maximum gross weight of 50 tons.

5. Rubber tired tractive equipment shall be used on base courses and asphalt pavements. Other type tractive equipment may be used on embankment subgrade. The heavy pneumatic tire roller unit shall be capable of turning 180 degrees in the crown width or operating in forward and reverse modes.

6. In lieu of the rolling equipment specified, the Contractor may, upon written permission from the A/E, operate other compacting equipment that will produce equivalent results in the same period of time as the specified equipment. If the substituted compaction equipment fails to produce the desired results within the same period of time as would be expected of the specified equipment, as determined by the A/E, its use shall be discontinued.

PART 3 - EXECUTION

3.1 GENERAL

A. Keep subgrade free of water, debris, and foreign matter during compaction or proof-rolling.

B. Bring subgrade to proper grade and cross-section and uniformly compact surface.

C. Do not use sections of prepared ground surface as hauls roads. Protect prepared subgrade from traffic.

D. Maintain prepared ground surface in finished condition until next course is placed.

E. The Contractor shall be responsible for providing accurate lines and grades of subgrade per drawings.

3.2 APPROVAL OF SUBGRADE

A. Proof-Rolling: Proof-roll subgrade below the building pad and pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

B. Completely proof-roll subgrade in one direction, each succeeding trip of the proof roller shall be offset by not greater than one tire width. Repeat proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.

C. Remove soft spots down to firm soil, minimum 12 inches deep, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by A/E representative, fill with select structural fill in maximum 8 inches deep lifts, and compact as specified.

3.3 MOISTURE CONDITIONING

A. Dry Subgrade: Add water, then mix to make moisture content uniform throughout.

B. Wet Subgrade: Aerate material by blading, diskng, harrowing, or other methods, to hasten drying process.

3.4 QUALITY CONTROL TESTING

A. QUALITY ASSURANCE in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.10 QUALITY ASSURANCE AND UGC Article 8.

B. Provide certifications and laboratory analysis results for all fill materials proposed for use on the project, indicating conformity to the specifications and source of materials.

C. Engage a testing laboratory for control testing during subgrade preparation operations to perform, document and report the required quality control tests at the designated frequency in accordance with Geotechnical Engineering Report and Supplementary Reports.

END OF SECTION 31 23 13
SECTION 31 31 16 - SOIL TREATMENT FOR SUBTERRANEAN TERMITE CONTROL

PART 1 - GENERAL
1.1 RELATED DOCUMENTS
   A. The Terms and Conditions of the Contract, including Supplementary and Special
      Conditions of the Contract, and the Drawings apply to this Section.

1.2 REFERENCES
   A. U.S. Environmental Protection Agency (EPA)
      1. 7 USC Section 136 – Federal Insecticide, Fungicide, and Rodenticide Act

1.3 SUMMARY
   A. Section includes treating completed subgrade both inside and outside of perimeter
      building grade beams, piers, and entire subgrade below building slabs-on-grade and to a
      line five feet beyond the perimeter walls of Electrical, Storage, Data, and Security Rooms
      with termiticide.

1.4 RELATED WORK
   A. Related work of other Sections includes:
      1. Section 31 00 00 – Site Earthwork.

1.5 SUBMITTALS
   A. Submit in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL
      CONDITIONS SECTION 1.09 SUBMITTALS and UGC Article 8.
   B. Submit termiticide treatments application instructions and EPA-Registered Label.

1.6 QUALITY ASSURANCE
   A. QUALITY ASSURANCE in accordance with TPWD DIVISION 1 - SECTION 01000 -
      SPECIAL CONDITIONS SECTION 1.10 QUALITY ASSURANCE AND UGC Article 8.
   B. Comply with 7 USC Section 136 for requirements on Contractor's licensing, certification,
      and record keeping.
   C. For the application of pesticides, use the services of a subcontractor whose principal
      business is pest control. The subcontractor shall be licensed and certified in the state
      where the work is to be performed. Termiticide applicators shall also be certified in the
      U.S. Environmental Protection Agency (EPA) pesticide applicator category which
      includes structural pest control.
   D. Safety Requirements
      1. Formulate, treat, and dispose of termiticides and their containers in accordance with
         label directions. Draw water for formulating only from sites designated by the
         Contracting Officer, and fit the filling hose with a backflow preventer meeting local
         plumbing codes or standards. The filling operation shall be under the direct and
         continuous observation of a contractor's representative to prevent overflow. Secure
         pesticides and related materials under lock and key when unattended. Ensure that
         proper protective clothing and equipment are worn and used during all phases of
         termite application. Dispose of used pesticide containers at approved solid
         waste disposal facility.

1.7 DELIVERY, STORAGE, AND HANDLING
   A. Delivery
      1. Deliver termiticide material to the site in the original unopened containers bearing
         legible labels indicating the EPA registration number and manufacturer's registered
         uses. All other materials, to be used on site for the purpose of termite control, shall
         be delivered in new or otherwise good condition as supplied by the manufacturer or
         formulator.
   B. Inspection
      1. Inspect termiticides upon arrival at the job site for conformity to type and quality in
         accordance with paragraph TERMITICIDES. Each label shall bear evidence of
         registration under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA),
         as amended or under appropriate regulations of the host county. Other materials
         shall be inspected for conformance with specified requirements. Remove
         unacceptable materials from the job site.
C. Storage
1. Store materials in designated areas and in accordance with manufacturer's labels. Termiticides and related materials shall be kept under lock and key when unattended.

D. Handling
1. Observe manufacturer's warnings and precautions. Termiticides shall be handled in accordance with manufacturer's labels, preventing contamination by dirt, water, and organic material. Protect termiticides from sunlight as recommended by the manufacturer.

1.8 SITE CONDITIONS
A. The following conditions will determine the time of application
   1. Soil Moisture
      a. Soils to be treated shall be tested immediately before application. Test soil moisture content to a minimum depth of 3 inches. The soil moisture shall be as recommended by the termiticide manufacturer. The termiticide will not be applied when soil moisture exceeds manufacturer's recommendations because termiticides do not adhere to the soil particles in saturated soils.

2. Runoff and Wind Drift
   a. Do not apply termiticide during or immediately following heavy rains. Applications shall not be performed when conditions may cause runoff or create an environmental hazard. Applications shall not be performed when average wind speed exceeds 10 miles per hour. The termiticide shall not be allowed to enter water systems, aquifers, or endanger humans or animals.

3. Vapor Barriers and Waterproof Membranes
   a. Termiticide shall be applied prior to placement of a vapor barrier or waterproof membrane.

4. Utilities and Vents
   a. Prior to application, HVAC ducts and vents located in treatment area shall be turned off and blocked to protect people and animals from termiticide.

5. Placement of Concrete
   a. Place concrete covering treated soils as soon as the termiticide has reached maximum penetration into the soil. Time for maximum penetration shall be as recommended by the manufacturer.

1.9 SEQUENCING AND SCHEDULING
A. Arrange for application of termiticide after installation of deep footings, foundations and grade beams; underground plumbing and services; and soil backfill, fill and compaction within and adjacent to perimeter grade beams, but prior to pouring of slabs-on-grade.

1.10 WARRANTY
A. The Contractor shall provide a 5-year written warranty against infestations or reinfestations by subterranean termites of the buildings or building additions constructed under this contract. Warranty shall include annual inspections of the buildings or building additions. If live subterranean termite infestation or subterranean termite damage is discovered during the warranty period, and the soil and building conditions have not been altered in the interim, the Contractor shall:
   1. Retreat the soil and perform other treatment as may be necessary for elimination of subterranean termite infestation;
   2. Repair damage caused by termite infestation; and
   3. Reinspect the building approximately 180 days after the retreatment.

PART 2 - PRODUCTS
2.1 MATERIAL
A. Termiticide: Provide an EPA-registered termiticide complying with the requirements of authorities having jurisdiction, in a soluble or emulsifiable, concentrated formulation that dilutes with potable water or foaming agent, and formulated to prevent termite infestation. Use only soil treatment solutions that are not harmful to plants. Provide quantity required for application at the label volume and rate for the maximum termiticide concentration
allowed for each specific use, according to the product's EPA-Registered Label. Subject to compliance with requirements, provide one of the following:

1. Bifenthrin: "Baseline" by FMC Corp.
2. Cypermethrin: "Prevail FT" by FMC Corp. or "Demon TC by Zeneca Professional Products.
3. Imidacloprid: "Premise 0.5 SC" by Bayer Corp. or "Premise 75" by Bayer Corp.
4. Permethrin: "Dragnet FT" by FMC Corp. or "Prelude" by Zeneca Professional Products.

PART 3 - EXECUTION
3.1 EXAMINATION
A. Examine substrate areas and conditions with Applicator present for compliance with requirements for moisture content of soil, interfaces with earthwork, slab and foundation work, landscaping and other conditions affecting performance of termite control. Proceed with application of termiticide only after unsatisfactory conditions have been corrected.

3.2 SITE PREPARATION
A. Ground Preparation
1. Food sources shall be eliminated by removing debris from clearing and grubbing and post construction wood scraps such as ground stakes, form boards, and scrap lumber from the site, before termiticide application begins.

B. Verification
1. Before work starts, verify that final grades are as indicated and smooth grading has been completed in accordance with Section 31 00 00 Site Earthwork. Soil particles shall be finely graded with particles no larger than 1 inch and compacted to eliminate soil movement to the greatest degree

C. Foundation Exterior
1. Provide written verification that final grading and landscape planting operations will not disturb treatment of the soil on the exterior sides of foundation walls, grade beams, and similar structures.

D. Utilities and Vents
1. Provide written verification that the location and identity of HVAC ducts and vents, water and sewer lines, and plumbing have been accomplished prior to the termiticide application.

E. Crawl and Plenum Air Spaces
1. Provide written verification that the location and identity of crawl and plenum air spaces have been accomplished prior to the termiticide application.

F. Application Plan

3.3 TERMITICIDE APPLICATION
A. Equipment Calibration and Tank Measurement
1. Immediately prior to commencement of termiticide application, calibration tests shall be conducted on the application equipment to be used and the application tank shall be measured to determine the volume and contents. These tests shall confirm that the application equipment is operating within the manufacturer's specifications and will meet the specified requirements. Provide written certification of the equipment calibration test results within 1 week of testing.

B. Mixing and Application
1. Formulating, mixing, and application shall be performed in the presence of the Owner’s Designate Representative. A closed system is recommended as it prevents the termiticide from coming into contact with the applicator or other persons. Water for formulating shall only come from designated locations. Filling hoses shall be fitted with a backflow preventer meeting local plumbing codes or standards. Overflow shall be prevented during the filling operation. Prior to each day of use, the equipment used for applying termiticides shall be inspected for leaks, clogging, wear, or damage. Any repairs are to be performed immediately

C. Treatment Method
1. For areas to be treated, establish complete and unbroken vertical and/or horizontal soil poison barriers between the soil and all portions of the intended structure which may allow termite access to wood and wood related products. Application shall not be made to areas which serve as crawl spaces or for use as a plenum air space.

D. Surface Application
1. Use surface application for establishing horizontal barriers. Surface applicants shall be applied as a coarse spray and provide uniform distribution over the soil surface. Termicide shall penetrate a minimum of 1 inch into the soil, or as recommended by the manufacturer.

E. Rodding and Trenching
1. Use rodding and trenching for establishing vertical soil barriers. Trenching shall be to the depth of the foundation footing. Width of trench shall be as recommended by the manufacturer, or as indicated. Rodding or other approved method may be implemented for saturating the base of the trench with termicide. Immediately after termicide has reached maximum penetration as recommended by the manufacturer, backfilling of the trench shall commence. Backfilling shall be in 6 inch rises or layers. Each rise shall be treated with termicide

F. Sampling
1. The Owner’s Designated Representative may draw from stocks at the job site, at any time and without prior notice, take samples of the termicides used to determine if the amount of active ingredient specified on the label is being applied.

3.4 CLEAN UP, DISPOSAL, AND PROTECTION
A. Clean Up
1. The site shall be cleaned of all material associated with the treatment measures, according to label instructions, and as indicated. Excess and waste material shall be removed and disposed off site.

B. Disposal of Termicide
C. Dispose of residual termicides and containers off Government property, and in accordance with label instructions and EPA criteria.

D. Protection of Treated Areas
1. Post warning signs that termicide has been applied after areas have been treated. Remove signs just prior to installation of subsequent construction. Avoid disturbance of treated soil after application. Reapply soil treatment solution in areas disturbed by subsequent excavation, grading, landscaping or other construction activities following treatment application.

END OF SECTION 31 31 16
SECTION 31 32 13 - SOIL MIXING STABILIZATION

PART 1 - GENERAL
1.1 RELATED DOCUMENTS
A. The Terms and Conditions of the Contract, including Supplementary and Special Conditions of the Contract, and the Drawings apply to this Section.

1.2 SUMMARY
A. Section includes furnishing and installing cement stabilized sand subgrade, and related work as shown and detailed on the Drawings.

1.3 RELATED WORK
A. Related work of other Sections includes:
   1. Section 31 00 00 – Site Earthwork.
   2. Section 31 23 13 – Subgrade Preparation.

1.4 REFERENCES

B. TxDOT: Texas Department of Transportation, 125 East 11th Street, Austin, Texas 78701

1.5 WEATHER CONDITIONS
A. Start cement application only when the air temperature is at least 35 degrees F and rising or is at least 40 degrees F. The temperature will be taken in the shade and away from artificial heat.
B. Minimize dust and scattering of cement by wind. Do not apply cement when, in the opinion of the Owners Designated representative, wind conditions cause blowing cement to become dangerous to traffic or objectionable to adjacent property owners.

1.6 SUBMITTALS
A. Submit in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.09 SUBMITTALS and UGC Article 8.
B. Mix design.

PART 2 - PRODUCTS
2.1 CEMENT
A. Type I Portland Cement conforming to ASTM C150.

2.2 WATER
A. Potable water, free of oils, acids, alkalis, organic matter, or other deleterious substances, meeting requirements of ASTM C94.

PART 3 - EXECUTION
3.1 CONDITIONS
A. Stabilization shall be mixed and compacted in one lift and shall be completed the same day.

3.2 MIX DESIGN
A. The optimum percentage of cement to be added shall be determined based on compressive strength tests on samples with varying percent cement and prepared in accordance with Tex-120-E. The percentage cement added shall provide a minimum strength of 200 pounds per square inch.

3.3 PREPARATION
A. Shape the existing material in accordance with the plans.
B. Pulverize or scarify the existing material after shaping so that 100% passes a 2-1/2" sieve.

3.4 PLACEMENT
A. Dry Placement
   1. Cement shall be uniformly spread and mixed into the subgrade material prior to the application of water.
B. Slurry Placement
   1. Slurry placement is not acceptable for this project.

3.5 MIXING
A. Thoroughly mix the material and cement using approved equipment.
B. Mix until a homogeneous mixture is obtained.
C. Add water as necessary to maintain optimum mixing moisture.
D. Spread and shape the completed mixture in a uniform layer.
E. After mixing, sample material and test in accordance with Tex-101-E, Part III, to determine compliance with the gradation requirements below:

<table>
<thead>
<tr>
<th>G. Sieve Size</th>
<th>H. Base</th>
<th>I. Subgrade</th>
</tr>
</thead>
<tbody>
<tr>
<td>J. 1-3/4 in.</td>
<td>K. 100</td>
<td>L. 100</td>
</tr>
<tr>
<td>M. 3/4 in.</td>
<td>N. 85</td>
<td>O. 85</td>
</tr>
<tr>
<td>P. No. 4</td>
<td>Q. -</td>
<td>R. 60</td>
</tr>
</tbody>
</table>

3.6 COMPACTION
A. Compact the mixture in one lift.
B. Sprinkle or aerate the treated subgrade to adjust the moisture content during compaction so that it is within 2.0 percentage points of optimum as determined by Tex-120-E. Determine the moisture content of the mixture at the beginning and during construction in accordance with Tex-103-E. Adjust operations as required.
C. Begin rolling longitudinally at the sides and proceed towards the center, overlapping on successive trips by at least one-half the width of the roller unit. Operate rollers at a speed between 2 and 6 miles per hour.
D. Compact to at least 95% of the maximum density determined in accordance with Tex-120-E. Determine roadway density in accordance with Test Method Tex-115-E and verify strength in accordance with Tex-120-E.
E. Remove material that does not meet density requirements. Remove areas that lose required stability, compaction, or finish. Replace with cement-treated mixture and compact and test as described above.
F. The Engineer may accept the section if no more than 1 of the 5 most recent density tests is below the specified density and the failing test is no more than 3 pcf below the specified density.

3.7 FINISHING
A. Immediately after completing compaction, clip, skin, or tight-blade the surface of the cement treated material with a maintainer or subgrade trimmer to a depth of approximately 1/4 inch. Remove loosened material and dispose of it at an approved location.
B. Roll the clipped surface immediately with a pneumatic-tire roller until a smooth surface is attained. Add small increments of water as needed during rolling. Shape and maintain the course and surface in conformity with the typical sections, lines and grades shown on the plans.
C. Finish grade of constructed subgrade shall be within 0.1 feet in the cross-section and 0.1 feet in 16 feet measured longitudinally.

3.8 CURING
A. Cure for at least three days.
B. During curing, maintain moisture content at no lower than 2 percentage points below optimum.
C. Maintain moisture content by sprinkling or by applying an asphalt material at the rate of 0.05 to 0.20 gallons per square yard.
D. Do not allow equipment on the finished course during curing except as required for sprinkling.
E. Continue curing until placing another course or opening the finished section to traffic.

3.9 TESTING
A. Perform one moisture-density test per 5,000 square feet of surface area on the treated subgrade.
B. Perform one after mixing gradation analysis per 5,000 square feet of surface area on the treated subgrade.

3.10 QUALITY ASSURANCE
A. QUALITY ASSURANCE in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.10 QUALITY ASSURANCE AND UGC Article 8.

END OF SECTION 31 32 13
SECTION 31 32 15 - LIME SOIL STABILIZATION

PART 1 - GENERAL
1.1 RELATED DOCUMENTS
A. The Terms and Conditions of the Contract, including Supplementary and Special Conditions of the Contract, and the Drawings apply to this Section.

1.2 SUMMARY
A. Section includes furnishing and treating the new subgrade of pavement sections by pulverizing, adding lime, mixing, and compacting the mixed material as specified and as shown and detailed on the Drawings.

1.3 RELATED WORK
A. Related work of other Sections includes:
1. Section 31 11 00 – Clearing and Grubbing
2. Section 31 00 00 – Site Earthwork
3. Section 31 23 13 – Subgrade Preparation

1.4 REFERENCES
3. ASTM D 421 – Practice for Dry Preparation of Soil Samples for Particle Size Analysis and Determination of Soil Constants
4. ASTM D422 – Standard Test Method for Particle-Size Analysis of Soils
5. ASTM D 698 - Test Method Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5-lb. (2.49-kg) Rammer and 12-in. (305-mm) Drop.
7. ASTM D 4318 - Test for Liquid Limit, Plastic Limit and Plasticity Index of soils.

1.5 SUBMITTALS
A. Submit in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.09 SUBMITTALS and UGC Article 8.

PART 2 - PRODUCTS
2.1 MATERIALS
A. All lime slurries used in "Slurry Placing" shall be furnished at or above the Minimum Dry Solids Content.
1. Lime slurry shall be Type A Hydrated Lime, meeting the following criteria:
   a. Chemical:
      1) Total "active" lime content, % by wt. - - - - -90.0 min. (i.e., % by wt Ca(OH)2 + % by wt CaO, if present)
      2) Unhydrated lime content, % by wt CaO: 5.0 max
      3) "Free Water" content, % by wt H2O: 5.0 max
   b. Physical
      1) Wet sieve requirement, as % by wt residue:
      2) Retained on No. 6 sieve: 0.2 max
      3) Retained on No. 30 sieve: 4.0 max
2. Quicklime shall be pelletized and suitable for either dry placement or for use in the preparation of a slurry for "Slurry Placing", meeting the following criteria:
   a. Chemical:
      1) Unhydrated lime content, % by wt CaO: -87.0 min.
   b. Physical
      1) Wet sieve requirement, as % by wt residue:
      2) Retained on No. 6 sieve: 8.0 max
3) Retained on 1 in sieve: 0.0
4) Retained on ¾ in. sieve: 10.0 max.
5) Retained on No. 100 sieve: 80.0 min.

PART 3 - EXECUTION

3.1 APPLICATION

A. The completed course shall be uniformly treated, free from loose or segregated areas, of uniform density and moisture content, well bound for its full depth and shall have a smooth surface.

B. Prior to treating existing material, it shall be shaped to conform to the typical sections as shown on the plans.

C. Before pulverizing or scarifying an existing material, the Construction Manager shall proof roll the required area in accordance with the following criteria:

   1. Equipment.
      a. The proof rolling equipment shall consist of not less than four pneumatic tired wheels, running on axles carrying not more than two wheels, and mounted in a rigid frame and provided with loading platform or body suitable for ballast loading. All wheels shall be arranged so that they will carry approximately equal loads when operating on uneven surfaces.
      b. The proof roller under working conditions shall have a rolling width of from 8 feet to 10 feet, and shall be so designed that, by ballast loading, the gross load may be varied uniformly from 25 tons to 50 tons. The tires shall be capable of operating under the various loads with variable air pressure up to 150 pounds per square inch. Tires shall be practically full of liquid. (Tires shall be considered as being practically full when liquid will flow from the valve stem of a fully inflated tire with the stem in the uppermost position). The operating load and tire pressure shall be within the range of the manufacturer’s chart as directed by the Engineer. The Construction Manager shall furnish the Engineer charts or tabulations showing the contact areas and contact pressures for the full range of tire inflation pressures and for the full range of loadings for the particular tires furnished.
      c. The proof roller shall be towed by a suitable crawler type tractor or rubber tired tractor of adequate tractive capacity, or may be of the self-propelled type. A proof roller unit shall consist of either a self-propelled roller or combination of roller and towing tractor.
      d. There shall be a sufficient quantity of ballast available to load the equipment to a maximum gross weight of 50 tons.
      e. Rubber tired tractive equipment shall be used on base courses and asphalt pavements. Other type tractive equipment may be used on embankment subgrade. The heavy pneumatic tire roller unit shall be capable of turning 180 degrees in the crown width or operating in forward and reverse modes.
      f. In lieu of the rolling equipment specified, the Construction Manager may, upon written permission from the Engineer, operate other compacting equipment that will produce equivalent results in the same period of time as the specified equipment. If the substituted compaction equipment fails to produce the desired results within the same period of time as would be expected of the specified equipment, as determined by the Engineer, its use shall be discontinued.

   2. Construction Methods.
      a. This work shall be done only when directed by the Engineer. The subgrade and/or base layer shall be proof rolled to locate unstable areas when directed by the Engineer.
      b. The load and tire inflation pressures shall be adjusted as directed by the Engineer. It is proposed to use a contact pressure corresponding as nearly as practical to the maximum supporting value of the earthwork or base. A minimum of two coverages of the proof roller will be required. Each
succeeding trip of the proof roller shall be offset by not greater than one tire width. Rollers shall be operated at speeds directed by the Engineer, which shall be between 2 and 6 miles per hour.

c. Where the operation of the proof roller unit shows an area to be unstable or non-uniform, it shall be corrected in accordance with the applicable Item of Work.

3. Soft spots shall be corrected.

D. In lieu of using the cutting and pulverizing machine, the Construction Manager shall excavate and window row the material to expose the secondary grade to the typical sections. Lines and grades shown on the plans.

E. A sufficient quantity of hydrated lime shall be mixed with the subgrade soils to decrease the soil-lime mixture plasticity index to 18 (based on a dry method of sample preparation, ASTM D4318) or less and increase the pH of the soil lime mixture to at least 12.4. For estimating purposes assume two percent (2%) lime by weight, actual lime quantity should be determined by laboratory testing prior to commencing construction. Laboratory testing should include soluble sulphates in subgrade soils to determine if sulphate-induced heave needs to be addressed. The lime-stabilized clay will have a minimum of 60%, on a weight basis, of the stabilized soil passing the No. 4 sieve at a moisture content at or above optimum. If the plasticity index cannot be reduced to less than 18, the optimum lime content will be determined using a pH meter as outlined in ASTM C977.

F. All construction methods shall meet or exceed the following criteria:

1. General.
   a. The completed course shall be uniformly treated, free from loose or segregated areas, of uniform density and moisture content, well bound for its full depth and shall have a smooth surface.

2. Preparation of Subgrade or Existing Base.
   a. Prior to treating existing material, it shall be shaped to conform to the typical sections, as shown on the plans or as established by the Engineer. This work shall be done in accordance with the provisions of applicable bid items. When shown on the plans, any existing asphaltic concrete pavement shall be removed and will be paid for in accordance with applicable bid items.
   b. Before pulverizing or scarifying an existing material, when shown on the plans and when directed by the Engineer, the Construction Manager shall proof roll the roadbed in accordance with 3.1C above.
   c. Soft spots shall be corrected as directed by the Engineer.
   d. When the Construction Manager elects to use a cutting and pulverizing machine that will process the material to the plan depth, the Construction Manager will not be required to excavate to the secondary grade or windrow the material. This method will be permitted only if a machine is provided which will insure that the material is cut uniformly to the proper depth and which has cutters that will plane the secondary grade to a uniform surface over the entire width of the cut. The machine shall provide a visible indication of the depth of cut at all times.
   e. In lieu of using the cutting and pulverizing machine, the Construction Manager shall excavate and windrow the material to expose the secondary grade to the typical sections, lines and grades as shown on the plans or as established by the Engineer.

3. Pulverization.
   a. The existing pavement or base material shall be pulverized or scarified so that 100 percent shall pass the two (2) inch sieve.

4. Application.
   a. The percentage by weight or pounds per square yard of lime to be added will be as shown on the plans and may be varied by the Engineer if conditions warrant.
b. Lime shall be spread only on that area where the mixing operations can be completed during the same working day.

c. Unless otherwise approved by the Engineer, the lime operation shall not be started when the air temperature is below 40°F and falling, but may be started when the air temperature is above 35°F and rising. The temperature will be taken in the shade and away from artificial heat. Lime shall not be placed when weather conditions in the opinion of the Engineer are unsuitable.

d. The application and mixing of lime with the material shall be accomplished by the methods herein described as "Dry Placing" or "Slurry Placing". Type A Hydrated Lime shall be applied by "Slurry-Placing" unless otherwise shown on the plans or approved by the Engineer.

e. Dry Placing.
1) The lime shall be distributed by a spreader approved by the Engineer or by bag distribution for Type A Hydrated Lime at the rate shown on the plans or as directed by the Engineer.
2) The lime shall be distributed at a uniform rate and in such a manner as to reduce the scattering of lime by wind. Lime shall not be applied when wind conditions, in the opinion of the Engineer, are such that blowing lime becomes objectionable to adjacent property owners or dangerous to traffic.
3) A motor grader shall not be used to spread Type A Hydrated Lime.
4) The material shall be sprinkled as approved by the Engineer.

f. Slurry Placing.
1) When Type A Hydrated Lime is specified and slurry placement is to be used, the Type A Hydrated Lime shall be mixed with water to form a slurry with a solids content approved by the Engineer.

h. Mixing.
1) The mixing procedure shall be the same for "Dry Placing" or "Slurry Placing" as herein described.
2) During the interval between application and mixing, hydrated lime that has been exposed to the open air for a period of six (6) hours or more or to excessive loss due to washing or blowing will not be accepted for payment.
3) The material and lime shall be thoroughly mixed by equipment approved by the Engineer. The material and lime shall be brought to the proper moisture content and may be left to cure one (1) to four (4) days as approved by the Engineer or the mixing continued until a homogeneous friable mixture of material and lime is obtained.
4) When shown on the plans or approved by the Engineer, the pulverization requirement may be waived when the material contains a substantial quantity of aggregate.
5) Following mixing, a sample of the material at roadway moisture will be obtained for pulverization testing. All non-slaking aggregates retained on the 3/4-inch sieve will be removed from the sample. The remainder of the material shall meet the following pulverization requirement when tested by Test Method ASTM D422:
   a) Minimum passing 1-3/4" sieve .........100
   b) Minimum passing 3/4" sieve ........85
i. Compaction Methods.

1) Prior to compaction, the material shall be aerated or sprinkled as necessary to provide the optimum moisture. Compaction of the mixture shall begin immediately after the pulverization requirement is met.

2) Compaction shall continue until the entire depth of the mixture is uniformly compacted by "Ordinary Compaction" or "Density Control" as shown on the plans. Throughout this entire operation the shape of the course shall be maintained by blading, and the surface upon completion shall be smooth and in conformity with the typical sections, lines and grades as shown on the plans or as established by the Engineer.

3) When shown on the plans or approved by the Engineer, multiple lifts will be permitted.

4) Ordinary Compaction. When "Ordinary Compaction" is shown on the plans the following provisions shall apply:

   a) The material shall be sprinkled and rolled as directed by the Engineer. All irregularities, depressions or weak spots which develop shall be corrected immediately by scarifying the areas affected, adding or removing material as required, reshaping and recompacting by sprinkling and rolling.

   b) Should the material lose the required stability, compaction or finish before the next course is placed or the project is accepted, it shall be reworked in accordance with section 6 below. However, compaction shall be in accordance with "Ordinary Compaction".

5) Density Control. When "Density Control" is shown on the plans the following provisions shall apply:

   a) Unless otherwise shown on the plans, each course shall be sprinkled as required and compacted to the extent necessary to provide not less than 98 percent of the optimum density as determined by Test Method ASTM D698. Roadway density testing will be as outlined in Test Method ASTM D1556.

   b) When the material fails to meet the density requirements, or should the material lose the required stability, density or finish before the next course is placed, or the project is accepted, it shall be reworked in accordance with section 6 below.

6) Reworking a Section. When a section is reworked within 72 hours after completion of compaction, the Construction Manager shall rework the section to provide the required compaction. When a section is reworked more than 72 hours after completion of compaction, the Construction Manager shall add 25 percent of the specified rate of lime. Reworking shall include loosening, road mixing as approved by the Engineer, compacting, and finishing. When a section is reworked, a new optimum density will be determined from the reworked material in accordance with Test Method ASTM D698.

7) Finishing and Curing.

   a) After the final layer or course of the lime treated material has been compacted, it shall be brought to the required lines and grades in accordance with the typical sections.

   b) The completed section shall then be finished by rolling with a pneumatic tire or other suitable roller as approved by the Engineer. The completed section shall be moist cured or prevented from drying by addition of an asphalt material at the rate of 0.05 to 0.20 gallons per square yard as determined by the Engineer. This material shall be the type shown on the plans. Curing shall continue for seven (7) days before further courses are added or traffic is permitted, unless otherwise approved by the Engineer.
c) However, the lime treated material may be covered by other courses, the day following finishing, when approved by the Engineer. When the plans provide for the treated material to be covered by other courses of material, the next course shall be applied within 14 calendar days after final compaction is completed, unless otherwise approved by the Engineer.

8) Tolerances. Tolerances shall conform to the following:
   a) Density Tolerances. The Engineer may accept the work providing not more than one (1) out of the most recent five (5) density tests performed is below the specified density, provided the failing test is no more than three (3.0) pounds per cubic foot below the specified density.
   b) Grade Tolerances. Any deviation in excess of 0.1 foot in cross section and 0.1 foot in 16 feet measured longitudinally shall be corrected by loosening, adding or removing the material, reshaping and recompacting by sprinkling and rolling.

G. The subgrade moisture content and density will be maintained until construction is complete.

H. Water will not be allowed to collect in or near foundation areas, pavement areas or floor slab areas during or after construction. Care will be taken to ensure that water is not allowed to collect in natural or fill soils beneath or around the structures and pavement areas.

I. Excavations and undercut areas will be protected from changes in moisture content.

J. The Construction Manager shall have on site portable pumps and appropriate appurtenances for ensuring water ponding does not occur.

3.2 FIELD QUALITY CONTROL
   A. Testing Service: Engage a qualified independent testing agency to perform materials evaluation tests and to design mixtures.
   B. Testing of subgrade operations shall conform to the Geotechnical Report as outlined in Excavation and Fill.
   C. QUALITY ASSURANCE in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.10 QUALITY ASSURANCE AND UGC Article 8.

END OF SECTION 31 32 15
SECTION 31 50 00 - EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. The Terms and Conditions of the Contract, including Supplementary and Special Conditions of the Contract, and the Drawings apply to this Section.

1.2 SUMMARY
A. Section includes furnishing and installing all equipment, materials, and labor for a trench safety system meeting appropriate requirements established in Occupational Safety and Health Administration (OSHA) Safety and Health Regulations, Part 1926, Subpart P - Excavations, Trenching, and Shoring.

1.3 RELATED WORK
A. Related work of other Sections includes:
   1. Section 31 00 00 – Site Earthwork
   2. Section 33 10 00 – Water Utilities
   3. Section 33 30 00 – Sanitary Sewerage Utilities
   4. Division 22 Sections – Piping and appurtenances.
   5. Division 26 Sections – Electric.

1.4 REFERENCES


1.5 SUBMITTALS
A. Submit drawings showing the design and details of proposed sheeting, shoring and bracing, and the proposed sequence of excavation and backfill to the Owner’s Representative for review.
   1. The drawings shall be sealed by a registered professional engineer licensed in the State of Texas.
   2. Refer to the geotechnical study included with the bid documents for soil classification, trench construction, trench shields, and trench shoring considerations.
   3. Do not begin construction of the sheeting, shoring, and bracing until the design and drawings have been reviewed.
   4. Review of the drawings by the Owner’s Representative is for acceptance only insofar as it affects compliance with OSHA Regulations, and such acceptance will not relieve the Contractor of the responsibility for the adequacy of the design, or for compliance with OSHA regulations.
   5. Submit in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.09 SUBMITTALS and UGC Article 8.

PART 2 - PRODUCTS

2.1 TIMBER
A. Trench sheeting materials shall be a minimum of 2" in thickness, solid and sound, free from weakening defects such as loose knots and splits. Shoring timber sizes shall not be less that that called for in OSHA regulations.

2.2 STEEL SHEET PILING
A. Steel sheet piling shall conform to the following specifications: ASTM A328,
B. ASTM A572, Grade 50.
C. Steel for stringers and cross braces shall conform to ASTM A588.

2.3 TRENCH BOXES
A. Portable trench boxes shall be constructed of steel conforming to ASTM A36. Connecting bolts shall conform to ASTM A307. Welds shall conform to requirements of AWS Specification DI.1.

PART 3 - EXECUTION
3.1 GENERAL
A. Trench safety system shall be constructed, installed and maintained in accordance with the OSHA regulations and to the design prepared by the Contractor's registered Professional Engineer to prevent death or injury to personnel or damage to structures in or near these trench excavations. Materials excavated from trench to be stored no closer to the edge of the trench that on-half the depth of the trench.

3.2 INSTALLATION
A. Installation of trench safety system shall meet OSHA regulations and the Contractor's registered Professional Engineer's requirements.

3.3 SUPERVISION
A. Contractor shall provide competent supervisory personnel at each trench while work is in progress to ensure Contractor's methods, procedures, equipment and materials pertaining to the safety systems in this item are sufficient to meet requirements of OSHA regulations.

3.4 MAINTENANCE OF SAFETY SYSTEM
A. The safety system shall be maintained in the condition required by the OSHA regulations or as specified by the Contractor's registered Professional Engineer.
B. The Contractor shall take all necessary precautions to ensure the safety systems are not damaged during their use. If at any time during its use a safety system is damaged, personnel shall be immediately removed from the trench or excavation area and the safety system repaired. The Contractor shall take all necessary precautions to ensure no loads, except those included in the safety system design, are imposed upon the excavation.

3.5 INSPECTION
A. Contractor shall make daily inspection of trench safety system to ensure that the system meets OSHA requirements. Daily inspection to be made by competent personnel. If evidence of possible cave-ins or slides is apparent, all work in the trench shall cease until necessary precautions have been taken to safeguard personnel entering trench. Contractor to maintain permanent record of daily inspections.

3.6 REMOVAL
A. Bed and backfill pipe to a point at least one foot above top of pipe prior to removal of any portion of trench safety system. Bedding and backfill to be in accordance to other applicable specification items. Backfilling and removal of trench supports shall progress together from bottom of trench upward. Remove no braces or trench supports until all personnel have evacuated the trench. Backfill trench to within 5 feet of natural ground prior to removal of entire trench safety system.

END OF SECTION 31 50 00
SECTION 32 01 90 - LANDSCAPE MAINTENANCE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to the work of this Section.

1.02 DESCRIPTION OF WORK

A. Extent: Furnish all labor, material, equipment, tools, and incidentals necessary for Landscape Maintenance as specified in this Section during the landscape maintenance period, referred to herein as the Maintenance Period. The work includes establishing the plantings, providing pest and disease control, mowing, and maintaining the optimum moisture to new plants and grass, and related construction elements during the Maintenance Period.

B. Related Work:
   1. Hydromulching and Seeding
   2. Landscape Planting

1.03 MAINTENANCE PERIOD

A. Time Limits: Maintenance Period shall commence from the date of approval of substantial completion and extend for 90 calendar days, or until final completion approval, whichever is later.

1.04 REVIEWS

A. Quality Assurance: Quality Assurance in accordance with TPWD Division 1 - Section 01000 - Special Conditions Section 1.10 Quality Assurance and UGC Article 8.

B. Substantial Completion Review: Contractor shall specifically request this review at least (5) five days in advance of the proposed start of the Maintenance Period. The Architect will review for a final checklist of minor items to be completed. Once the items are completed by the Contractor and approved by the Architect, the Maintenance Period shall commence. Items to be checked during this review include but are not limited to:
   1. All planted areas including turf.

C. Punch-list Check: The Contractor shall conduct this review within two weeks of the end of the Maintenance Period, at the request of the Architect, when punch-list items identified at Substantial Completion have been corrected and are ready for inspection. The Final Review shall be rescheduled at the discretion of the Architect, if additional time beyond the scheduled date of final completion is needed to correct Punch-list items.
D. **Final Review:** Contractor shall specifically request this review at least (5) five days in advance of the end of the Maintenance Period. Failure to request this notice shall automatically extend the date of completion. The Maintenance Period will continue until final completion is approved by the Architect. Items to be checked during this review include but are not limited to:

1. All planted areas including turf, including all punch-list items identified at Substantial Completion Review, and Punch-list Check.

### 1.05 MAINTENANCE PERIOD SUBMITTALS

A. Submit in accordance with TPWD Division 1 - Section 01000 - Special Conditions Section 1.09 Submittals and UGC Article 8.

B. **Fertilizer:** Submit written certificate showing rates, materials, and date of fertilizer application, to the Architect within five (5) days of each application.

C. **Pesticides / herbicides:** If pesticides / herbicides are used, submit written certificate showing rates, materials, and date to the Architect within five (5) days of each application.

D. **Mowing:** Submit mowing occurrences to the Architect each time mowings are completed.

### 1.06 SUBSTITUTIONS

A. Substitutions permitted per TPWD Special Conditions 1.09.C

### 1.07 MAINTENANCE BINDER ADDITIONAL DOCUMENTS

A. Submit **prior to the Final Review**, the following additional documents for the Maintenance Binder.

1. Counter-signed documents shall include the following items, countersigned by the Architect:
   a. Fertilizer applications, including initial application.
   b. Pesticide and herbicide applications, including initial application.
   c. Mowing occurrences
   d. In-service meeting discussion / decisions.

B. The Final Review shall not take place until the additional submittals and documents have been reviewed and approved by the Architect.

### PART 2 - MATERIALS

#### 2.01 FERTILIZER

A. For maintenance fertilization shall be as specified in Specification Section Landscape Planting.
2.02 WATER

A. During the course of construction and maintenance, water for landscape shall be provided by the Owner at the Maintenance Building, approximately 1/3 mile from the job site. The water source is a well that pumps approximately 40-50 gallons per minute. The contractor shall provide their own water truck to carry and pump the water at the job site. Submit watering schedule with dates, times, and frequency at start of the Maintenance Period.

2.03 PRE-AND/OR POST-EMERGENT HERBICIDE

A. As recommended by licensed Pest Control Operator and approved by Owner / Architect.

PART 3 - EXECUTION

3.01 GENERAL

A. Contractor's Responsibility: Work installed under this Contract damaged by vandalism, vehicular damage and/or theft during the installation of the work and up to the Substantial Completion approval, shall be repaired or replaced by the Contractor without costs to the Owner.

B. Owner's Responsibility: Throughout the Maintenance Period, these damages and similar factors such as excessive litter, abuse and defacement shall be the Owner's responsibility to repair or replace and shall not be a part of this Contract. No planting shall be guaranteed beyond the Maintenance Period, except as to conformance to specified species and variety, and as specified in Specification Section Landscape Planting.

3.02 BASIC REQUIREMENTS

A. All planting areas shall be kept weed-free at all times during the Maintenance Period. All pests and disease control shall be the Contractor's responsibility. All planting areas shall be kept at optimum moisture for plant growth. Settlement of soil and plants and soil erosion shall be repaired and areas replanted. Dying or deficient plants shall be replaced as they become apparent.

B. Weeding, Cultivating, and Clean-Up: Planting areas shall be kept neat and free from debris at all times and shall be cultivated and weeded at not more than ten (10) day intervals.

C. Fertilizer: Application for all planting areas including turf shall be as specified in Specification Section Landscape Planting.

D. Mowing Schedule:
   1. Winter - Mow grass to 1”.
   2. Other Seasons - Mow grass to 1.5”.

E. Pruning: Prune new trees and shrubs with the direction of the Architect. Do not remove lower branches from multi-trunk or low branching trees unless directed.
F. Insect, Pest, and Disease Control: Insects, pests, rodents and diseases shall be controlled by the use of approved pesticides, insecticides, and fungicides, as recommended and applied by a licensed pest control operator and as approved by the Architect.

G. Replacement Materials: Immediately replace any dead or damaged plant materials. Turf areas not fully established and healthy shall be repaired or replaced as directed by the Architect. Replacements shall be made to the specifications as required to match adjacent plantings at no cost to the Owner.

H. Irrigation: Apply water to plants and grass to maintain optimum moisture content throughout the maintenance period.

3.03 CONDITION OF PLANTING AT END OF MAINTENANCE PERIOD

A. All planting areas shall be free of all weeds (broadleaf and grass weeds). Plantings that do not conform to specifications shall be replaced and brought to a satisfactory condition before final acceptance of the work.

B. All turf areas, including seeded areas, shall be completely covered at the time of final acceptance. Turf areas shall be free of all weeds (broadleaf and grass weeds) and shall be mowed to specified height. Low spots and/or bare patches shall be patched with sod. Sod shall be equivalent to the sod or seed used during planting operations.

C. Remove all nursery tree stakes and associated tying materials prior to Final Review.

3.04 IN-SERVICE MEETING

A. Contractor shall request, prior to Final Review, an in-service meeting with the Owner’s maintenance staff to identify any landscape maintenance issues and verify mowing schedules.
1. The Contractor shall document any discussions / decisions at the in-service meeting and provide this to the Architect. Include a copy in the Maintenance Binder.
2. The Final Review shall not take place until the in-service meeting is completed, and final approval is contingent on the in-service meeting taking place to the satisfaction of the Architect.

3.05 CLOSEOUT

A. Close-out per UGC 12 and Special Conditions 1.13 and Warranty per UGC Article 13 and Special Conditions 1.14
SECTION 32 11 23 - AGGREGATE BASE COURSES

PART 1 - GENERAL
1.1 SUMMARY
   A. Section includes furnishing and installing flexible base for curbs and gutters, roadways, and parking areas as shown and detailed on the Drawings

1.2 RELATED WORK
   A. Related Work of Other Sections:
      1. Section 31 00 00 – Site Earthwork
      2. Section 31 23 13 – Subgrade Preparation
      3. Section 32 12 16 – Asphalt Paving

1.3 REFERENCES
   A. American Society of Testing and Materials (ASTM), 1916 Race Street, Philadelphia, Pennsylvania 19103. All references shall be to current active standard.
      4. ASTM D1557 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lb/ft³ (2,700 kN-m/m³)).
      8. ASTM D6938 – Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
   B. Texas Department of Transportation (TxDOT), 125 East 11th Street, Austin, Texas 78701.
      1. Tex-116-E – Ball Mill Method for Determining the Disintegration of Flexible Base Material
      2. Tex-117-E – Triaxial Compression for Disturbed Soils and Base Materials
      3. Tex-140-E – Measuring Thickness of Pavement Layer

1.4 SUBMITTALS
   A. Test Reports: Submit two (2) copies of test reports of the physical properties of base material for review and approval by the Owner's Representative.
   B. Laboratory analysis of each base course material proposed demonstrating compliance with the requirements listed below in 2.1A. Utilize the following ASTM and TxDOT standard laboratory test procedures:
      1. Moisture Content (ASTM D2216)
      2. Liquid Limit (ASTM D4318)
      3. Plasticity Index (ASTM D4318)
4. Sieve Analysis (ASTM D422)
5. Moisture-Density Determination (ASTM D1557)
6. Roadway Density (ASTM D6938)
7. Wet Ball Mill (Tex-116-E)
8. Compressive Strength (Tex-117-E)

C. Submit in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.09 SUBMITTALS and UGC Article 8.

1.5 QUALITY ASSURANCE

A. Obtain materials from same source throughout.
B. Take samples for laboratory testing in conformance with ASTM D75.
C. One optimum moisture-maximum density curve from proposed material.

D. QUALITY ASSURANCE in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.10 QUALITY ASSURANCE AND UGC Article 8.

PART 2 - PRODUCTS

2.1 BASE COURSE

A. Type A Base Course – Type A material shall be crushed stone produced and graded from oversize quarried aggregate that originates from a single, naturally occurring source. Crushed gravel or uncrushed gravel shall not be acceptable A material. No blending of sources and/or additive materials will be allowed in material.
B. Type E Base Course – Caliche.
C. Base Course material shall meet the following criteria:

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Grade 1-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Master Gradation Sieve Size (% Retained)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-1/2”</td>
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<td></td>
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<tr>
<td>1-3/4”</td>
<td></td>
<td>0-10</td>
</tr>
<tr>
<td>7/8”</td>
<td>ASTM D422</td>
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<tr>
<td>3/8”</td>
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<tr>
<td>No. 4</td>
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<td>45-75</td>
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<tr>
<td>No. 40</td>
<td></td>
<td>65-90</td>
</tr>
<tr>
<td>Liquid Limit (% Max.)</td>
<td>ASTM D4318</td>
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</tr>
<tr>
<td>Plasticity Index (Max.)</td>
<td>ASTM D4318</td>
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<tr>
<td>Wet Ball Mill (% Max.)</td>
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<td>40</td>
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<tr>
<td>Wet Ball Mill (% Max. Increase Passing No. 40 Sieve)</td>
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<td>Minimum Compressive Strength (psi)</td>
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<td>Lateral Pressure 0 psi</td>
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</tr>
<tr>
<td>Lateral Pressure 15 psi</td>
<td>Tex-117-E</td>
<td>175</td>
</tr>
</tbody>
</table>

1. The Engineer may accept material if no more than one (1) of the five (5) most recent gradation tests has an individual sieve outside the specified limits of the gradation.
2. The Engineer may accept material if no more than one (1) of the five (5) most recent plasticity index tests is outside the specified limit. No single test may exceed the allowable limit by more than 2 points.

PART 3 - EXECUTION

3.1 GENERAL

A. The Contractor shall provide and set all construction stakes as required by a Registered Professional Land Surveyor for the work required. All stakes shall be
checked for conformity with the drawings and existing conditions. After approval of lines and grades the Contractor shall protect and maintain the approved stakes until they have served their purpose. Blue tops shall be set by the Contractor for subgrade on centerline, quarter points, and curb lines at intervals not exceeding 50 feet or 25 feet within curves.

B. The subgrade shall have been compacted to a minimum of 95 percent density, to the typical sections, lines and grades shown on the drawings. The Contractor shall verify that the subgrade has been prepared and compacted in accordance with Section 31 23 13 by proof rolling. Any deviation shall be corrected and proof rolled prior to placement of aggregate, and must be approved by the Owner's Representative. As soon as possible after the acceptance of the condition of the subgrade, the base course shall be installed.

3.2 PLACEMENT

A. Placing: Flexible base shall be placed in eight inch (8") courses maximum and in accordance with the following:

1. First Course:
   a. It shall be the responsibility of the Contractor to deliver the required amount of base material to each 100-foot station. Base material shall be spread uniformly and shaped the same day as delivered. In the event inclement weather or other unforeseen circumstances render this impractical, the material shall be shaped as soon as practical.
   b. Prior to compacting the flexible base, the flexible base material shall be bladed and shaped to conform to the typical sections as shown on the plans. All areas of segregated coarse or fine material shall be corrected or removed and replaced with well-graded material, as directed by the Engineer and at the Contractor's expense.
   c. The Contractor shall sprinkle for dust control as directed by the Engineer.

2. Succeeding or Finish Courses:
   a. Construction methods shall be the same as required for the first course. Throughout this entire operation, the shape of each course shall be maintained by blading. Upon completion, the surface shall be smooth and in conformity with the typical section as shown on the plans and the established lines and grades. Prior to placing the surfacing on the completed base, the base shall be cured to the extent directed by the Engineer.

3. Compaction Method:
   a. The flexible base shall be compacted to a minimum of 98% of the maximum dry density as determined by the modified Proctor test (ASTM D1557) and the moisture content shall be within plus or minus 1.5% of the optimum moisture content.
   b. When the material fails to meet the density requirements, or it loses the required stability, density or finish before the next course is placed or the project is completed, it shall be reworked and retested in accordance with Section 3.2.A.4, below

4. Reworking a Section:
   a. Should the base course, due to any reason or cause, lose the required stability, density or finish before the surfacing is complete; it shall be
reworked, recompacted and refinished at the sole expense of the Contractor.

5. Tolerances shall conform to the following:
   a. Density Tolerances. The Engineer may accept the work providing not more than one (1) out of the most recent five (5) consecutive density tests performed is below the specified density, and providing that the failing test is no more than three (3.0) pounds per cubic foot below the specified density.
   b. Grade Tolerances. In areas on which surfacing is to be placed, any deviation in excess of 1/4 inch in cross section or 1/4 inch in a length of 16 feet measured longitudinally shall be corrected by loosening, adding or removing material, reshaping and recompacting by sprinkling and rolling.
   c. Thickness Measurement. When the measurement is by the square yard, the flexible base will be measured for depth in units of 4000 square yards, or fraction thereof. The measurements will be at location(s) determined by the Engineer and performed in accordance with Test Method Tex-140-E. In any unit where flexible base is deficient by more than 1/2 inch in thickness, the deficiency shall be corrected by scarifying, adding material as required, reshaping, recompacting and refinishing at the Contractor's expense.

B. Spreading
   1. Flexible base material deposited upon the prepared subgrade shall be spread, shaped and rolled the same day if possible. If not possible to do this within the first twenty-four hours (24), delay shall be held to a minimum. The base shall be wetted, bladed and rolled to achieve at least 98% compaction as determined by ASTM D1557. If the material fails to meet the density specified, it shall be re-worked as necessary to meet the density required.

C. Deviation
   1. Any deviation in the finish surface in excess of 1/4" in cross-section or removing material, reshaping and recompacting by sprinkling or rolling. Any re-working of the base course required to conform to these specifications shall be at the cost of the Contractor.

3.3 QUALITY CONTROL TESTING
   A. Inspect and test each lift of base course. Do not place base for subsequent lifts until test results for the previously placed lift verify compliance with compaction requirements.
   B. Perform field density tests in accordance with ASTM D6938.
   C. Perform at least one field in-place density test for every 500 square feet, in no case shall be less than three (3) tests for any base course placement.
   D. Moisture-Density Relationship: One test of a representative sample of each day's delivery.

END OF SECTION 32 11 23
SECTION 32 12 16 - ASPHALT PAVING

PART 1 - GENERAL
1.1 RELATED DOCUMENTS
A. The Terms and Conditions of the Contract, including Supplementary and Special Conditions of the Contract, and the Drawings apply to this Section.

1.2 SUMMARY
A. Section includes furnishing and installing asphalt concrete paving including prime coat, tack coats, and related work as shown and detailed on the Drawings.

1.3 RELATED WORK
A. Related work of other Sections includes:
   1. Section 31 00 00 – Site Earthwork
   2. Section 32 11 23 – Aggregate Base Courses

1.4 DEFINITIONS
A. Prime Coat – Prime coat is an asphalt binder applied to the finished base material to provide some waterproofing and to enable it to bond to a subsequent pavement layer (surface treatment or hot mix asphalt).
B. Tack Coat – Tack coat is applied as a binder between layers of hot mix asphalt.

1.5 ACRONYMS
A. AE-P – Asphalt Emulsion Prime
B. CSS – Cationic Slow Setting
C. EAP&T – Emulsified Asphalt Prime and Tack
D. H (suffix) – Harder Residue (lower penetration)
E. MC – Medium Curing
F. PCE – Prime, Cure and Erosion Control
G. SS – Slow Setting

1.6 REFERENCES
   1. ASTM D946 – Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction
   2. ASTM D977 – Standard Specification for Emulsified Asphalt
   3. ASTM D2027 – Standard Specification for Cutback Asphalt (Medium-Curing Type)
B. TxDOT: Texas Department of Transportation Standard Specifications for Construction of Highways, Streets and Bridges, TxDOT 2004 edition
   1. TxDOT Item 300 – Asphalts, Oils, and Emulsions
   2. TxDOT Item 340 – Dense-Graded Hot-Mix Asphalt

1.7 SUBMITTALS
A. Contractor shall certify the mixing plant will conform to the requirements of TxDOT Item 340.
B. Mix design reports for Type D mixture in accordance with TxDOT Method Tex-204-F.
C. Submit in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.09 SUBMITTALS and UGC Article 8.

1.8 DELIVERY, STORAGE AND HANDLING
A. Asphaltic Concrete Material shall be hauled in tight trucks previously cleaned of all dirt and foreign material with the load completely covered by canvas.

PART 2 - PRODUCTS

2.1 PRIME COAT
A. Provide material meeting the requirements of one of the following:
   1. MC-30 in accordance with ASTM D2027.
   2. AE-P meeting the requirements of TxDOT Item 300.
   3. EAP&T meeting the requirements of TxDOT Item 300.
   4. PCE meeting the requirements of TxDOT Item 300.

2.2 TACK COAT
A. Provide material meeting the requirements of one of the following:
   1. ASTM D977 emulsified asphalt, or ASTM D2397 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.
   2. CSS-1H meeting the requirements of TxDOT Item 300.
   3. EAP&T meeting the requirements of TxDOT Item 300.
   4. SS-1H meeting the requirements of TxDOT Item 300.

2.3 HOT MIX ASPHALTIC CONCRETE SURFACE COURSE
A. The asphaltic concrete surface course shall be plant mixed, hot laid TxDOT Item 340 Type D (Fine Graded Surface Course) meeting the master specifications requirements in listed below. The mix is to be designed for a stability of 40 (minimum) when tested in accordance with TxDOT Test Method Tex-208-F. The asphalt cement content by percent of total mixture weight shall fall within a tolerance of -0.2 to +0.4 percent asphalt cement from the specific mix. The grade of asphalt cement shall be PG 64-22, ASTM D946. In addition, the mix shall be designed so that 75 to 85 percent of the voids in the mineral aggregate (VMA) are filled with asphalt cement. The coarse aggregate shall be crushed limestone, not gravel. Aggregates known to be prone to stripping should not be used in the hot mix. The mix shall have at least 70 percent strength retention when tested in accordance with Tex-531-C.

<table>
<thead>
<tr>
<th>Master Gradation Bands (%) Passing by Weight or Volume</th>
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<tbody>
<tr>
<td>Sieve Size</td>
<td>% Passing</td>
</tr>
<tr>
<td>3/4”</td>
<td>-</td>
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<tr>
<td>1/2”</td>
<td>98.0 – 100.0</td>
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<tr>
<td>3/8”</td>
<td>85.0 – 100.0</td>
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<td>#4</td>
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<td>#50</td>
<td>7.0 – 20.0</td>
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<td>#200</td>
<td>2.0 – 7.0</td>
</tr>
</tbody>
</table>

2.4 HOT MIX ASPHALTIC CONCRETE BASE COURSE
A. The asphaltic concrete base course shall be plant mixed, hot laid TxDOT Item 340 Type A (Coarse Base) or Type B (Fine Base) meeting the master specifications requirements in listed below. The mix is to be designed for a stability of 40 (minimum) when tested in accordance with TxDOT Test Method Tex-208-F. The asphalt cement content by percent of total mixture weight shall fall within a tolerance of -0.2 to +0.4 percent asphalt cement from the specific mix. The grade of asphalt cement shall be PG 64-22, ASTM D946. In addition,
the mix shall be designed so to have a minimum 12.0 (Type A) or 13.0 (Type B) percent voids in mineral aggregate (VMA). Aggregates known to be prone to stripping should not be used in the hot mix. The mix shall have at least 70 percent strength retention when tested in accordance with Tex-531-C.

<table>
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<tr>
<th>Type A Master Gradation Bands (%) Passing by Weight or Volume</th>
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<table>
<thead>
<tr>
<th>Type B Master Gradation Bands (%) Passing by Weight or Volume</th>
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<tbody>
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<td>Sieve Size</td>
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2.5 EQUIPMENT
A. All equipment shall comply with the requirements below:
1. Asphalt Paver: Furnish a paver that will produce a finished surface that meets longitudinal and transverse profile, typical section, and placement requirements. Ensure paver does not support the weight of any portion of hauling equipment other than the connection. Provide loading equipment that does not transmit vibration or other motions to the paver that adversely affect the finished pavement quality. Equip the paver with an automatic, dual, longitudinal-grade control system and an automatic, transverse-grade control system.
2. Tractor Unit: Supply tractor unit that can push or propel vehicles, dumping directly into the finishing machine to obtain the desired lines and grades to eliminate any hand finishing. Equip the unit with a hitch sufficient to maintain contact between the hauling equipment’s rear wheels and the finishing machine’s pusher rollers while mixture is unloaded.
3. Screed: Provide a heated compacting screed that will produce a finished surface that meets longitudinal and transverse profile, typical section, and placement requirements. Screed extensions must provide the same compacting action and heating as the main unit unless otherwise approved.

4. Grade Reference: Provide a grade reference with enough support that the maximum deflection does not exceed 1/16 in. between supports. Ensure that the longitudinal controls can operate from any longitudinal grade reference including a string line, ski, mobile string line, or matching shoes. Furnish paver skis or mobile string line at least 40 ft. long unless otherwise approved.

5. Material Transfer Devices: Ensure the devices provide a continuous, uniform mixture flow to the asphalt paver.

6. Remixing: When required, provide equipment that includes a pug mill, variable pitch augers, or variable diameter augers operating under a storage unit with a minimum capacity of 8 tons.

7. Motor Grader: When allowed, provide a self-propelled grader with a blade length of at least 12 ft. and a wheelbase of at least 16 ft.

8. Handheld Infrared Thermometer: Provide a handheld infrared thermometer meeting the requirements of Tex-244-F.

9. Straightedges and Templates: Furnish 10 ft. straightedges and other templates as required or approved.

10. Coring Equipment: When coring is required, provide equipment suitable to obtain a pavement specimen meeting the dimensions for testing.

11. Rollers:
   a. Pneumatic Tire Rollers – Pneumatic tire rollers consist of rubber wheels on axels mounted in a frame with either a loading platform or body suitable for ballast loading. Arrange the rear tires to cover the gapes between adjacent tires of the forward group. Furnish rollers capable of forward and backward motion, Compact asphalt pavements and surface treatments with a roller equipped with smooth-tread tires. Compact without damaging the surface. When necessary, moisten the wheels with water or an approved asphalt release agent. Select and maintain the operating load and tire pressure within the range of the manufacturer’s charts or tabulations to attain maximum compaction. Furnish the manufacturer’s charts or tabulations showing the contact areas and contact pressures for the full range of loadings for the particular tires furnished. Maintain individual tire inflation pressures within 5 psi of each other. Provide uniform compression under all tires.

PART 3 - EXECUTION

3.1 INSPECTION
A. Proof-roll prepared subbase and base course surfaces to check for unstable areas and areas requiring additional compaction or which have become wet beyond acceptable limits. Do not begin paving work until deficient areas have been corrected and are ready to receive paving.

3.2 PRIME COAT
A. Conditions
   1. Prime coat shall not be applied when the air temperature is below 60 degrees F and falling, but it may be applied when the temperature is above 50 degrees F and is rising; the air temperature being taken in the shade and away from artificial heat.
B. Preparation
   1. Clean the surface by sweeping with a vacuum sweeper or other approved methods as directed by the Engineer

C. Application
   1. Apply with an approved sprayer. Prime coat shall be applied at a rate not to exceed 0.20 gallons per square yard over compacted base material, smoothly and evenly, and shall be cured for 24 hours minimum. During the application of prime coat care shall be taken to prevent splattering of adjacent pavement, curbs, gutters or structures.

3.3 TACK COAT
   A. Maximum Lift Thickness – if the proposed hot mix asphalt thickness exceeds the maximums listed below, it will be installed in multiple lifts with tack coat applied between the lifts:
      1. Type A: 6.0"
      2. Type B: 5.0"
      3. Type D: 3.0"
   B. Preparation
      1. Clean the surface by sweeping with a vacuum sweeper or other approved methods as directed by the Engineer.
   C. Application
      1. Apply with an approved sprayer. Tack coat shall be applied at a rate not to exceed 0.10 gallons per square yard over the surface, smoothly and evenly. All contact surfaces of curbs and surfaces and all joints shall be painted with a thin uniform coat of the tack coat material. During the application of prime coat care shall be taken to prevent splattering of adjacent pavement, curbs, gutters or structures.

3.4 SURFACE COURSE
   A. Conditions
      1. The asphaltic mixture, when placed with a spreading and finishing machine, or the tack coat shall be placed when the air temperature is at least 50 degrees F.
      2. The asphaltic mixture, when placed with a motor grader, shall not be placed when the air temperature is below 55 degrees F and is falling, but may be placed when the air temperature is above 45 degrees F and is rising.
      3. The air temperature shall be taken in the shade and away from artificial heat.
      4. If, after being discharged from the mixer and prior to placing, the temperature of the asphaltic mixture falls below 200 degrees F, it will be rejected.
   B. The surface course shall be the thickness as shown on the drawings and spread in lifts with a maximum thickness of 3.0". Spread the lift in such a manner that when compacted, the finished course will be smooth, of uniform density, and to section, line and grade as shown on the drawings. All surface course placement shall meet the requirements of TxDOT Item 300.

3.5 ROLLING
   A. A Troxler nuclear density gauge shall be used to determine rolling pattern.
   B. Begin rolling while pavement is still hot and as soon as it will bear the roller without undue displacement or hair cracking. To prevent adhesion of surface mixture to the roller, keep wheels properly moistened with water. Excessive use
of water will not be permitted. Complete compaction before mix temperature cools to 185 degrees F.

C. Compress the surface thoroughly and uniformly, first with power-driven, 3-wheel, or tandem rollers weighing a minimum of 12 tons. Obtain subsequent compression by starting at the side and rolling longitudinally toward the center of the pavement, overlapping on successive trips by at least on-half width of rear wheels. Make alternate trips slightly different in length. Continue rolling until not further compression can be obtained and all rolling marks are eliminated.

D. Use a tandem roller for the final rolling. Double coverage with an approved pneumatic roller on asphaltic concrete surface is acceptable after flat wheel and tandem rolling has been completed.

E. All rolling compaction shall be completed before the mixture temperature drops below 175 degrees F.

3.6 HAND TAMPING
A. Along walls, curbs, headers and similar structures, and in all locations not accessible to rollers, compact the mixture thoroughly with a vibrating plate compactor

3.7 DENSITY
A. Compact the surface course to the density between 91 and 95 percent of the maximum theoretical density as measured by TEX-207-F. If, during the construction, the results of density tests show that either the compacted base course, binder course or surface course has a density less than specified, an additional rolling with a 3-wheel or pneumatic roller will be required. Such a rolling shall be done before the mix cools if it is to be successful.

3.8 SURFACE TESTS
A. The Contractor shall conduct surface testing. The completed surface, when tested with a 10-foot straightedge laid parallel to the center line of the pavement, shall show no deviation in excess of 3/16 inch per foot from the nearest point of contact. The maximum ordinate measured from the face of the straightedge shall not exceed 1/4 inch at any point. Furnish approved templates for checking subgrade in finished sections. The strength and rigidity of templates shall be such that if a support is transferred to center, no deflection is excess of 1/8 inch will be observed.

3.9 CONSTRUCTION JOINTS
A. Place courses as nearly continuously as possible. Pass the roller over unprotected ends of the freshly laid mixture only when the mixture has become chilled. When work is resumed, cut back the laid material to produce a slightly beveled edge for the full thickness of the course. Remove old material which has been cut away and lay the new mix against the fresh cut.

3.10 DEFECTIVE PAVEMENT
A. Recompact pavement sections not meeting specified densities or replace them with new asphaltic concrete material. Replace with new material section of surface course pavement not meeting surface test requirements or having an unacceptable surface texture. Patch asphalt pavement sections in accordance with procedures established by the Asphalt Institute. Replace asphalt pavement sections which did not meet the specifications.

3.11 DEFICIENT SURFACE THICKNESS
A. Any area of asphalt surface found deficient in thickness by more than 0.25 inches, and if low and causing ponding, shall be removed and replaced, at the
Contractor's expense, with asphalt surface of the thickness shown on the drawings. Care should be taken not to damage or remove the pavement below the asphalt surface. Should damage to the pavement below the asphalt surface occur, it shall also be removed and replaced at the Contractor's expense.

B. No additional payment over the contract price will be made for any asphalt surface of a thickness exceeding that required by the drawings.

3.12 QUALITY CONTROL TESTING

A. Perform document and report the following quality control tests:
   1. Bulk specific gravity tests of the in-place, compacted bituminous mixtures in accordance with TxDOT Test Method Tex-207-F, Part I.
   2. For Type D mixture take three (3) cores for each 500 tons placed.
   3. QUALITY ASSURANCE in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.10 QUALITY ASSURANCE AND UGC Article 8.

END OF SECTION 32 12 16
SECTION 32 13 13 - CONCRETE PAVING

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section includes:
   1. Driveways.
   2. Roadways.
   3. Parking lots.
   4. Curbs and gutters.
   5. Walks.

B. Related Sections:
   1. Section 01 43 00 – Quality Assurance
   2. Section 01 45 00 – Quality Control
   3. Section 03 30 00 – Cast-In-Place Concrete
   4. Section 31 00 00 – Site Earthwork
   5. Section 31 11 00 – Clearing and Grubbing
   6. Section 31 23 13 – Subgrade Preparation

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 REFERENCES
A. Geotechnical Report
B. AASHTO: American Association of State Highway and Transportation Official, 444 N Capitol St. NW, Suite 249, Washington, DC 20001. All references are to current active publication.
   1. AASHTO M182 – Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats.
C. ACI: American Concrete Institute, 38800 Country Club Drive, Farmington Hills, Michigan 48331, USA. All references shall be to current active publication.
   2. ACI 301 – Specifications for Structural Concrete.
   5. ACI 325 – Guide for Design of Jointed Concrete Pavements for Streets and Local Roads
   1. ASTM A615 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
3. ASTM C31 – Standard Practice for Making and Curing Concrete Test Specimens in the Field.
11. ASTM C231 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
15. ASTM C618 – Standard Specification for Coal Fly Ash and Raw or Natural Pozzolan for Use in Concrete.

1.5 SUBMITTALS
A. Product Data: For each type of product indicated.
B. Shop Drawings: Indicate joint layout, pavement markings, lane separations, and defined parking spaces.
C. Other Action Submittals:
   1. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

E. Material Certificates: For the following, from manufacturer:
1. Cementitious materials.
2. Steel reinforcement and reinforcement accessories.
3. Fiber reinforcement.
4. Admixtures.
5. Curing compounds.
7. Bonding agent or epoxy adhesive.
8. Joint fillers.

F. Material Test Reports: For each of the following:
1. Aggregates.

G. Field quality-control reports.

H. Submit in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.09 SUBMITTALS and UGC Article 8.

1.6 QUALITY ASSURANCE
A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94 requirements for production facilities and equipment.
B. ACI Publications: Comply with ACI 301 unless otherwise indicated.
C. Pre-installation Conference: Conduct conference at Project site.
   1. Review methods and procedures related to concrete paving, including but not limited to, the following:
      a. Concrete mixture design.
      b. Quality control of concrete materials and concrete paving construction practices.
   2. Require representatives of each entity directly concerned with concrete paving to attend, including the following:
      a. Contractor's superintendent.
      b. Independent testing agency responsible for concrete design mixtures.
      c. Concrete paving subcontractor.
D. QUALITY ASSURANCE in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.10 QUALITY ASSURANCE AND UGC Article 8.

1.7 PROJECT CONDITIONS
A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities

1.8 DELIVERY, STORAGE AND HANDLING
A. All requirements for storage of materials, conveying, depositing, temperature for placing and protecting as specified under Section 03 30 00 shall apply to the concrete work performed under this section.

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. Do not use notched and bent forms.
   2. Curb and gutter outside forms shall have a height equal to the full depth of the curb or gutter. The inside form of curb shall have batter as indicated and shall be securely fastened to and supported by the outside form. Rigid forms shall be provided for curb returns, except that benders or thin plank forms may be used for curb or curb returns with a radius of 10 feet or more, where grade changes occur in the return, or where the central angle is such that a rigid form with a central angle of 90 degrees cannot be used. Back forms for curb returns may be made of 1-1/2 inch benders, for the full height of the curb, cleated together. In lieu of inside forms for curbs, a curb "mule" may be used for forming and finishing this surface, provided the results are approved.

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. Reinforcing Bars: Deformed steel bars, ASTM A615, Grade 60.
B. Joint Dowel Bars: ASTM A615, Grade 60, unless otherwise noted. Cut bars true to length with ends square and free of burrs.
C. Epoxy-Coated Joint Dowel Bars: ASTM A775; with ASTM A615, Grade 60, plain-steel bars
D. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:
   1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
   2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

2.3 CONCRETE MATERIALS
A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source throughout Project:
   1. Portland Cement: ASTM C150, [gray] [white] Portland cement Type I/II. Supplement with the following:
   2. Fly Ash: ASTM C618, Class F
   3. Ground Granulated Blast-Furnace Slag: ASTM C989, Grade 100 or 120.
B. Normal Weight Aggregates: ASTM C33, Class 4S, uniformly graded. Provide aggregates from a single source with documented service record data of at least 10 years satisfactory service in similar paving application and service conditions using similar aggregates and cementitious materials.
   1. Maximum Coarse-Aggregate Size:
   3. Curb and Sidewalk: 1 inch nominal.

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: 1/2 to 3/4 inch nominal.

D. Water: Potable and complying with ASTM C94.


F. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain no more than 0.1 percent water-soluble chloride ions by mass of cementitious material:
1. Water-Reducing Admixture: ASTM C494, Type A.
2. Retarding Admixture: ASTM C494, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C494, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C494, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C494, Type G.
6. Plasticizing and Retarding Admixture: ASTM C1017, Type II

G. Color Pigment: ASTM C979, 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: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   2. ChemMasters.
   3. Davis Colors.
   4. Dayton Superior Corporation.
   5. Elementis Pigments.
   7. Lambert Corporation.
   8. LANXESS Corporation.
   9. QC Construction Products.
  11. Solomon Colors, Inc.
  12. Stampcrete International, Ltd.
  14. Color: As selected by Architect 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 C1116, 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:
   2. Monofilament Fibers:
      1) Axim Concrete Technologies; Fibrasol IIP.
      2) Euclid Chemical Company (The); Fiberstrand 100.
      3) FORTA Corporation; Forta Mono.
5) Metalcrete Industries; Polystrand 1000.
6) SI Concrete Systems; Fibermix Stealth

3. Fibrillated Fibers:
1) Axim Concrete Technologies; Fibrasol F.
2) Euclid Chemical Company (The); Fiberstrand F.
3) FORTA Corporation; Forta.
5) SI Concrete Systems; Fibermes

2.5 CURING MATERIALS

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

B. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   b. Concrete Chemicals, Inc.: CCI Evaporation Retardant.
   c. Contractors Paving Supply: CPSI-ER.
   d. Euclid Chemical Company: Eucobar
   e. L&M Construction Chemicals, Inc.: E-Con.
   f. Master Builders: MasterKure ER 50.
   g. Nox-Crete: Nox-Crete Monofilm.
   h. Poly-Tuff System: TuffAid Evaporative Retarder & Finishing Aid.
   i. Sika Corp.: SikaFilm.
   j. Spec Chem: SpecFilm (RTU & Concentrate).
   k. Texas Polymer Systems: TPS ER.
   l. US SPEC: Monofilm ER.
   m. Vexon Chemicals: Certi-Vex Envio Assist.

E. Liquid Membrane-Forming Concrete Curing Compound: ASTM C309. Type 1D or Type 2 Class A.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   b. Concrete Paving Solutions: Type I-D, code 1140.
   c. Dayton Superior: Type I, code: Resin Cure w/dye J11WD; Type II, code: White Resin Cure TX; and Type II, code: Texas WWC J9A.
   d. Hunt Process Corp.: Type II, code: WTX; and Type II, code: WWTX1 White Wax Cure.
   e. Prime Eco Group: Type I-D, code: TID-300; Type II, code TSC-100; and Type II, code: Eco1000.
f. Right Pointe: Type II, code: White Water Resin; and Type II White Water Wax Cure.
g. Spec Chem: Type I-D, code: Pave Cure Rez Clear-TX; Type II, code: Pave Cure Rez White-TX; and Type II, code: PCWW-1 Wax.
h. Texas Polymer Systems: Type I, code: Clear Cure; and Type II, code: White Cure.
i. W.R. Meadows: Type I-D, code: 1140 SEALTITE 1310; Type II, code: 1240; and Type II, code: 1600 series (1610 white).

2.6 RELATED MATERIALS
A. Joint Fillers: ASTM D1751 asphalt saturated cellulosic fiber in preformed sheets.
B. Slip Resistive Aggregate Finish: Factory-graded, packaged, rustproof, non-glazing, 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 C1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
D. Epoxy Bonding Adhesive: ASTM C881, 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 IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
E. 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.
F. Joint Sealants: Acceptable sealants include, but are not limited to:
   1. MasterSeal SL1 by BASF
   2. Sikaflex-1A, by Sika Corporation
   3. Eucolastic 1SL, by Euclid Chemical Company

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):
      a. Concrete Pavement: 4,000 psi.
      b. Concrete Sidewalk: 3,000 psi.
      c. Concrete Curb and Gutter: 3,500 psi.
   2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.45.
   3. Slump Limit: 5 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: 4-1/2 percent plus or minus 1.5 percent for 1-1/2-inch nominal maximum aggregate size.
2. Air Content: 4-1/2 percent plus or minus 1.5 percent for 1-inch nominal maximum aggregate size.
3. Air Content: 5 percent plus or minus 1.5 percent for 3/4-inch nominal maximum aggregate size.

D. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
   1. Use water-reducing admixture in concrete as required for placement and workability.
   2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

E. Cementitious Materials: Limit percentage by weight of cementitious materials other than Portland cement according to ACI 301 requirements.

F. 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. 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.

PART 3 - EXECUTION
3.1 EXAMINATION
A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding
   1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph.
   2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
   3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch according to requirements in Section 31 23 13 – Subgrade Preparation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION
A. Prepare subgrade as per Section 31 23 13 – Subgrade Preparation.
B. Remove loose material from compacted subbase surface immediately before placing concrete/
C. Notify A/E a minimum of 24 hours prior to commencement of concreting operations.
D. Moisten base as required to minimize absorption of water from fresh concrete. Do not permit puddles of water to accumulate.

3.3 EDGE FORMS AND SCREED CONSTRUCTION
A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
3.4 STEEL REINFORCEMENT

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

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

E. 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.

3.5 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

2. Align joints in pavement, curb and sidewalks.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.

2. Provide tie bars at sides of paving strips where indicated.

3. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.

4. Dowelled 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, other fixed objects, and where indicated.

1. Locate expansion joints at maximum intervals of 50 feet unless otherwise indicated for curbs and sidewalks.

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 as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:
   1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces.
   2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut joints into concrete when cutting action will not tear, abrade, or otherwise damage surface. Joints are to be soft saw cut with an early entry saw, same day as pour. If not shown provide at approximately 4’ intervals for walks and 10’ intervals for paving unless otherwise indicated. Construct joints 1/4 of paving thickness unless otherwise indicated. Verify with A/E.

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.

B. Remove snow, ice, or frost from subbase, surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

E. 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.

F. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.

G. Screed paving surface with a straightedge and strike off.

H. 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.

I. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.

J. 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.
K. 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.

L. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
   1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
   2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
   3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas

3.7 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.

3.8 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 40 lb/100 sq. ft of dampened, slip-resistive aggregate over paving surface 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.
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.

3.9 DETECTABLE WARNINGS

A. Blockouts: Form blockouts in concrete for installation of detectable paving units specified in Division 32 Section "Unit Paving".

1. Tolerance for Opening Size: Plus 1/4 inch, no minus.

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. Reccoat 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 (10 mm), 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.
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.

3.12 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 C172 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.
2. 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.
3. Slump: ASTM C143; 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.
4. Air Content: ASTM C231, pressure method; 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; 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.
6. Compression Test Specimens: ASTM C31; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
7. Compressive-Strength Tests: ASTM C 39; test one specimen at seven days and two specimens at 28 days.
8. 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.

3.13 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 32 13 13
SECTION 32 17 13 - PARKING BUMPERS

PART 1 - GENERAL
1.1 RELATED DOCUMENTS
   A. The Terms and Conditions of the Contract, including Supplementary and Special Conditions of the Contract, and the Drawings apply to this Section.

1.2 SUMMARY
   A. Furnish all labor, materials and equipment for providing all of the following complete and in place:
      1. Parking bumpers.
      2. Adhesive.
      3. Steel bars for installation.

1.3 RELATED WORK
   A. Related work of other Sections includes:
      1. Section 03 30 00- Cast-In-Place Concrete

1.4 REFERENCES
   A. American Society for Testing and Materials (ASTM), 1916 Race Street, Philadelphia, Pennsylvania 19103, U.S.A. All references are to current active standard
      1. ASTM A615 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
   B. Texas Department of Transportation. Department of Transportation (TxDOT), 125 East 11th Street, Austin, Texas 78701
      1. TxDOT DMS-6100 – Epoxies and Adhesives.

1.5 SUBMITTALS
   A. General: Refer to Section 01 33 00 - Submittal Procedures, and Section 01 33 23 – Shop Drawings, Product Data and Samples, for submittal requirements and procedures.
   B. Shop Drawings: Submit Shop Drawings of bumpers, including plan layout and installation details, for approval.
   C. Product Data: Submit manufacturers’ product data of precast bumpers and epoxy adhesives for approval.
   D. Submit in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.09 SUBMITTALS and UGC Article 8.

1.6 QUALITY ASSURANCE
   A. Precast parking bumpers shall be manufactured for the intended purpose by a company or firm specializing in the manufacture of precast concrete parking appurtenances.
   B. QUALITY ASSURANCE in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.10 QUALITY ASSURANCE AND UGC Article 8.

PART 2 - PRODUCTS
2.1 MATERIALS
   A. Parking Bumpers:
      1. Provide precast concrete parking bumpers conforming to the dimensions shown on the plans.
      2. Bumpers shall be manufactured of air entrained concrete; 2,500 psi minimum compressive strength; approximately 4" high x 8" wide x 72" long, with a vertical hole in each end for anchorage as indicated on the plans.
      3. Provide (2) #3 reinforcing bars running the length of the wheel stop. Anchor in place with two No. 4 bars, 18" long.
   B. Adhesive: Adhesive for anchoring parking bumpers to pavement shall be an epoxy adhesive manufactured for the purpose, meeting the requirements of TxDOT DMS-6100, Type V.
   C. Steel Bars for Installation: Epoxy coated rebar, No. 4 size, ASTM A615, Grade 60, epoxy coated, with less than 2 percent damaged coating in each 12-inch of bar length.

PART 3 - EXECUTION
3.1 INSTALLATION
   A. Asphalt Pavement
1. Precast concrete parking bumpers shall be anchored in position on at-grade asphalt pavements, as indicated, with two No. 4 epoxy coated dowels and an appropriate epoxy adhesive as specified above.

B. Concrete Pavement

1. Core drill holes 1/8 inch larger than steel bar. Anchor in position as indicated, with two No. 4 epoxy coated dowels and an appropriate epoxy adhesive as specified above. Grout annular opening around hole.

OR

2. Precast concrete bumpers shall be secured in position on at-grade concrete pavements using a bed of epoxy grout meeting the requirements of TxDOT DMS-6100, Type V.

END OF SECTION 32 17 13
SECTION 32 17 23 - PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. The Terms and Conditions of the Contract, including Supplementary and Special Conditions of the Contract, and the Drawings apply to this Section.

1.2 SUMMARY
   A. Section includes parking striping, handicapped stall graphics, drive lane markings, and related work as shown and detailed on the Drawings.

1.3 SUBMITTALS
   A. Submit product data; include surface preparation, product handing and application requirements.

PART 2 - PRODUCTS

2.1 MATERIALS
   A. Marking Paint: Paint shall be chlorinated rubber federally approved traffic paint applied with two coats at the manufacturer's recommended rate (total minimum rate of 100 to 110 sq. ft/gal). Stripes shall match color and parking/drive layouts that currently exist.
   B. Provide "White" paint to mark paving stalls, directional arrows, etc. for asphalt paving areas. Provide "Yellow" paint to mark paving stalls, directional arrows, etc. for concrete paving areas. Provide "Blue" color for handicapped marking, and "Red" for fire lanes, unless otherwise indicated. Provide white stenciled "No Parking - Fire Lane" marking as applicable.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Examine areas and conditions under which work is to be performed and notify Owner's Representative of conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 PREPARATION
   A. Confirm that asphalt and concrete paving has cured a minimum of 30 days and that pavement surfaces are dry before starting pavement marking.
   B. Surface Preparation:
      1. Sweep and clean surface with power broom supplemented by hand brooming to remove loose material, dust and debris.
      2. Remove grease and oil deposits with solvents and detergents.
   C. Carefully and accurately lay out the location and termination of traffic and lane markings at the locations indicated. Protect adjacent curbs, walks, fences, and other items from receiving paint.
   D. Pavement-marking paint shall not be applied until layout, colors, and placement have been verified with the Owner.
3.3 QUALITY ASSURANCE

QUALITY ASSURANCE in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL
CONDITIONS SECTION 1.10 QUALITY ASSURANCE AND UGC Article 8.

3.4 APPLICATION

A. Striping: Apply paint with mechanical equipment to produce stripes with uniform straight
dges, minimum 4" wide. Apply in 2 coats at manufacturers recommended rates to provide a
15-mil minimum wet film thickness.

3.5 CURING AND PROTECTION

A. Curing and Protection: Barricade pavement areas to prevent traffic until coatings are
completely cured and ready to receive traffic in accordance with coating manufactures printed
instructions and recommendations.

END OF SECTION 32 17 23
SECTION 32 91 13 - SOIL PREPARATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to the work of this Section.

1.02 DESCRIPTION OF WORK

A. Extent: Furnish all labor, material, equipment, tools, and incidentals necessary for Soil Preparation of planting areas as shown on the Drawings and as specified in this Section. The work includes installation of soil amendments, finish grading and plant pit backfill.

B. Related work includes but is not limited to:
   1. Landscape Planting

1.03 REVIEWS

A. Quality Assurance: Quality Assurance in accordance with TPWD Division 1 - Section 01000 - Special Conditions Section 1.10 Quality Assurance and UGC Article 8.

B. Contractor shall specifically request at least (2) two days in advance the following review prior to progressing with the work:
   1. Intermediate Review – completion of site grading, amendment depths, finish grade.
   2. See Specification Sections Landscape Planting for other items to be inspected during this review.
   3. The review shall be conducted only after all items pertaining to the review as noted above and in related Sections have been completed by the Contractor.

1.04 SUBMITTALS

A. Test Samples: Contractor shall provide samples, as specified herein, to an agricultural soils testing laboratory approved by the Architect, referred to herein as the Testing Lab, unless delivered to the site in original, unopened containers, each bearing the manufacturer guaranteed analysis.
   1. Testing Lab – Soil, Water and Forage Testing Laboratory, 2610 F&B Road, College Station, TX 77845, (979) 845-4816 or prior approved equal.
   2. Use of an alternate soil testing lab without prior approval shall be cause for rejection of the submitted analysis.
   3. No material shall be delivered to the site until the Architect approves the material.
   4. The same Testing Lab shall be used for all tests specified herein.
   5. Contractor shall pay for all testing fees from the Testing Lab for all tests specified herein.
B. Submit in accordance with TPWD Division 1 - Section 01000 - Special Conditions Section 1.09 Submittals and UGC Article 8.

C. Product Certificates: Certification stating quantity, type, and composition, weight and origin for all amendments and chemicals shall be delivered to the Architect within fourteen (14) days of the Notice to Proceed and before the material is delivered to the site.

D. Testing – Existing Soil: Prior to finish grading operations or at least four weeks before proposed planting operations, Contractor shall take a sample each of the topsoil and sub-soil, from 0”-12" deep, in three separate locations across the site after rough grading, as directed by the Architect. Samples shall be mixed from the three locations to provide a composite sample, representative of the entire site, combined volume of samples not less than 2 quarts. Soil samples shall be forwarded to the Testing Lab by the Contractor for testing and recommendations as to exact fertilizers and soil amendments to be used in planting, analysis tests 7 and 10 or approved equal.
   1. Amendment and fertilizer recommendations by the Testing Lab shall be specific to the proposed amendments to be used. Generic recommendations will require the Contractor to re-obtain specific recommendations from the Testing Lab.
   2. Soils report shall include an estimated infiltration rate for the tested soils.

E. Testing – Amendments: Contractor shall provide, along with a sample, latest analysis of amendments/bulk organic materials by the Testing Lab for verification of conformance to this specification, and specific recommendations as to exact quantities to be used in planting.
   1. Analysis shall conform to physical and chemical properties specified herein.
   2. Analysis shall not be more than three months old at the time of submitting sample.
   3. The amendment recommendations, if different from those provided in the existing soils test, shall superseded those of the existing soils test.

F. Submit delivery tags for all amendments and fertilizers delivered to the Site for the Project.

G. Substitutions permitted per TPWD Special Conditions 1.09.C

1.05 PROTECTION

A. Protect concrete from any sulfate-based amendments that may be specified from soils analysis to avoid staining. Concrete damaged from amendment placement shall be replaced at the Contractor's expense.

PART 2 - PRODUCTS

2.01 EXISTING SOIL

A. Topsoil: The top layer of existing soil in planting areas below the grass root zone, containing minerals and organic materials including humus. Depth of topsoil shall be taken to be 2-4 inches deep or as determined by the Architect at the time of construction after clearing and grubbing.
B. Sub-soil: Shall be the remaining existing soil on the site after clearing & grubbing, after topsoil has been removed, and after all rocks over one cubic inch and all foreign debris and organic material have been removed.
   1. Soil under paving and aggregate base areas shall be considered as subsoil provided contamination testing as specified elsewhere in this section indicates that it is free of contaminants that are harmful to plant growth.

2.02 FERTILIZER

A. Fertilizer shall be the following:
   1. Commercial fertilizer: for soil amendment shall be 16-6-8 (N-P-K) uniform pellet.
   2. Commercial fertilizer packets: for plants shall be controlled-release three year 16-8-8 (N-P-K) by Nutri Pak.
   3. The requirements above are for bidding purposes only, exact fertilizer types to be determined by Testing Lab analysis.

2.03 SOIL AMENDMENTS

A. Nitrogen Stabilized Organic Amendment: shall be mineralized and nitrogen stabilized bark or sawdust humus, with wetting agent and properly pulverized and shall have a minimum of 270 lbs. per cubic yard of amendment. Submit sample analysis for approval.

B. Gypsum: Agricultural Grade

2.04 CHEMICALS

A. The following brand names of various chemicals to be used in this Section are provided for ease of specifying; equals or brands with similar chemicals that will match or improve performance may be used at the Contractor’s discretion. Contractor shall verify use of any chemicals with Architect prior to application:
   1. Pre-emergent herbicides - (granular form only) “Treflan” or “Ron Star”

PART 3 - EXECUTION

3.01 GENERAL

A. Limits and Grades: Prior to commencing soil preparation operations, Contractor shall request a review by the Architect to verify grading work completed to date and verify specified limits of soil preparation work to commence.

3.02 AMENDMENT PLACEMENT

A. The requirements below are for bidding purposes only, adjustments to the bidding formula shall be determined by the Testing Lab analysis.
B. All planting areas shall be thoroughly tilled to a minimum 4 inch depth. Upon completion of tilling, the amendments shall be applied, as follows:

<table>
<thead>
<tr>
<th>Amount/1000 Square Feet</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 cubic yards</td>
<td>Nitrogen Stabilized Organic Amendment</td>
</tr>
<tr>
<td>12 lbs.</td>
<td>Commercial Fertilizer</td>
</tr>
<tr>
<td>50 lbs</td>
<td>Gypsum</td>
</tr>
</tbody>
</table>

C. The materials shall then be uniformly spread and incorporated to obtain a homogeneously blended soil, five inches in depth.

D. Plant pits: Soil which has been amended in the above manner shall be used as the backfill mix around the sides of the root balls. See Specification Section Landscape Planting for plant pit requirements.

3.03 FINISH GRADING

A. Contractor shall finish grade all planting areas unless otherwise noted, and shall remove all rocks and clods over one cubic inch. In lawn areas, all rocks and clods shall be removed. All areas shall be smooth and uniformly graded. All erosion damage during the construction period shall be repaired by the Contractor.

B. Unless otherwise noted, all soil finish grades in sod areas shall be 1 inch below finish grade of walks, pavements, and curbs.

3.04 CHEMICALS

A. Herbicides and pesticides: Contractor shall verify compatibility, dosage and other application procedures with the manufacturer. All chemicals shall be applied by a pest control operator licensed in the State of Texas.

B. Planting areas: Treat all non-seeded areas for weed control with pre-emergent herbicide, as recommended by the manufacturer. See Specification Section Landscape Maintenance for related work.

C. Include copies of documentation of pesticide and herbicide applications, countersigned by the Architect, in the Maintenance Binder – see Specification Section Landscape Maintenance.

END OF SECTION 32 91 13
SECTION 32 93 03 - LANDSCAPE PLANTING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to the work of this Section.

1.02 DESCRIPTION OF WORK

A. Extent: Furnish all labor, material, equipment, tools, and incidentals necessary for the provision and installation of plant materials as shown on the Drawings and as specified in this Section.

B. Related work includes but is not limited to:
   1. Soil Preparation
   2. Landscape Maintenance

1.03 QUALITY ASSURANCE

A. Quality Assurance in accordance with TPWD Division 1 - Section 01000 - Special Conditions Section 1.10 Quality Assurance and UGC Article 8.

B. Quality: Minimum quality of all plant material shall unless otherwise indicated conform to:
   1. ANSI Z60.1-2004 American Standard for Nursery Stock, Sponsored by the American Nursery and Landscape Association (ANLA)
   2. Additional standards as indicated on the Drawings and as specified herein.

C. Applicable ASTM International Standards (latest revisions) as they apply to this work and related test methods, including:
   1. C602 Specification for Agricultural Liming Materials

1.04 SUBMITTALS

A. Submit in accordance with TPWD Division 1 - Section 01000 - Special Conditions Section 1.09 Submittals and UGC Article 8.

B. General: Within fourteen (14) days after Notice to Proceed submit the following:
   1. Documentation certifying quantity and species of plant material ordered, the nursery supplier(s), any plant material not available at that time, or proposed substitutions to be reviewed.
   2. Product data on all associated planting products specified herein.

C. Substitutions: Substitutions permitted per TPWD Special Conditions 1.09.C.
1.05 REVIEWS

A. Contractor shall specifically request at least (2) two days in advance the following review prior to progressing with the work:
   1. Intermediate Review – plant material approval and layout/locations. See Specification Section Soil Preparation for other items to be inspected during this review.

B. Contractor shall specifically request at least (5) five days in advance the following reviews prior to progressing with the work:
   1. Substantial Completion Review (to initiate Maintenance Period) – all planting areas including turf. See Specification Section Landscape Maintenance.
   2. Final Review (at the completion of Maintenance Period) - all planting areas including turf, including all punch-list items identified at Substantial Completion Review. See Specification Section Landscape Maintenance.

C. Each review shall be conducted only after all items pertaining to that review as noted above and in related Sections have been completed by the Contractor.

PART 2 - PRODUCTS

2.01 GENERAL

A. Nomenclature and Labels: Plant botanical names conform to “Standardized Plant Names,” second edition. All plants of each clone, species, and cultivar shall be delivered to the site labeled with their full botanical name. Every plant species shall be labeled with no less than one label for every ten plants of a species.

B. Quantities: The quantities shown on the plant list and in labels are for the Architect’s use and are not to be construed as the complete and accurate limits of the Contract. Contractor shall furnish and install all plants shown schematically on the Drawings.

C. Health: Foliage and stems of all plants shall be of vigorous health and normal habit of growth for its species. All plants shall be free of all disease, insect stages, burns or disfiguring characteristics.

2.02 TREES

A. All trees shall have straight trunks of uniform taper, larger at the bottom. Trunks shall be free of damaged bark, with all minor abrasions and cuts showing healing tissue. Sucker basal growth and lateral growth shall be removed and treated to eliminate re-sprouting. Normal lower side branching shall remain. Trees unable to stand upright without support shall be rejected.
2.03 FERTILIZER

   1. The requirements above are for bidding purposes only, exact fertilizer types per Testing Lab analysis.

2.04 TREE STAKES AND GUYING

A. Pole Staking
   1. Stakes: Peeled lodge pole pine logs, clean, smooth, new, and sized as follows:
      a. 2” dia x 8’ long for trees less than 8’ height
      b. 3” dia. x 8’-10” long for trees between 8’-10’ height.
      c. Stake height per requirements of plant – see planting details.
   2. Ties: Flat rubber ties 24” minimum length. Use roofing nails of adequate length to firmly attach ties to stake.

2.05 MULCH

A. Shall be double shredded hardwood mulch, color brown.

2.06 TURF SOD

A. Sod shall be grown from high quality seed in soil treated with appropriate State and Federal agency approved pesticides, fungicides, and herbicides and regularly inspected by the State.
   1. Sod shall have a well-developed root structure sufficiently mature so that it will hold together when held by one end of the roll.
   2. Yellowing, brown, diseased, dried, or pest infested sod shall be rejected.
   3. Soil thickness of the sod shall be 1/4 inch to 5/8 inch thick excluding top growth and thatch.
   4. Size of rolls or slabs shall be consistent to the supplier’s standard length and width and is not to vary by more than 2% in either dimension.
   5. See submittal requirements for sod soil as specified herein.

B. Sod shall be Common Bermuda.

2.07 PLANT MATERIAL

A. Plants shall be selected from a pre-approved nursery inspected for invasive ants. Contractor may also provide the vendor, and at no cost to the owner, may request an inspection for invasive ants. Vendor location shall be within two (2) hours of the construction site.

2.08 WEED MAT

A. Weed mat shall be a woven needle-punched polypropylene fabric. Pre-approved products:
   1. Dewitt Pro-5, 5.0 oz by Dewitt Company (800) 888-9669 www.dewittcompany.com
2.09 EDGING

A. Edging: As specified in the drawings.
   1. Edging shall include stakes as supplied by the manufacturer.

PART 3 - EXECUTION

3.01 GENERAL

A. Plant Material Approvals: Before planting operations commence, all plant material shall be reviewed by the Architect. Defective plants shall be removed from the site and acceptable material substituted in its place. The review does not accept defective plants which may be installed.

B. Layout: Only those plants to be planted in any single day should be laid out. Locations of all plants shall be reviewed prior to planting. Plants installed without this review may be transplanted/relocated as directed by the Architect.

C. Protection of Plants: Contractor shall maintain all plant material in a healthy growing condition prior to and during planting operation. Contractor shall be responsible for vandalism, theft, and damage to plant material until commencement of the maintenance period.

D. Pruning: Contractor shall do no pruning without specific authorization of the Architect. Plants pruned without authorization shall be replaced by the Contractor if necessary.

3.02 PLANT PITS

A. Rootball shall rest only on undisturbed soil, or in the case of fill areas, on compacted, un-amended sub-grade. See Specification Section Soil Preparation for backfill mix requirements. Plant rootball and pits shall have their sides and bottoms loosened and otherwise broken to prevent glazing or compaction.
   1. Plant pit sizes shall be as shown on the Drawings.
   2. Plant pits in paved areas shall extend to the edge of the planter opening in all directions unless otherwise noted on the Drawings.

3.03 TREE INSTALLATION

A. Watering basins: Construct basins as required to water trees during establishment period. Basin bottoms shall drain away from plant trunks. See Specification Section Landscape Maintenance for removal of basins.

B. Staking: All trees less than 4” caliper shall be staked. Install stakes as per the Details.
   1. Stakes shall be driven securely into existing soil on the windward side of the tree. A minimum of two figure-eight, rubber tree ties shall be required.
   2. If using rubber ties without wire, nail rubber ties to the back of stakes in areas of severe wind conditions.
3.04 CHEMICALS

A. Pesticide: Contractor shall verify compatibility, dosage and other application procedures with the manufacturer. All pesticides shall be applied by a pest control operator licensed in the State of Texas.

B. Include copies of documentation of pesticide applications, countersigned by the Architect, in the Maintenance Binder – see Specification Section Landscape Maintenance.

3.05 FERTILIZER

A. Apply Commercial Fertilizer at 5 pounds per 1,000 square feet to all planting areas including turf, 30 days after planting. Re-application shall be scheduled at 45 day intervals until completion of Landscape Maintenance.
   1. The requirements above are for bidding purposes only, exact application rates per Testing Lab analysis.

B. Include copies of documentation of fertilizer applications, countersigned by the Architect, in the Maintenance Binder – see Specification Section Landscape Maintenance.

3.06 MULCH

A. Install mulch to a minimum depth of 2-inches to tree rings. See finish grading in Specification Section Soil Preparation. Mulch shall not touch or be mounded against tree trunks.

3.07 SOD INSTALLATION

A. The installation specifications below shall prevail over the sod grower’s installation specifications, unless otherwise noted.

B. Grading / Soil Preparation: Finish grade to smooth, even surface, allowing for sod thickness at pavement and other structures to leave the sod flush to the finish grade of adjacent surfaces. The soil surface shall be sufficiently firm to resist impressions over 1/4 inch deep, and shall be lightly rolled until meeting this firmness. The top six to eight inches of soil shall be watered until this zone has an optimum moisture content for root growth.

C. Installation: Sod shall be laid in rows with staggered ends neatly and tightly butted on all edges. Harvesting netting shall be removed upon installation. Sod shall be protected from wind and sun exposure during storage, with a maximum storage period of twenty-four hours. No overlap, gaps, ripples, or other uneven placement will be accepted. Contractor shall lightly roll sod after installation to insure optimum contact with the soil. Trimming and cutting around structures shall be completed with sharp tools and carefully fitted so the final appearance is a solid, continuous turf.

D. Establishment Watering / Mowing: Follow sod grower’s specifications.
E. Rolling: The sod shall be allowed to grow for a minimum of two weeks before rolling. Roll both in length and width.

3.08 EDGING

A. Alignment and grade of edging shall be staked and limited to accurately reflect the plan layout prior to commencing work. After approval by the Architect, edging shall be assembled to form well crafted and securely constructed lines.

3.09 WEED MAT

A. Install weed mat to all rock areas per manufacturer’s instructions. Weed mat shall thoroughly cover the soil area of the rock areas. Overlap fabric pieces by at least 6-inches and staple per manufacturer’s instructions.

3.10 MAINTENANCE

A. See Specification Section Landscape Maintenance

3.11 CLEAN UP

A. After completion of all operations, Contractor shall remove all trash, excess soil and other debris. All walks, walls, and pavement shall be swept and washed clean. Leave the entire area in a neat, orderly condition.

END OF SECTION  32 93 03
PART 1 - GENERAL

1.1 GENERAL DOCUMENTS

A. This specification provides the technical requirements necessary to ensure proper installation of tracer wire and related components for the purposes of locating both conductive and non-conductive underground water/sewer utilities. It recognizes that the first step in protecting underground utility assets is installing a quality, reliable locating system. This specification is based on best practices for underground utility locating.

If using Copperhead® products, part numbers are in **bold** print.

* denotes color (B=blue, G=green, P=purple)
** spool size (500’, 1000’, 2500’)

### Materials

#### General

- All system components, including tracer wire, connectors, ground rods, and access boxes, must be compatible.
- All tracer wire shall have HDPE insulation for direct bury, and color coded per APWA standard for the specific utility being marked.

#### Tracer Wire

- **Open Trench** - Tracer wire shall be copper-clad steel 12-AWG High Strength with minimum 450 lb. break load, minimum 30 mil HDPE insulation thickness (1230*-HS-**).
- **Directional Drilling/Boring** - Tracer wire shall be copper-clad steel 12-AWG Extra High Strength with minimum 1,150 lb. break load, minimum 45 mil HDPE insulation thickness (1245*-EHS-**).
- **Pipe Bursting** - Tracer wire shall be 7x7 stranded copper-clad steel with 4,700 lb. break load, minimum 50 mil HDPE insulation thickness (PBX-50*-**).

#### Connectors

- All mainline tracer wires shall be interconnected at intersections, at mainline tees, and mainline crosses. At tees, the three wires shall be joined using a single, three-way locking connector (LSC1230*). At crosses, the four wires shall be joined using two, three-way locking connectors (LSC1230*) with a short jumper wire between them.
- Direct bury wire connectors shall include three-way lockable locking connectors (LSC1230*) and Mainline-to-Service connectors (3WB- 01) specifically manufactured for use in underground tracer wire installation. Connectors shall be dielectric silicone filled to seal out moisture and corrosion and shall be installed in a manner as to prevent any uninsulated wire exposure.
- Non-locking, friction fit, twist on, or taped connectors are prohibited.

#### Grounding

- Tracer wire must be properly grounded at all dead-end mains, service laterals, and curb stops.
- Grounding of tracer wire shall be achieved by using a 1.5-lb, drive-in, magnesium ground rod (ANO-12) with a minimum 20-feet, #12 red HDPE insulated copper-clad steel wire connected to the rod, specifically manufactured for this purpose.
- When grounding the tracer wire in areas where the tracer wire is continuous and neither the mainline trace wire or the grounding anode wire will be terminated at/above grade, install grounding anode directly beneath and in-line with the tracer wire. Do not coil excess wire from grounding anode. In this installation method, the grounding anode wire shall be trimmed to an appropriate length before connecting to tracer wire with a mainline to service connector.
Where the anode wire will be connected to a tracer wire access box, a minimum of 2 ft. of excess/slack wire is required after meeting final elevation.

When installing tracer wire from curb stop to residence, if sewer and water are in the same trench, tracer wire only needs to be installed with water. Tracer wire needs to be connected to existing blue wire at base of curb stop using an approved three-way connector (3WB-01). Existing grounding anode may be used at base of curb stop. At base of exterior foundation, tracer wire needs to be properly grounded using approved grounding anode.

**Termination/Access**

- All tracer wire termination points must utilize an approved tracer wire access box (above ground access box or grade level/in-ground access box as applicable), (LD14*2T or SP-SWLID-*2) specifically manufactured for this purpose.
- All at-grade access boxes shall be appropriately identified with “sewer” or “water” cast into the cap and be color-coded.
- All two-terminal tracer wire access boxes must include a manually interruptible conductive/connective link between the terminal for the tracer wire connection and the terminal for the ground rod wire connection.
- Grounding anode wire shall be connected to the identified (or bottom) terminal on all access boxes.

**Service Laterals on public property** - Tracer wire shall terminate at an approved at-grade, two-terminal access box (LD14*2T or SP-SWLID-*2) near the curb stop for water, or near the clean-out for sewer and storm applications. Water access box shall be installed under a top hat (A1) with curb stop when located in driveway. Sewer access box shall be located under a top hat (A32). Clean-out shall also be located under a top hat (A32) when in driveway. See Grounding.

**Service Laterals on private property** - Tracer wire must terminate at an approved at-grade two terminal access box, (LD14*2T or SP-SWLID-*2) near the curb stop for water, or near the clean-out for sewer and storm applications. When installing sewer and water from curb stop to residence, if sewer and water are in the same trench, tracer wire only needs to be installed with water. Tracer wire needs to be connected to existing blue wire at base of curb stop using an approved three-way connector (3WB-01). At base of exterior foundation, tracer wire needs to be properly grounded. See Grounding.

**Hydrants** – Tracer wire must terminate at an approved above-ground tracer wire access box, properly affixed to the hydrant grade flange (T2-B01). 5/8 for hydrants with 5/8” bolts, and 3/4 for hydrants with 3/4” bolts. Affixing with tape or plastic ties shall not be acceptable.

**Long-runs** - In excess of 500 linear feet without service laterals or hydrants. Tracer wire access must be provided utilizing an approved grade level/in-ground tracer wire access box, located at the edge of the road right-of-way, and out of the roadway.

**Installation General**

- Tracer wire installation shall be performed in such a manner that allows proper access for connection of line tracing equipment, proper locating of wire without loss or deterioration of low frequency (512 Hz) signal, and without distortion of signal caused by more than one wire being installed in close proximity to one another.
- Tracer wire systems must be installed as a single continuous wire, except where using approved connectors. No looping or coiling of wire is allowed.
- Any damage occurring during installation of the tracer wire must be immediately repaired by removing the damaged wire, and installing a new section of wire with approved connectors. Taping and/or spray coating shall not be allowed.
- Tracer wire shall be installed at the bottom half of the pipe and secured (taped/tied) at 5’ intervals.
• Mainline tracer wire shall not be connected to existing conductive pipes. Treat as a mainline dead-end ground using an approved waterproof connector to a ground rod driven into virgin soil beneath, in line with the utility, and buried at the same depth as the tracer wire.
• Tracer wire must be properly grounded as specified.
• All service lateral tracer wire shall be a single wire, connected to the mainline tracer wire using a three-waymainline-to-service connector, installed without cutting/splicing the mainline tracer wire.
• In occurrences where an existing tracer wire is encountered on an existing utility that is being extended or tied into, the new tracer wire and existing tracer wire shall be connected using approved connectors.
• Two feet of excess/slack wire is required in all tracer wire access points after meeting final elevation.
• At all dead-end mains, service laterals, and curb stops, tracer wire shall go to ground using an approved connection to a drive-in magnesium ground rod.

Sanitary Sewer System
• A mainline tracer wire must be installed, with all service lateral tracer wires properly connected to the mainline tracer wire, to ensure full tracing/locating capabilities from a single connection point.
• Lay mainline tracer wire continuously, by-passing around the outside of manholes/structures on the north or east side.
• Tracer wire on all sanitary service laterals must terminate at an approved at-grade, two-terminal access box color coded green (LD14G2T or SP-SWLID-G2) and located directly above the service lateral near the clean-out, or curb stop. Access box shall be installed under a top hat (A32) when located in driveway.

Water System
• A mainline tracer wire must be installed, with all service lateral tracer wires properly connected to the mainline tracer wire, to ensure full tracing/locating capabilities from a single connection point.
• Lay mainline tracer wire continuously, by-passing around the outside of valves and fittings on the north or east side.
• Tracer wire on all water service laterals must terminate at an approved at-grade, two-terminal tracer wire access box, color coded blue, (LD14B2T or SP-SWLID-B2) and located directly above the service lateral near the curb stop. Access box shall be installed under a top hat (A1) with curb stop when located in driveway.
• Above-ground tracer wire access boxes will be installed on all fire hydrants (T2-B01).
• All conductive and non-conductive service lines shall include tracer wire.

Storm Water System
• If the storm sewer system includes service laterals for connection of private drains and tile lines, tracer wire shall terminate at an approved at-grade, two-terminal access box (LD14G2T or SP-SWLID-G2) near the clean-out.
• Lay mainline tracer wire continuously, by-passing around the outside of manholes/structures on the north or east side.

Prohibited Products and Methods
The following products and methods shall NOT be allowed or acceptable:
• Uninsulated tracer wire
• Stainless steel tracer wire
• Tracer wire insulations other than HDPE
• Non-locking, friction fit, twist on, or taped connectors
• Brass or copper ground rods
• Wire connections utilizing taping or spray-on waterproofing
• Looped wire or continuous wire installations that have more than one wire laid side-by-side or in close proximity to one another
• Tracer wire wrapped around the corresponding utility
• Brass fittings with tracer wire connection lugs
• Wire terminations within the roadway in valve boxes, cleanouts, manholes, etc.
• Connecting tracer wire to existing conductive utilities

Testing
All new tracer wire installations shall be located using typical low frequency (512 Hz) line tracing equipment, witnessed by the contractor, engineer, and facility owner as applicable, prior to acceptance of ownership.

This verification shall be performed upon completion of rough grading and again prior to final acceptance of the project.

Continuity testing in lieu of actual line tracing shall not be accepted.
100% Construction Documents

12.04.2020
#12 AWG COPPER CLAD STEEL - GREEN (TYP)  
MINIRE TO LATERAL LUG CONNECTOR (TYP)  
GRADE (TYP), 1 IN GROUND ACCESS BOX AND DRIVE-IN MAGNESIUM GROUNDBAND ANODE (SEE SEWER SERVICE DETAIL)  
4-WAY CONNECTION OR TWO 2-WAY CONNECTORS: WITH SHORT JUMPER WIRE  
MANHOLE (TYP)  

NOTES:  
1. WIRE SHOWN AWAY FROM PIPE FOR CLARITY. WIRE SHALL BE INSTALLED ON THE BOTTOM SIDE OF THE PIPE BELOW THE SPRING LINE. THE WIRE SHALL BE FASTENED TO THE PIPE WITH TAPE OR PLASTIC TIES AT 5' INTERVALS.

TRACE WIRE PLAN (SEWER)  
NOTES:

TPWD # 121096A
TPWD LAKE CORPUS CHRISTI STATE PARK
RESTROOM REPLACEMENT

100% Construction Documents
33 02 10 - CONDUCTIVE TRACE WIRE FOR NONMETALLIC PIPE INSTALLATION
12.04.2020
Page 8 of 10
END OF SECTION 33 02 10
SECTION 33 10 00 - WATER UTILITIES

PART 1 - GENERAL
1.1 SUMMARY
A. Section includes furnishing and installing water mains, fittings and appurtenances from a point 5 feet outside building lines to the point of connection to an existing system. Refer to Division 22 Sections for continuation of water systems.

1.2 RELATED WORK
A. Related Work of Other Sections:
1. Section 03 30 00 – Cast-In-Place Concrete.
2. Section 31 00 00 – Site Earthwork
3. Section 31 50 00 – Excavation Support and Protection
4. Section 33 02 10 – Conductive Trace Wire For Nonmetallic Pipe Installation

1.3 DEFINITIONS
A. Private Fire Service Main – That pipe and it appurtenances on private property that is between a source of water and the base of the system riser or between a source of water and the base elbow of private fire hydrants.
B. Public Water Main – A water supply pipe for public utilization controlled by public authority.
C. Water Supply System – All piping and components that convey potable water from the public water main to the points of usage.

1.4 REFERENCES
A. American National Standards Institute (ANSI) 1899 L Street, NW, 11th Floor, Washington, DC 20036
1. ANSI/NSF 61 – Drinking Water System Components - Health Effects
B. American Water Works Association (AWWA), 6666 West Quincy Avenue, Denver, Colorado 80235. All references are to currently active publication.
1. AWWA C104/A21.4 – Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
2. AWWA C110/A21.10 – Ductile-Iron and Gray-Iron Fittings for Water
3. AWWA C111/A21.11 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
4. AWWA C115/A21.15 – Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
5. AWWA C151/A21.51 – Ductile-Iron Pipe, Centrifugally Cast, for Water
7. AWWA C500 – Metal-Seated Gate Valves for Water Supply Service
8. AWWA C502 – Standard for Dry-Barrel Fire Hydrants
9. AWWA C508 – Swing-Check Valves for Waterworks Service, 2 In. (50 mm) Through 24 In. (600 mm) NPS
10. AWWA C509 – Resilient-Seated Gate Valves for Water Supply Service
11. AWWA C600 – Installation of Ductile-Iron Water Mains and Their Appurtenances
12. AWWA C605 – Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water
13. AWWA C800 – Underground Service Line Valves and Fittings
14. AWWA C900 – Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Distribution
15. AWWA C901 – Polyethylene Pressure Pipe & Tubing, ½”-3” (13mm-76mm) For Water Service
16. AWWA C906 – Polyethylene (PE) Pressure Pipe and Fittings, 4 in. (100 mm) Through 63 in. (1,600 mm) for Water Distribution and Transmission
17. AWWA M23 – Manual: PVC Pipe - Design and Installation

C. American Society of Testing and Materials (ASTM), 1916 Race Street, Philadelphia, Pennsylvania 19103. All references shall be to current active standard.
2. ASTM A307 – Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
6. ASTM B88 – Standard Specification for Seamless Copper Water Tube
11. ASTM D402 – Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
27. ASTM F477 – Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
28. ASTM F1290 – Standard Practice for Electrofusion Joining Polyolefin Pipe and Fittings
29. ASTM F1473 – Standard Test Method for Notch Tensile Test to Measure the Resistance to Slow Crack Growth of Polyethylene Pipes and Resins
31. ASTM F2620 – Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings

D. International Code Council
   1. International Plumbing Code (IPC)

E. International Standards Organization (ISO)
   1. ISO 13477 – Thermoplastics pipes for the conveyance of fluids -- Determination of resistance to rapid crack propagation (RCP) -- Small-scale steady-state test (S4 test)
   2. ISO 9001 – Quality management systems -- Requirements

F. National Fire Protection Association (NFPA)
   1. NFPA 24 – Standard for the Installation of Private Fire Service Mains and Their Appurtenances

   1. Para 337.204 – Water Sources.

H. Plastic Pipe Institute (PPI), 105 Decker Court, Suite 825 Irving TX, 75062
   1. PPI TR-4 – PPI Listing of Hydrostatic Design Basis (HDB), Pressure Design Basis (PDB) and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe

I. Texas Commission on Environmental Quality (TCEQ)

J. Underwriters Laboratories (UL)
   2. UL 246 – Hydrants for Fire-Protection Service
   3. UL 262 – Gate Valves for Fire-Protection Service
   4. UL 312 – Check Valves for Fire-Protection Service
   5. UL 789 – Standard for Indicator Posts for Fire-Protection Service

K. Uni-Bell PVC Pipe Association (UBPPA)
   1. UBPPA UNI-B-3 – Recommended Practice for the Installation of Polyvinyl Chloride (PVC) Pressure Pipe (Nominal Diameters 4-36 Inch)
   2. UBPPA UNI-B-8 – Recommended Practice for the Direct Tapping of Polyvinyl Chloride (PVC) Pressure Water Pipe (Nominal Diameters 6-12 Inch)

1.5 SUBMITTALS
   A. Shop Drawings
      1. Product Submittals
         a. Pipe Materials, fittings, joints, valves and couplings.
         b. Fire Hydrants
         c. Indicator posts.
d. Corporation stops.
e. Valve boxes.

2. Test Reports
   a. Backfill density tests.
   b. Bacteriological tests.
   c. Hydrostatic tests.

B. Submit Record Documents (As Built) locating actual horizontal and vertical location of installed piping, service connections, valves, and appurtenances.

C. Provide Owner with three (3) valve keys each for operating gate valves, both cast iron and brass.

D. Submit in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.09 SUBMITTALS and UGC Article 8.

1.6 DELIVERY STORAGE AND HANDLING

A. Delivery and Storage
   1. Inspect materials delivered to site for damage. Unload and store with minimum handling. Store materials on site in enclosures or under protective covering. Store plastic piping, jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes, fittings, valves and hydrants free of dirt and debris.

B. Handling
   1. Handle pipe, fittings, valves, hydrants, and other accessories in a manner to ensure delivery to the trench in sound undamaged condition. Take special care to avoid injury to coatings and linings on pipe and fittings; make repairs if coatings or linings are damaged. Do not place any other material or pipe inside a pipe or fitting after the coating has been applied. Carry, do not drag pipe to the trench. Use of pinch bars and tongs for aligning or turning pipe will be permitted only on the bare ends of the pipe. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material without additional expense to the Owner. Store rubber gaskets that are not to be installed immediately, under cover out of direct sunlight.

2. Miscellaneous Plastic Pipe and Fittings
   a. Handle Polyvinyl Chloride (PVC) pipe and fittings in accordance with the manufacturer's recommendations. Store plastic piping and jointing materials that are not to be installed immediately under cover out of direct sunlight.
   b. Storage facilities shall be classified and marked in accordance with NFPA 704.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials which come in contact with water, including but not limited to pipes, coatings, valves, water meters, fittings, gaskets, adhesives, and lubricants, shall be evaluated, tested and certified for conformance with ANSI/NSF 61.

2.2 PIPING

A. All pipes 4 inch to 12 inch shall meet the requirements of AWWA C900, Class 200, unless otherwise noted. Pipe shall be gasket bell end. Gasket shall be in conformance with ASTM F477. Integral bell shall be at least as strong as the pipe in conformance with ASTM D3139.

B. All service lines smaller than 4 inch shall be:
1. Schedule 80 PVC meeting the requirements of ASTM D1785 with Injection Molded PVC Schedule 80 fittings meeting ASTM D2467. PVC threaded fittings shall conform to ASTM D2464.

2. Type “K” copper meeting the requirements of NSF 61 and ASTM B88

C. High-Density Polyethylene (HDPE) Pipe and Fittings

1. Pipe and fittings shall be made from Extra High Molecular Weight (EHMW) high-density polyethylene with a standard thermoplastic material designation of PE4710 and having a cell classification of PE445574A when tested in accordance with ASTM D3350.

2. Materials used to manufacture pipe and fittings shall be listed under the Manufacturer’s name in PPI TR-4. The Manufacturer shall supply a product with a standard grade HDB rating of 1600 psi (minimum) at 73 degrees F and 800 psi (minimum) for 180 degrees F. Upon request, the Manufacturer shall supply certification that the materials used to manufacture the pipe and fittings meet the above requirements.

3. The materials shall meet the following nominal physical property requirements:

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Nominal Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material Designation</td>
<td>PPI/ASTM</td>
<td>PE4710</td>
</tr>
<tr>
<td>Cell Classification</td>
<td>ASTM D3350</td>
<td>PE445574A</td>
</tr>
<tr>
<td>Density, Natural</td>
<td>ASTM D792</td>
<td>0.946 gm/cc</td>
</tr>
<tr>
<td>Melt Index (190°C/2.16 kg)</td>
<td>ASTM D1238</td>
<td>0.10 gm/10 min.</td>
</tr>
<tr>
<td>Flow Rate (190°C/21.6 kg)</td>
<td>ASTM D1238</td>
<td>7.0 gm/10 min.</td>
</tr>
<tr>
<td>Tensile Strength @ Yield</td>
<td>ASTM D638</td>
<td>3,500 psi</td>
</tr>
<tr>
<td>Ultimate Elongation</td>
<td>ASTM D638</td>
<td>&gt;500%</td>
</tr>
<tr>
<td>Flexural Modulus, 2% Secant</td>
<td>ASTM D790</td>
<td>152,000 psi</td>
</tr>
<tr>
<td>Resistance to Rapid Crack Propagation</td>
<td>ISO 13477</td>
<td>&gt;174 psi</td>
</tr>
<tr>
<td>Pc – S-4 @ 32°F</td>
<td>ISO 13477</td>
<td>&lt;2°F</td>
</tr>
<tr>
<td>Tc – S-4 @145 psi</td>
<td>ISO 13477</td>
<td></td>
</tr>
<tr>
<td>Slow Crack Growth PENT @2.4 MPa</td>
<td>ASTM F1473</td>
<td>&gt;10,000 hr</td>
</tr>
<tr>
<td>176°F</td>
<td>ASTM F1473</td>
<td>&gt;10,000 hr</td>
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<tr>
<td>194°F</td>
<td>ASTM F1473</td>
<td></td>
</tr>
<tr>
<td>Brittleness Temperature</td>
<td>ASTM D746</td>
<td>&lt;-103°F</td>
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<tr>
<td>Izod Impact Strength, Notched</td>
<td>ASTM D256</td>
<td>9.1 ft-lb/in</td>
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<tr>
<td>PPI Hydrostatic Design Basis (As listed in PPI TR-4)</td>
<td>ASTM D2837</td>
<td>1,600 psi</td>
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<tr>
<td></td>
<td></td>
<td>HDB @ 73°F</td>
</tr>
<tr>
<td></td>
<td></td>
<td>800 psi</td>
</tr>
<tr>
<td></td>
<td></td>
<td>HDB @ 180°F</td>
</tr>
</tbody>
</table>

4. The dimensional and performance characteristics of pipe and tubing shall conform to the requirements of AWWA C-901 (1/2 inch through 3 inch) or AWWA C906 (4 inch through 65 inch). Each lot of material shall be tested for melt index, density, and percent carbon. Upon request the Manufacturer shall furnish test data.

5. Polyethylene fabricated fittings shall be manufactured from polyethylene pipe, sheet stock or molded fittings meeting the material requirements of this specification and all appropriate requirements of AWWA C901 or AWWA C906.

6. Pipe shall be pressure rated using the certified HDB from 2.1.C.2 and shall be determined in accordance with the following formula:

\[ PC = 2 \times HDB \times DF / (DR - 1) \]

1) Where:
   a) PC=Pressure Rating
   b) DF=Design Factor, dimensionless (0.5 for water @ 73.4°F)
   c) DR=Dimensional Ration=Actual Outside Diameter (in)/Minimum Wall Thickness (in)

b. WPR shall be the lesser of the following:

1) WPR=PC
2) WPR=1.5PC-RS
3) WPR=2.0PC-OS
4) Where:
   a) The Pressure Class (PC) of the polyethylene pipe and fittings shall be specified on the basis of the Working Pressure Rating (WPR) of the water system as defined in AWWA C906.

   b) Recurring pressure surges (RS) are those that occur frequently and are inherent in the design and operation of the system such as normal pump startup or shutdown and normal valve opening and closing.

   c) Occasional pressure surges (OS) are those that occur infrequently and are usually the result of a malfunction such as pump seize-up, valve stem or pressure relief valve failure.

   c. The WPR determined above must be equal to or greater than the working pressure of the system.

7. Polyethylene fittings, including custom fabrications, shall have the same internal pressure rating as the mating pipe. At the point of fusion, the wall thickness and outside diameter of the fitting shall be in accordance with AWWA C901 or AWWA C906 for the same pipe size.

8. The Manufacturer’s Quality system shall be certified to be in accordance with ISO 9001.

D. Ductile Iron Pipe
1. All ductile iron pipe shall be centrifugally cast with mechanical joints meeting the requirements of AWWA C151.A21.51.29

2. All pipe shall have an interior cement mortar lining applied in accordance with AWWA C104/A21.4. No asphaltic coating will be required on the interior cement mortar lining.

3. Exterior coating shall consist of a nominal 1 mil thick asphaltic material allied to the outside of the pipe as described in Section 51.8 of AWWA C151.

4. All rubber joint gaskets utilized on ductile iron pipe shall be in conformance with AWWA C111/A21.11.

2.3 FITTINGS
A. Fittings for AWWA C900 pipe shall comply with the requirements of AWWA C110 and AWWA C153, with a minimum pressure rating of 250 psi.

B. Fittings for Schedule 80 PVC pipe shall be compatible with Schedule 80 PVC pipe.

C. Fittings for ductile iron pipe shall meet the requirements of AWWA C111/A21.11.

2.4 JOINT RESTRAINT
A. Joint restraint system utilized for PVC C900 pipe shall meet the requirements of ASTM F1674.

B. Joint restraint system utilized for ductile pipe shall meet the requirements of UL 194.

2.5 VALVES
A. Valves shall be resilient-seated type meeting the requirements of AWWA C509. Valves for fire protection lines shall also be UL 262 compliant.

B. Valves shall be designated for installation in either a horizontal or vertical position as required.

C. The sealing mechanism shall consist of a replaceable rubber disc seat ring, internally reinforced with a concentric steel ring, molded separately from the disc. Said seat ring shall be secured to the disc with self-locking stainless steel screws and shall be so shaped as to prevent improper installation. Resilient material for seal shall be natural rubber.

D. All mechanical joint valves shall be supplied with glands, bolts, and gaskets. Bolts for mechanical joints shall be high strength low alloy steel meeting the requirements of AWWA C111.
E. Valve ends shall have either a flanged mechanical joint, hub-end, push-on joint (“Ring-Tite”), or any combination thereof.
F. Contractor to confirm existing site standard for valves (open clockwise or open counter clockwise).
G. Valves shall have a minimum 10 YEAR LIMITED WARRANTY from the manufacturer on materials and workmanship.
H. Resilient wedge valves shall be MUELLER SUPER SEAL Model 2360, or approved equal.
I. Automatic Air Release Valves shall be APCO Series 140C, or approved equal
J. Post indicator valves shall be UL listed in accordance with NFPA 24 and FM approved.
K. Double check valve assemblies shall be approved by the Foundation for Cross-Section Control and Hydraulic Research at the University of Southern California.

2.6 VALVE BOXES
A. Each valve box assembly shall be of cast-iron and shall consist of a base, top section and lid.
B. Valve boxes shall be of a single size with a nominal diameter of 6 inches.
C. The valve box lid shall be designed so that it will remain firmly seated in place when subjected to vehicular traffic.
D. The valve box assembly shall be of sufficient toughness and strength to withstand impact loads and shock resulting from vehicular traffic.
E. The valve box assembly shall be coated with a bituminous coating of either coal tar or asphaltic basic applied to all inside and outside surfaces.
F. The word “WATER” shall be cast on the lid.

2.7 DEBRIS CAPS
A. Provide SW Services (22223 N 16th Street, Phoenix, Arizona 85024, 1-800-462-2773) plastic debris caps, or approved equal, with blue handles in all new exterior water valve boxes.

2.8 FREESTANDING FIRE HYDRANTS
A. Fire hydrants shall comply with the requirements of AWWA Standard C502. The bronze used for valve seats, drain outlet, stems and all other hydrant components shall not contain more than 15 percent zinc or more than 2 percent aluminum.
B. Shut-off valves shall be of the compression type.
C. Main valve shall be circular with a minimum opening of 5 inches in diameter.
D. Inlet connection shall be an elbow with AWWA Standard bell designed for 6 inch mechanical joint, hub end, or “Ring-Tite” assembly as specified.
E. Bury length shall be as specified.
F. Hydrants shall have 2 hose nozzles and one pumper nozzle.
G. Nominal inside diameter shall be 2-1/2 inches for the hose nozzles and 4 inches for the pumper nozzle.
H. Hose nozzle and pumper nozzle threads shall be in conformance with NFPA 1963.
I. Nozzle gaskets are required and shall be of rubber composition.
J. Hydrants shall be open right (clockwise).
K. Stuffing box shall be O-ring seal type and bronze.
L. A lubrication chamber shall be provided, sealed top and bottom with O-rings, and filled with a noon-toxic lubricant which shall remain fluid through a temperature range of -60 degrees F to +150 degrees F. The design shall be such that the thrust collar and the threaded operating parts are automatically lubricated each time the hydrant is cycled. There shall be no less than two (2) O-rings separating the oil reservoir from the waterway and that portion of the stem contacting the O-rings shall be sleeved with bronze. An anti-friction device shall be in place above the collar to further minimize operating torque.
M. Hydrants shall be painted with a suitable primer and finished with a color determined by the Owner from the top of the hydrant to a point 24 inches below the centerline of the pumper nozzle.

N. Hydrants shall have at least one un-tapped drain opening. When the main valve is in the fully opened position, leakage through the drain opening shall be cause for rejection.

O. All gaskets shall be of rubber or Neoprene composition.

P. All fire hydrants having mechanical joint inlets shall be supplied with glands, bolts, and gaskets. Bolts shall be high strength low allow steel meeting the requirements of AWWA C111.

Q. Hydrants shall have non-rising stems.

R. Barrel shall have an inside diameter of not less than 7 inches. The wall thickness shall be in accordance with AWWA C502.

S. Hydrants shall be equipped with a breakable coupling on the barrel section and the stem. These couplings shall be at least two (2) inches above the finished grade line. The breakable coupling shall be so designed that in case of a traffic collision, the barrel safety flange and stem safety flange will break before any other part of the hydrant. The coupling shall be designed to allow the hydrant to rotate 360 degrees.

T. Valve stems shall have a diameter of 1-1/4” for hydrants up to and including 5’-0” bury. Hydrants with a bury of greater than 5’-0” shall have a stem diameter of not less than 1-3/8”.

U. Hydrants shall have a minimum 10 YEAR LIMITED WARRANTY from the manufacturer on materials and workmanship. Manufacturer repair and replacement parts must be used to maintain valid warranty.

V. Hydrants shall be MUELLER SUPER CENTURION 200, or approved equal.

W. Failure to comply with any of the above requirements is sufficient cause for rejection of proposed hydrant.

X. The Owner reserves the right to accept only those materials which are in FULL compliance with these specifications and are deemed most advantageous to its interests.

2.9 TAPPING SLEEVES

A. Tapping sleeves shall be JCM Industries 432 SS Tapping Sleeve, PowerSeal 3490AS or 3490MJSS, Ford Meter Box Company FTSS, or Dresser Style 610.

2.10 TRACER WIRE FOR NONMETALLIC PIPING

A. Tracer wire shall be minimum 12 gauge (AWG) single strand, insulated copper wire with high molecular weight polyethylene (HMWPE) insulation, specifically manufactured for direct burial applications.

B. Provide tracer wire in sufficient length to be continuous over each separate run of non-metallic pipe.

C. All spliced or repaired wire connections in the tracer wire system shall be made using approved connectors.

D. Tracer wire to have blue insulation.

2.11 WARNING TAPE

A. Detectable underground aluminum warning tape shall be minimum 3 inches wide, minimum 5 mils thick. Tape to be color coded according to American Public Works Association (APWA) Uniform Color Codes.

2.12 CONCRETE FOR THRUST BLOCKS

A. Concrete shall meet the requirements of ASTM C94, having a minimum 28 day compressive strength of 2,500 psi.

PART 3 - EXECUTION

3.1 PROJECT CONDITIONS
A. Perform no pipe work in fill areas until embankment or fill has been completed to at least 2 feet above the top of pipe and has been properly compacted.

3.2 PREPARATION
A. Stake locations of fittings, fire hydrants and valves prior to installation for review by Engineer.
B. Prior to installation, remove foreign matter from within the valves and fire hydrants. Inspect the valves and fire hydrants in open and closed position to verify that parts are in satisfactory working condition.

3.3 PIPE INSTALLATION
A. Preparation:
   1. Do not lay pipe in water, or when trench or weather is unsuitable to work. Keep water out of trench until jointing is complete and initial backfill is placed on top of pipe. When work is not in progress, close ends of pipes and fittings securely so that no trench water, earth or other substance will enter pipes or fittings.
   2. Remove fins and burrs from pipe and fittings.
   3. Clean inside of pipe, fitting, valves, accessories, and maintain in a clean condition.
   4. Provide proper facilities for lowering sections of pipe into trenches. Do not under any circumstances drop or dump pipe, fittings, valves or any other water line material into trenched.
   5. Before installation, inspect pipe for defects and tap with a light hammer to detect cracks. Replace sections of pipe found to be defective, damaged or unsound before or after laying.
B. Pipe Laying and Jointing
   1. Water line shall be installed with 4 feet of cover.
   2. Locate joints no closer than 9 feet from sanitary sewer cross-overs.
   3. Piping bedding and backfill shall be as shown on the Drawings.
   4. Cut pipe in a neat workmanlike manner accurately to length established at the site and work into place without springing or forcing. Replace by one of the proper length any pipe or fitting that does not allow sufficient space for proper installation of jointing material.
   5. Blocking or wedging between bells and spigots will not be permitted.
   6. Lay bell and spigot pipe with the bell end pointing in the direction of laying.
   7. Lay pipe so that the full length of each section of pipe and each fitting will rest solidly on the pipe bedding; excavate recesses to accommodate bell, joints, and couplings. Take up and relay pipe when grade or joint is disturbed after laying.
   8. Install mechanical joints in accordance with manufacturer’s recommendations.
   9. Do not exceed pipe manufacturer’s recommendations for deflections from straight line or grade as required by vertical curves, horizontal curves, or offsets. If alignment requires deflections in excess of these limitations, furnish special bends or a sufficient number of shorter lengths of pipe to provide angular deflections within limits set or approved.
   10. Anchor tees, bends and plugged, valved or capped ends of water lines with concrete thrust blocks as necessary and as shown on the Drawings. Place blocks so that the joints will be accessible for inspections and repair.
   11. Where pipe ends are left for future connections, install valves, plugs or caps and thrust blocking as shown on the drawings.
   12. HDPE Joining Methods
      a. Butt Fusion
         1) The pipe shall be joined by the butt fusion procedure outlined in ASTM F2620 or PPI TR-33.
2) All fusion joints shall be made in compliance with the pipe or fitting manufacturer's recommendations.

3) Fusion joints shall be made by qualified fusion technicians per PPI TN-42.

4) Butt fusions performed between pipe ends or pipe ends and fitting outlets shall be within the following allowable wall mismatches:
   a) 2 DR difference for pipe and fitting diameters 6 inch IPS and smaller.
   b) 1 DR difference for above 6 inch through 18 inch.
   c) No difference for diameters above 18 inch.

5) The difference in DR's is determined from the following DR values: 7.3, 9, 11, 13.5, 17, 21, 26, and 32.5.

b. Saddle Fusion
   1) Saddle fusion shall be done in accordance with ASTM F2620 or PPI TR-41 or the fitting manufacturer's recommendations and PPI TR-41.

   2) Saddle fusion joints shall be made by qualified fusion technicians. Qualification of the fusion technician shall be demonstrated by evidence of fusion training within the past year on the equipment to be utilized on the project.

c. Socket Fusion
   1) Molded socket fusion fittings are only to be used for joining of HDPE pipe from ½ inch to 2 inch in size.

   2) Socket fusion shall be done in accordance with ASTM F2620 or the fitting manufacturer's recommendations.

   3) Socket fusion joints shall be made by qualified fusion technicians. Qualification of the fusion technician shall be demonstrated by evidence of fusion training within the past year on the equipment to be utilized on the project.

d. Electrofusion
   1) Electrofusion shall be performed in accordance with ASTM F1290 and PPI TN-34 or manufacturer's recommendations.

   2) Electrofusion joints shall be made by qualified fusion technicians. Qualification of the fusion technician shall be demonstrated by evidence of fusion training within the past year on the equipment to be utilized on the project.

e. Other Methods of Joining
   1) Polyethylene pipe and fittings may be joined together or to other materials through the use of flange adapters with back-up rings, mechanical couplings designed for connecting polyethylene pipe and fittings to itself or to another material or mechanical joint (MJ) adapters. The manufacturer of the joining device shall be consulted for proper joining procedure.

C. Installation of Tracer Wire
   1. Install a continuous length of tracer wire for the full length of each run of nonmetallic pipe. Attach wire to top of pipe at minimum 10 foot intervals in such a manner that it will not be displaced during construction operations. Extend ends of tracer wire into valve boxes and anchor in place. Refer to Section 33 02 10 for additional information and directions.

D. Installation of Detectable Warning Tape
   1. Install detectable warning tape 12 inches below finished grade.

E. Connections to Existing Water Lines
   1. Make connections to existing water line after approval is obtained from Owner and with a minimum interruption of service on the existing line.

   2. Make connections to existing lines under pressure in accordance with the recommended procedures of the manufacturer of the pipe being tapped.
3. Underground piping is to be completely flushed before the connection is made to the downstream piping.

F. Installation of Ductile Iron Pipe
1. Install ductile iron pipe per the above requirements and AWWA C600.

G. Installation of PVC Pipe
1. Install pipe and fittings in accordance with the above requirements and UNI-B-3.

3.4 INSTALLATION OF VALVES AND HYDRANTS
A. Installation of Valves
1. Install gate valves, AWWA C509, in accordance with the requirements of AWWA C600 for valve and fitting installation and with the recommendations of the Appendix ("Installation, Operation, and Maintenance of Gate Valves") to AWWA C500.
2. Set valves plumb and as detailed on the Drawings.
3. Center valve boxes on valves.

B. Installation of Fire Hydrants
1. Install hydrants in accordance with AWWA C600.

3.5 STERILIZATION
A. Sterilize each unit of completed distribution system with chlorine before acceptance for domestic operation. Use not less than 50 mg/liter chlorine to water. Flush lines thoroughly before introducing chlorinating materials. Introduce chlorinating material to the water lines in and distribution systems in an approved manner.

B. After contact period of not less than 24 hours, flush system with clean water until residual chlorine is no greater than 0.2 mg/liter chlorine to water.

3.6 FIELD QUALITY CONTROL TESTING
A. Public Water Main Hydrostatic Test:
1. All testing to comply with TCEQ regulations.
2. Prior to completion of backfill, and while joints and fittings are still exposed, test new water lines hydrostatically. Conduct hydrostatic tests in presence of Owner’s Designated Representative. Provide pumps, gages, meters and other equipment necessary for performance of tests.
3. Test water lines at 200 psi.
4. Before applying pressure test, expel air from pipe by slowly filling each valved section of pipe with water and providing taps if necessary to expel trapped air.
5. Test water lines in lengths between valves or plugs of no more than 1,500 feet, unless otherwise directed by the Engineer.
6. Examine pipe, fittings and joints during testing.
7. Allowable leakage shall not exceed 11.65 gallons per inch of diameter per mile of pipe per 24 hours.
8. No joint leakage is allowed.
9. Minimum duration of testing for each section shall be 4 hours for new mains in excess of 1,000 linear feet and 1 hour for new mains less than 1,000 linear feet after the main has been brought up to test pressure.
10. Replace defective material with sound material and repeat test until satisfactorily completed and approved.
11. Repair observed or visible leaks at exposed joints, regardless of total leakage.

B. Water Supply System Hydrostatic Test
1. The tests shall be performed in compliance with IPC Sections 107 and 312.
2. Upon completion of a section of or the entire water supply system, the system, or portion completed, shall be tested and proved tight under a water pressure not less than the
working pressure of the system; or for piping systems other than plastic, by an air test of not less than 50 psi. This pressure shall be held for not less than 15 minutes.

3. The water utilized for tests shall be obtained from a potable source of supply.

C. Private Fire Service Main Hydrostatic Test
   1. All testing shall be in accordance with the requirements of NFPA 24.
   2. Prior to completion of backfill, and while joints and fittings are still exposed, test new water lines hydrostatically. Conduct hydrostatic tests in presence of Owner’s Designated Representative. Provide pumps, gages, meters and other equipment necessary for performance of tests.
   3. All piping and attached appurtenances subject to system working pressure shall be hydrostatically tested at gauge pressure of 200 psi or 50 psi in excess of system working pressure, whichever is greater, and shall maintain that pressure at gauge pressure of +/- 5 psi for 2 hours.
   4. Acceptable test results shall be determined by indication of either a pressure loss less than gauge pressure of 5 psi or no visible leakage.
   5. Where additional water is added to the system to maintain test pressure, the amount of water shall be measured and shall not exceed 0.057 gph/100 ft of pipe for 6” nominal pipe diameter and 0.076 gph/100 ft of pipe for 8” nominal pipe diameter

D. Bacteriological Tests:
   1. After sterilizing and flushing mains, obtain services of an approved laboratory to gather representative samples and conduct bacteriological tests.
   2. Tests shall meet requirements of Texas Department of Health and Texas Commission On Environmental Quality.
   3. Make necessary correction, repeat sterilization and flushing procedures, and retest affected lines if test results are not acceptable.
   4. Repeat this procedure until satisfactory test results are obtained.
   5. No main shall be placed in service or accepted until water samples are approved by applicable regulatory agency.

E. QUALITY ASSURANCE in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.10 QUALITY ASSURANCE AND UGC Article 8.

3.7 CLEANUP
   A. Upon completion of the installation of water lines and appurtenances, all debris and surplus materials resulting from the work shall be removed.

END OF SECTION 33 10 00
SECTION 33 30 00 - SANITARY SEWERAGE UTILITIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes sanitary sewer and appurtenances from a point 5 feet outside building lines to the point of disposal. Refer to Division 22 Sections for continuation of sanitary sewer system.

1.2 RELATED WORK

A. Related Work of Other Sections:
   1. Section 03 30 00 – Cast-In-Place Concrete.
   2. Section 31 00 00 – Site Earthwork
   3. Section 31 50 00 – Excavation Support and Protection
   4. Section 33 10 00 – Water Utilities
   5. Section 33 02 10 – Conductive Trace Wire For Nonmetallic Pipe Installation

1.3 DEFINITIONS

A. Building Drain – That part of the lowest piping of the drainage system that receives the discharge from soil, waste and other drainage pipes inside and that extends 30 inches in developed length of pipe beyond the exterior walls of the building and conveys the drainage to the Building Sewer.

B. Building Sewer – That part of the drainage system that extends from the end of the Building Drain and conveys the discharge to a public sewer, private sewer, individual sewage disposal system or other point of disposal.

1.4 REFERENCES

A. American Concrete Pipe Association (APA) 8445 Freeport Parkway, Suite 350, Irving, Texas 75063-2595. All references are to most recent edition.
   1. ACPA 01-102 – Concrete Pipe Handbook
   2. ACPA 01-103 – Concrete Pipe Installation Manual

B. ASME International (ASME) Three Park Avenue, New York, New York 10016. All references are to currently active publication.
   1. ASME B1.20 – Pipe Threads, General Purpose (Inch)
   2. ASME B16.1 – Gray Iron threaded Fittings, Classes 25, 125, and 250
   3. ASME B18.2.2 – Standard for Square and Hex Nuts

C. American National Standards Institute (ANSI), 1819 L Street NW, Suite 600 Washington, DC 20036. All references are to current active specification.
   1. A21.4 – Cement Mortar Lining for Ductile Iron Pipe and Fittings

   5. ASTM A307 – Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
22. ASTM C972 – Compression Recovery of Tape Sealant.
37. ASTM D1785 – Standard Specification for Poly (Vinyl Chloride) (PVC), Plastic Pipes, Schedules 40, 80, and 120.
47. ASTM D2996 – Filament Wound “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.
48. ASTM D2997 - Centrifugally Cast "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.
49. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
60. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
63. ASTM F794 - Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.

E. Cast Iron Soil Pipe Institute (CISPI) 1064 Delaware Avenue SE, Atlanta, Georgia 30316. All references are to most recent edition.
F. International Code Council
   1. International Plumbing Code (IPC)
G. Plastic Pipe Institute (PPI), 105 Decker Court, Suite 825 Irving TX, 75062
   1. PPI TN-34 – Installation Guidelines For Electrofusion Couplings 14” and Larger.
   3. PPI TR-4 – PPI Listing of Hydrostatic Design Basis (HDB), Pressure Design Basis (PDB) and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe
   5. PPI TR-41 – Generic Saddle Fusion Joining Procedure for Polyethylene Gas Piping
H. Texas Commission on Environmental Quality (TCEQ)
   2. TAC Title 30, Part 1, Chapter 217, Subchapter 217, Rule 217.58 – Testing requirements for Manholes

1.5 SUBMITTALS
A. Shop Drawings
   1. Submit drawings for the system, showing pipe sizes, locations, elevations, and slopes for horizontal runs. Include details of manholes, piping, fittings, and connections.
   2. Product Submittals
   3. Pipe Materials
   4. Test Reports
B. Certifications
   1. For fiberglass manholes the manufacturer shall provide independent certification consisting of the manufacturer’s test report and accompanied by a copy of the test results that the manhole has been sampled, tested, and inspected in accordance with the provisions of ASTM D3735 and meets all requirements.
C. Submit Record Documents (As Builts) locating actual horizontal and vertical location of installed sanitary sewer piping, cleanouts, manholes, and related work.
D. Submit in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.09 SUBMITTALS and UGC Article 8.

1.6 DELIVERY STORAGE AND HANDLING
A. Delivery and Storage
   1. Piping
      a. 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
      a. 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 Reinforce
      a. As specified in Section 03 30 00 Cast-In-Place Concrete.
B. Handling
   1. 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.
   2. Handle HDPE the pipe in accordance with the PPI Handbook of Polyethylene Pipe (2nd Edition), Chapter 2 using approved strapping and equipment rated for the loads
encountered. Do not use chains, wire rope, forklifts or other methods or equipment that may gouge or damage the pipe or endanger persons or property.

3. If any gouges, scrapes or other damage to the pipe results in loss of 10% of the pipe wall thickness, cut out that section or do not use.

4. Do not drop or impact fiberglass manholes. Lift manholes with two slings on spreader bar in horizontal position or by use of 4 in. x 4 in. timber inserted crosswise inside the manhole to the underside of the collar with rope or woven fabric slings attached to backhoe or other lifting device. Under no conditions shall cables or chains be put around fiberglass manholes. Do not roll fiberglass manholes when moving or during installation.

PART 2 - PRODUCTS
2.1 PIPING


B. High-Density Polyethylene (HDPE) Pipe and Fittings

1. HDPE sanitary sewer pipe and fittings shall be a minimum of SDR 17.

2. Pipe and fittings shall be made from Extra High Molecular Weight (EHMW) high-density polyethylene with a standard thermoplastic material designation of PE3608 and having a cell classification of 345464C, D, or E when tested in accordance with ASTM D3350.

3. The Manufacturer shall provide a product supplying a minimum Hydrostatic Design Basis (HDB) of 1,600 psi at 73.4 degrees F. The stress regression testing shall have been performed in accordance with ASTM D2837. Upon request, the Manufacturer shall supply certification that the materials used to manufacture the pipe and fittings meet the above requirements.

4. The materials shall meet the following nominal physical property requirements:

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Nominal Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material Designation</td>
<td>PPI/ASTM</td>
<td>PE4710</td>
</tr>
<tr>
<td>Cell Classification</td>
<td>ASTM D3350</td>
<td>PE445574A</td>
</tr>
<tr>
<td>Density, Natural</td>
<td>ASTM D792</td>
<td>0.946 gm/cc</td>
</tr>
<tr>
<td>Melt Index (190°C/2.16 kg)</td>
<td>ASTM D1238</td>
<td>0.10 gm/10 min.</td>
</tr>
<tr>
<td>Flow Rate (190°C/21.6 kg)</td>
<td>ASTM D1238</td>
<td>7.0 gm/10 min.</td>
</tr>
<tr>
<td>Tensile Strength @ Yield</td>
<td>ASTM D638</td>
<td>3,500 psi</td>
</tr>
<tr>
<td>Ultimate Elongation</td>
<td>ASTM D638</td>
<td>&gt;500%</td>
</tr>
<tr>
<td>Flexural Modulus, 2% Secant</td>
<td>ASTM D790</td>
<td>152,000 psi</td>
</tr>
<tr>
<td>Resistance to Rapid Crack Propagation</td>
<td>ISO 13477</td>
<td>&gt;174 psi</td>
</tr>
<tr>
<td></td>
<td>ISO 13477</td>
<td>&lt;2°F</td>
</tr>
<tr>
<td>Slow Crack Growth PENT @2.4 MPa</td>
<td>ASTM F1473</td>
<td>&gt;10,000 hr</td>
</tr>
<tr>
<td>176°F</td>
<td>ASTM F1473</td>
<td>&gt;10,000 hr</td>
</tr>
<tr>
<td>194°F</td>
<td>ASTM F1473</td>
<td>&gt;10,000 hr</td>
</tr>
<tr>
<td>Britteness Temperature</td>
<td>ASTM D746</td>
<td>&lt;-103°F</td>
</tr>
<tr>
<td>Izod Impact Strength, Notched</td>
<td>ASTM D256</td>
<td>9.1 ft-lb/in</td>
</tr>
<tr>
<td>PPI Hydrostatic Design Basis (As listed in PPI TR-4)</td>
<td>ASTM D2837</td>
<td>1600 psi HDB @ 73°F</td>
</tr>
<tr>
<td></td>
<td></td>
<td>800 psi HDB @ 180°F</td>
</tr>
</tbody>
</table>

5. Piping shall be manufactured from compounds in compliance with the above table. The dimensional and performance characteristics shall conform to the requirements of ASTM F714 for sizes 4 inch IPS and larger and to ASTM D3035 for sizes smaller than 4 inch IPS. Each lot of material shall be tested for melt index, density, and %carbon. Upon request, the Manufacturer shall furnish test data.

6. Polyethylene fabricated fittings shall be manufactured from polyethylene pipe, sheet stock or molded fittings meeting the material requirements of this specification.

7. Polyethylene fittings, including custom fabrications, shall have the same internal pressure rating as the mating pipe. At the point of fusion, the wall thickness and outside diameter of the fitting shall be in accordance with ASTM F714 or ASTM D3035 for the same pipe size.
8. The Manufacturer's Quality system shall be certified to be in accordance with ISO 9001:2000.

C. Pressure Polyvinyl Chloride Pipe and Fittings (Outside Building Slabs and Pavements)

1. Pipe and Fittings Less Than 4” in Diameter:
   a. Pipe, couplings and fittings shall be manufactured of materials in conformance with ASTM D1784, Class 12454B.
   b. Screw-Joint: Pipe shall conform to dimensional requirements of ASTM D1785, Schedule 80, with points meeting requirements of 150 psi working pressure, 200 psi hydrostatic test pressure, unless otherwise shown or specified. Fittings for threaded pipe shall conform to requirements of ASTM D2464, threaded to conform to the requirements of ASME B1.20.1 for use with Schedule 80 pipe and fittings. Pipe couplings, when used, shall be tested as required by ASTM D2644.
   c. Push-On Joint: ASTM D3139, with ASTM F477 gaskets. Fittings for push-on joints shall be iron conforming to AWWA C110/A21.10 or AWWA C111/A21.11. Iron fittings and specials shall be cement-mortar lined (standard thickness) in accordance with AWWA C104/A21.4.

D. Solvent Cement Joint: Pipe shall conform to dimensional requirements of ASTM D1785 or ASTM D2241 with joints meeting the requirements of 150 psi working pressure and 200 psi hydrostatic test pressure. Fittings for solvent cement Cast Iron Soil Piping

1. Cast Iron Hub and Spigot Soil Pipe and Fittings
   a. ASTM A74 with ASTM C564 compression type rubber gaskets.

2. Cast Iron Hubless Soil Pipe and Fittings
   a. CISPI 301 with CISPI 310 coupling joints.
   b. Jointing shall conform to ASTM D2466 or ASTM D2467.

E. Ductile Iron Pipe and Fittings

1. Ductile Iron Pipe shall be centrifugally cast of 60-42-10 iron and shall conform to the requirements of the latest revision of ANSI A21.51/AWWA C151. Thickness or class shall be that required for laying condition type 4 or 5, in accordance with actual conditions at the site. Ductile Iron Pipe may be “thickness designed” in accordance with requirements of the latest revision of ANSI A21.50/AWWA C150. The thickness design shall be based on standard laying conditions 4 or 5 in accordance with conditions at the site. Fittings for ductile iron pipe shall have not less than the thickness, class, or pressure rating specified for ductile iron pipe. Fittings shall be furnished with all necessary glands, gaskets, bolts, etc. as may be required to complete the joints.

2. Rubber gasket joints for mechanical joints or push on type joints shall conform to the requirements of ANSI A21/AWWA C111.

3. All ductile iron pipe and fittings shall be cement mortar lined or polyethylene lined.
   a. Cement mortar lining shall be in accordance with ANSI A21.4/AWWA C104.
   b. Polyethylene lining for pipe and fittings shall be virgin polyethylene complying with ASTM D1248, compounded with inert filler and with sufficient carbon black to resist ultraviolet rays during storage of the pipe and fittings. The polyethylene shall be bonded to the interior of the pipe or fitting by heat. Polyethylene lining in pipe and in fittings shall be 40 mils nominal thickness. Minimum lining thickness shall be 30 mils.

2.2 MORTAR

A. Masonry Mortar - ASTM C270, Type M. For minor amounts of mortar, packaged materials complying with ASTM C387, Type M will be accepted

2.3 PORTLAND CEMENT

A. Submit certificates of compliance stating the type of cement used in manufacture of precast manholes. Portland shall conform to ASTM C150. Type II for concrete used in precast manholes. Where aggregates are alkali reactive, as determined by Appendix XI of ASTM C33, a cement containing less than 0.60 percent alkalis shall be used.

2.4 PORTLAND CEMENT CONCRETE

A. Ready-mixed – meeting ASTM C94, Option A, and the following:
1. Manhole Base: Minimum Compressive Strength: conforming to the requirements of ASTM C478.

2. Riser:
   a. Minimum Compressive Strength: 3,000 psi at 28 days.
   c. Slump: 2 to 4 inches.

B. Cement shall conform to one of the following:
1. ASTM C150, Type II
2. ASTM C150, Type I, limited to a maximum tricalcium aluminate (C₃A) content of 12 percent and combined with fly ash as specified herein.
3. ASTM C595, Type IP blended hydraulic cement provided the cement conforms to ASTM C150 and fly ash is as specified herein.
6. Amount of Fly Ash: Minimum 15 percent, and maximum 25 percent, of the cementitious materials, unless otherwise directed by the Owner's Representative.
7. Water/Cement Ratio (Cementitious Materials) Ratio: Maximum of 0.49.

C. Fly Ash
1. Provide as specified in Section 03 30 00.

D. Mortar
1. Standard premixed meeting ASTM C387, or proportion 1 part Portland cement to 2 parts clean, well-graded sand, which will pass a 1/8-inch screen.
2. Admixtures may be included but do not exceed the following percentages of weight of cement:
   a. Hydrated Lime: 10 percent.
   b. Diatomaceous Earth or Other Inert Material: 5 percent.
3. Consistency:
   a. Tongue and Groove Type Joint: Such that mortar will readily adhere to pipe.
   b. Confined Groove (Keylock) Joint: Such that excess mortar will be forced out of groove, the tongue will not provide support for the section being placed.

E. Bonding Agent
2. Sika Corp., Sikador Hi-Mod.

F. Forms
1. Trench walls, large rock, or earth are not acceptable form material.
2. Exposed Surface: Plywood or steel panels.
3. Other Surfaces: Matched boards, plywood, or other approved material.

G. Reinforcing Steel
1. Reinforcing steel shall conform to ASTM A615, Grade 60, deformed bars.

2.5 MANHOLES
A. Cast-In-Place Manholes
1. Acceptable, subject to the Owner’s Representative approval.

B. Precast Manhole Riser Sections
1. Minimum 48 inches in diameter for sanitary sewer uses and 48 inches for storm drain uses, conforming to ASTM C478.
2. Minimum Wall Thickness: 4 inches or 1/12 times inside diameter, whichever is greater.
3. Provide eccentric cones for manholes. Cones shall have same wall thickness and reinforcement as riser section.
4. First riser section shall be monolithic.
5. Top and bottom of section shall be parallel.
6. Confined O-ring with rubber gaskets meeting ASTM C443
7. Prior to delivery of any size precast manhole section to jobsite, conduct yard test at point of manufacture.
8. Precast sections to be tested will be selected at random from stockpiled material to be supplied for the job.

C. Fiberglass Manholes
1. Fiberglass manholes shall comply with the requirements of ASTM D3753.
2. Manhole cylinders, manway 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 process may include contact molding, compression molding, pultrusion, etc. The manholes 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 H-20 traffic loading without damage to the manhole.
3. All manholes shall be watertight.
4. Manholes shall be a one-piece monolithic designed unit.
5. Exterior Surface:
   a. For a UV inhibitor the resin on the exterior surface of the manhole shall have a 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 resin from different manufacturers shall not be permitted.
6. All manholes must have an anti-flotation ring.
7. Minimum bottom thickness shall be 0.5 in.
8. All manholes shall be marked in letters minimum 1 in’ high with the following information:
   a. Manufacturer’s name or trademark.
   b. Manufacturer’s factory location.
   c. Manufacturer’s serial number.
   d. Manhole length.
   e. ASTM designation.
   f. Installation assist marks (vertical lines 90 degrees apart at bas of manhole).

2.6 PRECAST BASE SECTIONS AND BASES
A. As specified on other sections of specifications.
B. All precast bases shall be monolithic.

2.7 MANHOLE EXTENSIONS
A. In general, provide manhole extensions on manholes in streets or other locations where a subsequent change in existing grade may be likely. Limit extensions to maximum height of 12 inches.
B. Concrete Grade Rings for Extensions: Maximum 6 inches high with a minimum of one No. 2 reinforcing bar centered in the ring.

2.8 PREFORMED PLASTIC GASKETS
A. Preformed plastic gaskets may NOT be used on this Project.

2.9 MANHOLE FRAMES AND COVERS
A. Cast or ductile iron of size and shape with the words SANITARY SEWER in 2-inch raised letters.
B. Castings: Tough, close-grained gray iron, sound smooth, clean, free from blisters, blowholes, shrinkage, cold shuts, and defects.
C. Conform to ASTM A48, Class 30B for cast iron ASTM A536, Grade 60-40-12 for ductile iron.
D. Plane or grind bearing surfaces to ensure flat, true surfaces.
E. Covers: True and seat within ring at all points.

2.10 MANHOLE COATING
A. Combination Coating
   1. Kernoes SewperCoat 2000 HR
B. Cementitious Coating
   1. Permaform CR-9000 (1 inch thick application)
   2. Strong-Seal MS-2C (1 inch thick application)
   3. Standard Cement Material Inc. Reliner (1 inch thick application)
   4. Quadex Aluminaliner (1 inch thick application)
5. ConShield Biotech Armor (1 inch thick application)

C. Epoxy Coating
   1. Raven 405 Series High Build Epoxy Liner
   2. Spray Wall polyurethane System
   3. Carboline Plasite 4500

2.11 TRACER WIRE FOR NONMETALLIC PIPING
   A. Tracer wire shall be minimum 12 gauge (AWG) single strand, insulated copper wire with high molecular weight polyethylene (HMWPE) insulation, specifically manufactured for direct burial applications.
   B. Provide tracer wire in sufficient length to be continuous over each separate run of non-metallic pipe.
   C. All spliced or repaired wire connections in the tracer wire system shall be made using approved connectors.
   D. Tracer wire to have green insulation.
   E. Refer to Section 33 02 10 for additional requirements.

2.12 WARNING TAPE
   A. Detectable underground aluminum warning tape shall be minimum 3 inches wide, minimum 5 mils thick. Tape to be color coded according to American Public Works Association (APWA) Uniform Color Codes.

2.13 MARKING
   A. Pipe and tubing shall be permanently marked in accordance with all applicable standards. Marking shall be heat stamped indent print and shall remain legible under normal handling and installation practices.
   B. Fittings shall be marked on the body or hub. Marking shall be in accordance with the applicable standard depending on the fitting type. Mechanical fittings shall be marked with size, body material designation code, pressure rating, and the Manufacturer’s name or trademark.

PART 3 - EXECUTION

3.1 INSPECTION
   A. Examine the areas and conditions under which sanitary sewer system work is to be installed and do not proceed with the work until unsatisfactory conditions have been corrected in an acceptable manner.

3.2 HDPE JOINING METHODS
   A. Butt Fusion
      1. The pipe shall be joined by the butt fusion procedure outlined in ASTM F2620 or PPI TR-33.
      2. All fusion joints shall be made in compliance with the pipe or fitting Manufacturer’s recommendations.
      3. Fusion joints shall be made by qualified fusion technicians per PPI TN-42.
      4. Butt fusions performed between pipe ends or pipe ends and fitting outlets shall be within the following allowable wall mismatches:
         a. 2 DR difference for pipe and fitting diameters 6 inch IPS and smaller.
         b. 1 DR difference for above 6 inch through 18 inch.
         c. No difference for diameters above 18 inch.
      5. The difference in DR’s is determined from the following DR values: 7.3, 9, 11, 13.5, 17, 21, 26, and 32.5.
   B. Saddle Fusion
      1. Saddle fusion shall be done in accordance with ASTM F2620 or PPI TR-41 or the fitting Manufacturer’s recommendations and PPI TR-41.
      2. Saddle fusion joints shall be made by qualified fusion technicians. Qualification of the fusion technician shall be demonstrated by evidence of fusion training within the past year on the equipment to be utilized on the project.
   C. Socket Fusion
      1. Molded socket fusion fittings are only to be used for joining of HDPE pipe from ½ inch to 2 inch in size.
2. Socket fusion shall be done in accordance with ASTM F2620 or the fitting Manufacturer’s recommendations.

3. Socket fusion joints shall be made by qualified fusion technicians. Qualification of the fusion technician shall be demonstrated by evidence of fusion training within the past year on the equipment to be utilized on the project.

D. Electrofusion

1. Electrofusion shall be performed in accordance with ASTM F1290 and PPI TN-34 or Manufacturer’s recommendations.

2. Electrofusion joints shall be made by qualified fusion technicians. Qualification of the fusion technician shall be demonstrated by evidence of fusion training within the past year on the equipment to be utilized on the project.

E. Other Methods of Joining

1. Polyethylene pipe and fittings may be joined together or to other materials through the use of flange adapters with back-up rings, mechanical couplings designed for connecting polyethylene pipe and fittings to itself or to another material or mechanical joint (MJ) adapters. The Manufacturer of the joining device shall be consulted for proper joining procedure.

3.3 INSTALLATION OF CONDUIT

A. General:

1. Install conduit in accordance with governing authorities having jurisdiction, except where more stringent requirements are indicated.

2. Inspect conduit before installation to detect any apparent defects. Mark defective materials with white paint and promptly remove from the Project Site.

3. Lay conduit beginning at the low point of the system, true to the grades and the alignment indicated with unbroken continuity of invert.

4. Install gaskets in accordance with manufacturer’s recommendations for the use of lubricants, cements, and other types of special installation requirements.

5. After inspection of cast iron soil pipe, and at least 48 hours prior to backfilling, apply a single coat of high-build bituminous coating to the external surfaces to attain a dry film thickness of not less than 12 mils.

B. Handling: Carefully remove pipe from trucks; do not “whip” over the side. Handle pipe and accessories to ensure delivery to trench in sound, undamaged condition. Carry pipe into position; do not drag. Use of pinch bars and tongs for aligning or turning pipe will be permitted only on the bare ends of the pipe. Thoroughly clean pipe interior and accessories of foreign matter before lowering into trench, and keep clean during laying operations by plugging or other approved method. Inspect pipe before laying for defects; remove and replace defective material. Rubber gaskets that are not to be installed immediately shall be stored in a cool and dark place.

C. Cut pipe in a neat and workmanlike manner. Unless otherwise recommended by the pipe manufacturer and authorized by the Owner's Representative, cutting shall be done with an approved type mechanical cutter. Wheel cutters shall be used when practicable.

D. Location: Do not place sanitary sewer pipes in the same ditch with water lines; separate water lines from sewer lines by at least 10 feet, unless otherwise approved by the Engineer.

E. Pipe Bedding: Provide sand, as per Section 31 00 00, bedding for all sizes and depths of sewer pipe as detailed on Drawings and specified in Section 31 00 00.

F. Joint Deflection: Under no circumstances will the joint deflections recommended by the manufacturer of the pipe used be exceeded.

G. Joint Adapters: Make joints between cast iron pipe and other types of pipe with standard manufactured cast iron adapters and fittings.

H. Install HDPE pipe in compliance with the requirements of ASTM D2321.

I. Placing and Laying Pipe: Pipe and accessories shall be carefully lowered into the trench by means of derrick, ropes, belt slings, or other authorized equipment. Under no circumstances shall any of the water line materials be dropped or dumped into the trench. Except where necessary in making connections with other lines or as authorized by the A/E, pipe shall be laid with the bells facing in the direction of laying. The full length of each section of pipe shall
rest solidly upon the pipe bed, with recesses excavated to accommodate bells, couplings, and joints. Pipe that has the grade or joint disturbed after laying shall be taken up and re-laid. Pipe shall not be laid in water or when trench conditions are unsuitable for the work. Water shall be kept out of the trench until jointing is complete. When work is not in progress, open ends of pipe and fittings shall be securely closed so that no trench water, earth, or other substance will enter the pipes or fittings. Pipe ends left for future connections shall be plugged or capped and anchored as shown.

J. Service Connections: Locate far-side service connections and near-side service stubs as shown on Mechanical Drawings. Use wyes and tees as indicated.
   1. Show actual locations of installed service connections on Project Record Drawings.

K. Interior Inspection: Inspect conduit to determine whether line displacement or other damage has occurred.
   1. Make inspection after lines between manholes or manhole locations have been installed and approximately 2’ of backfill is in place and at completion of Project.
   2. If the inspection indicates poor alignment, debris, displaced pipe, infiltration, or other defects, take whatever steps are necessary to correct such defects to the satisfaction of the Architect/Engineer.

L. Cleaning Conduit:
   1. Clear interior of conduit of dirt and other superfluous material as work progresses. Maintain a swab or drag in line and pull past each joint as it is completed.
   2. Place plugs in the ends of uncompleted conduit at the end of day or whenever work stops.
   3. Flush lines between manholes if required to removed debris.

3.4 TAP CONNECTIONS
A. Make connections to existing underground structures so that finished work will conform as nearly as practicable to requirements specified for new work.
   1. Use commercially manufactured wyes for branch connections. Field cutting into conduit will not be permitted. Spring wyes into existing line and encase the entire wye, plus 6” overlap, with not less than 6” of 3,000 psi 28-day compressive strength concrete.
   2. For branch connections from side into existing underground structure, cut an opening into unit sufficiently large to allow 3” of concrete, with not less than 6” of 3,000 psi 28 day compressive strength, to be packed around entering connection. Cut ends of connection passing through conduit or structure wall to conform to shape of and be flush with inside wall. On outside of conduit or structure wall, encase entering connection in 6” of concrete for a minimum length of 12” to provide additional support or collar from connection to undisturbed ground. Use an epoxy bonding compound as an interface between new and existing concrete and conduit materials.
   3. Take care while making tap connections to prevent concrete or debris from entering the existing structure. Remove any debris, concrete, or other extraneous material which may accumulate.

3.5 MANHOLES
A. Concrete Bases
   1. All manhole bases shall be placed on nine (9) inches of 1-1/2 sack cement/C.Y. cement stabilized sand.

B. Placing Precast Manhole Sections
   1. Thoroughly clean ends of sections to be joined.
   2. Thoroughly wet joint with water prior to placing mortar.
   3. Place mortar on groove of lower section.
   4. Set next section in place.
   5. Fill joint completely with mortar of proper consistency.
   6. Trowel interior and exterior surfaces smooth on standard tongue and groove joints.
   7. Prevent mortar from premature drying and curing by applying an approved curing compound or comparable approved product.
   8. Do not use mortar mixed for longer than thirty minutes. Chip out and replace cracked or defective mortar.

C. Fiberglass Manholes
1. Fiberglass manholes shall be installed according to manufacturer’s installation instructions.

D. Manhole Invert
1. Shall be the flow line of the pipe or as specified on the drawings.

E. Manhole Extensions
1. Install extension as shown, to height not exceeding 12 inches.
2. Lay grade rings in mortar with sides plumb and tops level. Seal joints with mortar as specified for manhole sections and make watertight.

F. Manhole Frames and Covers
1. Install on top of manholes to positively prevent infiltration of surface or groundwater into manholes.
2. Set frames in bed of mortar with mortar carried over flange as shown.
3. Set tops of covers flush with surface of adjoining pavement. Set tops of covers outside of pavement areas flush with ground surface, unless otherwise shown or directed.
4. Covers shall be adjusted to final grade at no additional cost to the Owner.

G. Backfilling and Compaction
1. General: Backfill open-cut trenches closely following laying, jointing and bedding of pipe, and after initial inspection and testing are completed. Comply with the requirements of Section 31 00 00. All trenching in existing paved areas or areas to be paved shall comply with the requirements of Section 31 00 00.
2. Installation of Tracer Wire
   a. Install a continuous length of tracer wire for the full length of each run of nonmetallic pipe. Attach wire to top of pipe at minimum 10 foot intervals in such a manner that it will not be displaced during construction operations. Extend ends of tracer wire into valve boxes and anchor in place.
3. Installation of Detectable Warning Tape
   a. Install detectable warning tape 12 inches below finished grade.

3.6 TESTING
A. Piping
1. General: During construction, perform leakage testing and displacement testing as work progresses. No more than 500 linear feet of installed sewer shall be allowed to remain untested. After backfilling and removing debris from each section of sewer line, conduct a line acceptance test under the observation of the Owners Designated Representative.
2. Testing of sanitary sewer pipe and manholes for leakage and testing of flexible pipe for deflection shall be inspected by a qualified inspector.
3. Leakage Testing: Test the sanitary sewer lines in strict accordance with the following leakage test using low-pressure air. If the test results indicate an unacceptable installation, locate the source of leakage, correct the defect, and retest until the installation is proven satisfactory. Testing shall comply with the requirements of ASTM F1417 Standard practice for Installation Acceptance of Plastic Non-Pressure Sewer Lines Using Low-Pressure Air.
   a. Minimum Requirements for Equipment
      1) Control panel.
      2) Low pressure air supply connected to control panel.
      3) Pneumatic plugs of acceptable size for diameter of pipe to be tested; capable of withstanding internal test pressure without leaking or requiring external bracing.
      4) Air hose from control panel to:
         a) Air supply.
         b) Pneumatic plugs.
         c) Sealed line for pressurizing.
         d) Sealed line for monitoring internal pressure.
b. Test pneumatic plugs: Test plugs before using in actual test installation.
   1) Place one length of pipe on ground and seal at both ends of pneumatic plugs to be checked.
   2) Pressurize plugs to 25 psig; then pressurize sealed pipe to 5 psig.
   3) Plugs are acceptable if they remain in place against the test pressure without external aids.

c. Compensating for Groundwater Pressure:
   1) Where groundwater exists, install a capped pipe nipple at the same time the sewer line is placed. Use a 1/2-inch capped pipe nipple approximately 10 inches long. Make installation through the manhole wall on top of the sewer line where the line enters the manhole.
   2) Immediately before performing the line acceptance test, remove the pipe cap, clear the pipe nipple with air pressure, and connect a clear plastic tube to pipe nipple. Support the tube vertically and allow water to rise in the tube. After the water stops rising, measure the height in feet of water over the invert of the pipe. Divide this height by 2.3 feet/psi to determine the groundwater pressure to be used in line testing.

d. Line Testing: After pneumatic plugs have been checked, place plugs in line at manholes and inflate lugs to 25 psig. Introduce low-pressure air into the sealed line until the internal air pressure reaches 3.5 psig greater than the groundwater pressure. Allow at least 2 minutes for air pressure to stabilize. Once the pressure is stabilized, the minimum time allowable for the pressure to drop from 3.5 pounds per square inch gauge to 2.5 pounds per square inch gauge shall be as required the table below. The test may be stopped if no pressure loss has occurred during the first 25% of the calculated testing time. If any pressure loss or leakage has occurred during the first 25% of the testing period, then the test shall continue for the entire test duration or until failure.

<table>
<thead>
<tr>
<th>Pipe Diameter (inches)</th>
<th>Minimum Time (seconds)</th>
<th>Maximum Length for Minimum Time (feet)</th>
<th>Time for Longer Length (seconds/foot)</th>
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<tr>
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<tr>
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</tr>
</tbody>
</table>

4. Deflection Testing
   a. Deflection test shall be performed on all flexible pipes. For pipelines with inside diameters less than 27 inches, a rigid mandrel shall be used to measure deflection. For pipelines with an inside diameter 27 inches and greater, a method approved by the Owner or Engineer shall be used to test for vertical deflections. The test shall be conducted after the final backfill has been in place at least 30 days. No pipe shall exceed a deflection of five percent. If a pipe should fail to pass a deflection test, the problem shall be corrected and a second test shall be conducted after the final backfill has been in place an additional 30 days. The tests shall be performed without mechanical pulling devices.
   b. Deflection testing must comply with the requirements of Texas Administrative Code, Title 30, Part 1, Chapter 217, Subchapter C, Rule 217.57
      1) Mandrel Sizing: The rigid mandrel shall have an outside diameter (O.D.)
equal to 95% of the inside diameter (I.D.) of the pipe. The inside diameter of the pipe, for the purpose of determining the outside diameter of the mandrel, shall be the average outside diameter minus two minimum wall thicknesses for O.D. controlled pipe and the average inside diameter for I.D. controlled pipe. All dimensions shall be per appropriate standard. Statistical or other "tolerance packages" shall not be considered in mandrel sizing.

2) Mandrel Design: The rigid mandrel shall be constructed of a metal or a rigid plastic material that can withstand 200 psi without being deformed. The mandrel shall have nine or more "runners" or "legs" as long as the total number of legs is an odd number. The barrel section of the mandrel shall have a length of at least 75% of the inside diameter of the pipe. Adjustable or flexible mandrels are prohibited.

B. Building Sewer Testing
1. Building sewer is to be tested in compliance with IPC Section 312.6.
   a. Gravity sewer tests shall consist of plugging the end of the building sewer at the point of connection with the public sewer, filling the building sewer with water, testing with not less than a 10-foot head of water and maintaining such pressure for 15 minutes.

C. Manhole Testing: Test manholes per the requirements of Texas Administrative Code, Title 30, Part 1, Chapter 217, Subchapter C, Rule 217.58.
1. Hydrostatic Testing
   a. The maximum leakage for hydrostatic testing or any alternative test methods is 0.025 gallons per foot diameter per foot of manhole depth per hour.
   b. To perform a hydrostatic exfiltration test, an owner shall seal all wastewater pipes coming into a manhole with an internal pipe plug, fill the manhole with water, and maintain the test for at least one hour.
   c. A test for concrete manholes may use a 24-hour wetting period before testing to allow saturation of the concrete.
2. Vacuum Testing
   a. To perform a vacuum test, plug all lift holes and exterior joints with a non-shrink grout and plug all pipes entering a manhole.
   b. No grout may be placed in horizontal joints before testing.
   c. Stub-outs, manhole boots, and pipe plugs must be secured to prevent movement while a vacuum is drawn.
   d. Use a minimum 60 inch/lb. torque wrench to tighten the external clamps that secure a test cover to the top of a manhole.
   e. A test head must be placed at the inside of the top of a cone section, and the seal inflated in accordance with the manufacturer’s recommendations.
   f. There must be a vacuum of 10 inches of mercury inside a manhole to perform a valid test.
   g. A test does not begin until after the vacuum pump is off.
   h. A manhole passes the test if after 2.0 minutes and with all valves closed, the vacuum is at least 9.0 inches of mercury.

D. Manhole Coating
1. After a manhole has passed all testing, approved coating(s) shall be applied. Coatings shall consist of either:
   a. Combination Coating – 1” thick application installed per manufacturer’s instructions, or
   b. Cementitious and Epoxy Coating
      1) Cementitious Coating – 1” thick application installed per manufacturer’s instructions.
      2) Epoxy Coating – 125 mil thick application installed per manufacturer’s instructions.

E. New sanitary sewers outside buildings shall be television inspected. Videotape shall be turned over to the Owner.
3.7 CLEAN UP
   A. Upon completion of all sewer lines and appurtenances, all debris and surplus materials resulting from work shall be removed.

END OF SECTION 33 30 00
SECTION 33 40 00 - STORM DRAINAGE UTILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Terms and Conditions of the Contract, including Supplementary and Special Conditions of the Contract, and the Drawings apply to this Section.

1.2 SUMMARY

A. Section includes storm sewer system and appurtenances from a point five (5) feet outside the building to the point of disposal.

1.3 RELATED WORK

A. Related work of other Sections includes:
   1. Section 03 30 00 – Cast-In-Place Concrete
   2. Section 31 00 00 – Site Earthwork
   3. Section 31 50 00 – Excavation Support and Protection
   4. Section 33 02 10 – Conductive Trace Wire For Nonmetallic Pipe Installation

1.4 REFERENCES

A. American Society for Testing and Materials (ASTM), 1916 Race Street, Philadelphia, Pennsylvania 19103, U.S.A. All references are to current active standard
24. ASTM C786 – Standard Test Method for Fineness of Hydraulic Cement and Raw Materials by the 300-μm (No. 50), 150-μm (No. 100), and 75-μm (No. 200) Sieves by Wet Methods.

B. American Water Works Association (AWWA), 6666 W. Quincy Ave., Denver, CO 80235.

C. American Concrete Institute (ACI):
1. ACI 301-84, Specifications for Structural Concrete for Buildings.

1.5 SUBMITTALS
A. General: Refer to Section 01 33 00 - Submittal Procedures, and Section 01 33 23 – Shop Drawings, Product Data and Samples, for submittal requirements and procedures.
B. Shop Drawings:
1. Submit shop drawings for the system, showing pipe sizes, locations, elevations, and slopes for horizontal runs.
2. Submit for review Shop Drawings showing design, reinforcing steel placement, and construction of all concrete structures.
3. Cast-in-Place Structures: Details of construction.
4. Construction details of structure frames, covers, and grates.
C. Product Data:
1. Submit manufacturers’ product data of inlets, junction boxes, piping and appurtenances.
2. Proposed mix designs in accordance with ACI 301, Chapter 3.9. Each proposed mix design shall be accompanied by a complete standard deviation analysis based on no less than thirty (30) consecutive strength tests or by three laboratory trial mixtures with confirmation tests.
3. Mill test certificates of supplies concrete reinforcing, indicating results of chemical and physical analysis.
5. Submit manufacturer’s certificates for the following:
   a. Certification of Compliance confirming that the pipe meets or exceeds specified requirements as stated in ASTM C478.
   b. Precast Manhole Sections: Results of tests performed on representative sections to be furnished.
   c. Fly Ash: certifications that each fly ash shipment meets specified requirements.
D. As-Builts, locating actual horizontal and vertical location of installed storm sewer piping, inlets, manholes, and related work shall be prepared and submitted to the Owner.
E. Submit in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.09 SUBMITTALS and UGC Article 8.

1.6 QUALITY CONTROL
A. The testing laboratory shall sample and test concrete in accordance with the provisions of these specifications.
B. Concrete Mix Designs
1. Selection of Proportions: Proportions of ingredients for concrete mixes shall be determined by an independent testing laboratory or qualified concrete supplier in accordance with the requirements of ACI 301, Chapter 3. If testing laboratory provides concrete mix designs, it shall be selected by the Contractor, approved by the Owner's Designated Representative, and paid by the Contractor.

2. Required average strength above specified strength: Determination of required average strength above specified strength shall be based on the standard deviation record of the production facility in accordance with ACI 301. Calculation of standard deviation of compressive strength results shall be made in accordance with ACI 214. If a suitable record of strength tests is not available, proportions shall be selected on the basis of laboratory trial batches to produce an average strength greater than the specified strength by the amount defined in ACI 301, Table 3.9.2.2

C. QUALITY ASSURANCE in accordance with TPWD DIVISION 1 - SECTION 01000 - SPECIAL CONDITIONS SECTION 1.10 QUALITY ASSURANCE AND UGC Article 8.

PART 2 - PRODUCTS
2.1 CONDUIT MATERIALS
A. General: Furnish ells, tees, reducing tees, wyes, couplings, increasers, crosses, transitions, and end caps of the same type and class of material as the conduit, or of material having equal or superior physical and chemical properties as approved by the A/E

B. Reinforced Concrete Pipe (All piping over 12" or under vehicular pavement):
1. ASTM C76, Class III or IV as required based on pipe cover.
2. All reinforced concrete pipe to be bell and spigot or tongue and groove.
3. Joint assembly design shall be reinforced concrete incorporating a fully retained single or double rubber gasket complying with ASTM C443.

C. High Density Polyethylene Pipe (Pipe 12 inches or less):
1. Provide HDPE pipe and fittings that meet the requirements of AASHTO M 294
   a. Raw Materials: The pipes and fittings shall be manufactured from virgin Polyethylene (PE) compounds, which conform to the requirements of cell class 335400C as defined in ASTM D3350, except that carbon black content shall not exceed 5%. PE compounds shall meet the Environmental Stress Crack Resistance according to the SP-NCTL test set forth in AASHTO M294.
   b. Designation of Type: The HDPE pipes used for gravity flow drainage applications shall be of Type S (outer corrugated wall with smooth inner liner) or Type D (inner and outer smooth walls braced circumferentially or spirally with projections or ribs).
   c. Section Properties: Minimum wall thickness of the inner walls of Type S pipe and inner and outer walls of Type D shall be as specified in Section 7.2.2 of AASHTO M 294. The pipe stiffness at 5% deflection, when determined in accordance with ASTM D2412, shall be as specified in Section 7.4 of AASHTO M 294
2. Marking: All pipes shall be clearly marked at intervals of not more than 12 feet, and fittings an couplings shall be clearly marked as follows:
   a. Manufacturer's name or trademark.
   b. Nominal Size.
   c. Specification designation (e.g. AASHTO M 294).
   d. Plant designation code.
   e. Date of manufacture
3. Joints
   a. Joints shall be installed such that the connection of pipe sections will form a continuous line free from irregularities in the flow line.
   b. Joints shall conform to one of the following:
      1) Integral Bell and Spigot. The bell shall overlap a minimum of two corrugations of the spigot end when fully engaged. The spigot end shall have an O-ring gasket that meets ASTM F477
      2) Exterior Bell and Spigot. The bell shall be fully welded to the exterior of the pipe and overlap the spigot end so that the flow lines and ends match when
3) Watertight Joints. Joints meeting the requirements of ASTM D3212.

D. Polyvinyl Chloride (PVC)

2.2 CONCRETE
   A. Cement
      1. Type I portland cement shall conform to all the requirements of ASTM C150 with the following modifications:
         a. The specific surface area of Types I and II shall not exceed 2000 square centimeters per gram as measured by the ASTM C115 Standard Test for Fineness Of Portland Cement by the Turbidmeter. With each shipment, the Contractor shall furnish the Engineer a statement as to the specific surface area of the cement, expressed in square centimeters per gram. When Type II cement is used in concrete piling or prestressed concrete members, the specific surface area requirement is waived. When white cement is specified on the plans for use in concrete, Type I or Type II cement used need not meet the above limit on specific surface area.
         b. The Gillmore time of set test shall govern.
         c. When the cement is to be used in concrete with potentially-reactive aggregates, one of the following shall be adhered to: the cement shall have an alkali content Na₂O + 0.658 K₂O of 0.60 percent or less; the cement shall be Type IP; or the cement may have an alkali content in excess of 0.6 percent provided 25 to 35 percent, by absolute volume, of the cement is replaced with fly ash meeting the requirements of ASTM C618 and has an available alkali content of 1.5 percent or less.

   2. Coarse Aggregate
      a. Coarse aggregate shall be washed and shall consist of durable particles of gravel, crushed blast furnace slag, crushed stone, or combinations thereof and shall be free from frozen material or injurious amounts of salt, alkali, vegetable matter, or other objectionable material either free or as an adherent coating. When white Portland cement is specified, the coarse aggregates used in the concrete shall be light colored. Quality shall be reasonably uniform throughout. Coarse aggregate shall not contain more than 0.25 percent by weight of clay lumps, nor more than one (1.0) percent by weight of shale, nor more than five (5.0) percent by weight of laminated and/or friable particles when tested in accordance with Test Method ASTM D1863. Coarse aggregate from each source shall have a wear of not more than 40 percent when tested in accordance with Test Method ASTM C131.
      b. Unless otherwise shown on the plans, coarse aggregate from each source will be subjected to five (5) cycles of both the sodium sulfate and the magnesium sulfate soundness test in accordance with Test Method ASTM C88. When the loss is greater than 12 percent with sodium sulfate and/or 18 percent with magnesium sulfate, further testing will be required prior to acceptance or rejection of the material. A satisfactory record under similar conditions of service and exposure will be considered in the evaluation of material failing to meet these requirements.
      c. When tested in accordance with Test Method ASTM C136, the coarse aggregate, including combinations of aggregates when used, shall conform to the gradation requirements of ASTM C33 gradations 7, 57, 67 or 467.
      d. The loss by decantation in accordance with Test Method ASTM C117 plus the allowable weight of clay lumps shall not exceed one (1) percent, or the value shown on the plans, whichever is smaller. In the case of aggregates made primarily from the crushing of stone, if the material finer than the 200 sieve is definitely established to be the dust of fracture, essentially free from clay or shale, as established by Test Method ASTM C117, the percent may be increased to 1.5.

   3. Fine Aggregate
a. Fine aggregate shall be washed and consist of clean, hard, durable and uncoated particles of natural or manufactured sand or a combination thereof, with or without a mineral filler. When white Portland cement is specified the fine aggregate used in the concrete shall be light colored. It shall be free from frozen material or injurious amounts of salt, alkali, vegetable matter or other objectionable material and it shall not contain more than 0.5 percent by weight of clay lumps. When the aggregate is subjected to the color test for organic impurities in accordance with Test Method ASTM C40, the test result shall not show a color darker than standard.

b. Unless otherwise shown on the plans, the acid insoluble residue of fine aggregate used in concrete subject to direct traffic shall be not less than 60 percent by weight when tested in accordance with Test Method Tex-612-J.

c. When tested in accordance with Test Method ASTM C136, the fine aggregate or combinations of aggregates, including mineral filler, shall conform to the gradation requirements shown below:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Retained</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8&quot;</td>
<td>0%</td>
</tr>
<tr>
<td>No. 4</td>
<td>0 to 5%</td>
</tr>
<tr>
<td>No. 8</td>
<td>0 to 20%</td>
</tr>
<tr>
<td>No. 16</td>
<td>15 to 50%</td>
</tr>
<tr>
<td>No. 30</td>
<td>35 to 75%</td>
</tr>
<tr>
<td>No. 50</td>
<td>65 to 90%</td>
</tr>
<tr>
<td>No. 100</td>
<td>90 to 100%</td>
</tr>
<tr>
<td>No. 200</td>
<td>97 to 100%</td>
</tr>
</tbody>
</table>

d. Where manufactured sand is used in lieu of natural sand, the percent retained on the No. 200 sieve shall be 94 to 100.

e. Where the sand equivalent value is greater than 85, the retainage on the No. 50 sieve may be 65 to 94 percent.

f. Fine aggregate will be subjected to the Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate (Test Method ASTM D 2419). The sand equivalent shall not be less than 80 unless otherwise shown on the plans.

g. For all classes of concrete, the fineness modulus shall be between 2.30 and 3.10 as determined by Test Method ASTM C786. The fineness modulus for class K shall be 2.6 to 2.8 unless otherwise shown on the plans.

4. Slump shall not exceed four (4) inches.

5. Concrete shall be “Class C”, minimum 28-day compressive strength of 3600 psi and maximum W/C (water/cement) ratio of 0.45.

6. Mixing Water

a. Water for use in concrete and for curing shall be free from oils, acids, organic matter or other deleterious substances and shall not contain more than 1000 parts per million of chlorides as Cl nor more than 1000 parts per million of sulfates as \( \text{SO}_4 \).

b. Water from municipal supplies approved by the State Health Department will not require testing, but water from other sources will be sampled and tested before use in concrete. Tests shall be made in accordance with AASHTO T26.

c. Water used in white Portland cement concrete shall be free from iron and other impurities which may cause staining or discoloration.

2.3 MASONRY MATERIALS

A. Masonry Mortar: ASTM C270, Type M.

1. For minor amounts of mortar, packaged materials complying with ASTM C387, Type M will be acceptable.

2.4 MISCELLANEOUS METALS

A. Basins, Frames and Gratings:

1. Cast or ductile iron of size and shape with the words STORM SEWER in 2-inch raised letters.

2. Castings: Tough, close-grained gray iron, sound smooth, clean, free from blisters, blowholes, shrinkage, cold shuts, and defects.
3. Conform to ASTM A48, Class 30B for cast iron ASTM A536, Grade 60-40-12 for ductile iron.
4. Plane or grind bearing surfaces to ensure flat, true surfaces.
5. Covers: True and seat within ring at all points.
6. Comply with requirements of FS RR-F-621, for type and style required

B. Steel Expansion Joint Dowels:
1. Dowel bars shall be round smooth steel conforming to ASTM A36, Grade 60. One end shall be coated with asphalt mastic

2.5 REINFORCING STEEL
1. Reinforcing steel shall be deformed and conform to ASTM A615, new billet steel, Grade 60.
2. Reinforcing steel to be structurally welded shall comply with ASTM A706 or shall have a carbon equivalent (C.E.) of not more than 0.55%. A report of chemical analysis, showing the percentages of elements necessary to establish the carbon equivalency, will be required of all reinforcing steel that is to be structurally welded. Carbon equivalency will be calculated using the following formula:

\[
\text{C.E.} = \frac{\%C + \%Mn + \%Cu + \%Ni + \%Cr - \%Mo - \%V}{6} \\
\frac{40}{20} \frac{20}{10} \frac{50}{10}
\]

2.6 CURING MATERIALS
A. Membrane Curing: The liquid membrane-forming curing compound shall comply with ASTM C309.
B. Cotton mats shall consist of a filling material of cotton "bat" or "bats" (min. 12 oz. per sq. yd.); covered with unsized cloth (min. six (6) oz. per sq. yd.); tufted or stitched to maintain stability; shall be free from tears; and shall be in good general condition.
C. Polyethylene sheeting shall be four (4) mil. minimum thickness and free from visible defects. It shall be clear or opaque white except when the temperature during the curing period does not exceed 60 F or when applicable to control temperature during mass pours.
D. Burlap-polyethylene mats shall be made from burlap impregnated on one side with a film of opaque white pigmented polyethylene and free from visible defects.
E. Laminated mats shall have not less than one (1) layer of an impervious material such as polyethylene, vinyl plastic or other acceptable material (either as a solid sheet or impregnated into another fabric) and shall be free of visible defects

2.7 PREFORMED BITUMINOUS JOINT FILLER
A. Bituminous type conforming to ASTM D994 or D1752 unless otherwise specified or shown.

2.8 MANHOLES
A. Concrete
1. Ready-mixed, meeting ASTM C94, Option A, and the following:
   a. Manhole Base Minimum Compressive Strength: conforming to the requirements of ASTM C478.
   b. Riser Minimum Compressive Strength: 3,000 psi at 28 days.
   d. Riser Slump: 2 to 4 inches.
2. Cement shall conform to one of the following:
   a. ASTM C150, Type II.
   b. ASTM C150, Type 1, limited to a maximum tricalcium aluminate (C3A) content of 12 percent and combined with fly ash as specified herein.
   c. ASTM C595, Type IP blended hydraulic cement provided the cement conforms to ASTM C150 and fly ash is as specified herein.
5. Amount of Fly Ash: Minimum 15 percent, and maximum 25 percent, of the cementitious materials, unless otherwise directed by the Owner's Designated Representative.
6. Water/Cement (Cementitious Materials) Ratio: Maximum of 0.49.
B. Fly Ash
1. Provide as specified in Section 03 30 00.

C. Mortar
1. Standard premixed meeting ASTM C387, or proportion 1 part Portland cement to 2 parts clean, well-graded sand, which will pass a 1/8-inch screen.
2. Admixtures: May be included but do not exceed the following percentages of weight of cement.
   a. Hydrated Lime: 10 percent.
   b. Diatomaceous Earth of Other Inert Material: 5 percent.
   c. Consistency:
      i. Tongue-and-Groove Type Joint: Such that mortar will readily adhere to pipe.
      ii. Confined Groove (Keylock) Joint: Such that excess mortar will be forced out of groove. The tongue will not provide support for the section being placed

D. Bonding Agent
1. As manufactured by:
   b. Sika Corp., Sikador Hi-Mod.
   c. Horn Co., Epoxtite Binder 2385

E. Forms
1. Trench walls, large rock, or earth are not acceptable form material.
2. Exposed Surfaces: Plywood or steel panels.

F. Reinforcing Steel
1. Conform to ASTM A615, Grade 60, deformed bars.

G. Cast-In-Place Manholes
1. Acceptable subject to the Owner’s Representative’s approval.

H. Precast Manhole Riser Sections
1. Minimum 48 inches in diameter for sanitary sewer uses and 48 inches for storm drain uses, conforming to ASTM C478.
2. Minimum Wall Thickness: 4 inches or 1/12 times inside diameter, whichever is greater.
3. Provide eccentric cones for manholes. Cones shall have same wall thickness and reinforcement as riser section.
4. First riser section shall be monolithic.
5. Top and bottom of section shall be parallel.
7. Prior to delivery of any size precast manhole section to jobsite, conduct yard test at point of manufacture.
8. Precast sections to be tested will be selected at random from stockpiled material to be supplied for the job.
9. All test specimens shall be tested and meet the permeability test requirements of ASTM C76.

I. Precast Base Sections and Bases
1. As specified in other sections of specifications.
2. All precast bases shall be monolithic

J. Manhole Extensions
1. In general, provide manhole extensions on manholes in streets or other locations where a subsequent change in existing grade may be likely. Limit extensions to maximum height of 12 inches.
2. Concrete Grade Rings for Extensions: Maximum 6 inches high with a minimum of one No. 2 reinforcing bars centered in the ring

K. Preformed Plastic Gaskets
1. Preformed plastic gaskets may NOT be used on this Project.

L. Manhole Access
1. Portable ladders, complying with OSHA standards, are to be used for accessing manholes.
2. Personal gas detectors complying with OSHA regulations, and other equipment required by OSHA, shall be provided by the Contractor to all appropriate personnel.

2.9 DRAINAGE STRUCTURES
A. Unless otherwise shown on the plans, all drainage structures shall be precast concrete rated for H20 loading.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the areas and conditions under which storm sewer system work is to be installed and do not proceed with the work until unsatisfactory conditions have been corrected in an acceptable manner.

3.2 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 31 00 00 EARTHWORK and the requirements specified below.

1. Trenching
   a. 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 twelve 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. 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.

2. Removal of Rock
   a. 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 meter foot of fill over the top of the pipe, whichever is greater, but not more than three-fourths the nominal diameter of the pipe. 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. Rock excavation shall be as specified and defined in Section 31 00 00 Site Earthwork.

3. Removal of Unstable Material
   a. Where wet or otherwise unstable soil incapable of properly supporting the pipe, as determined by the Owner’s Designated Representative, 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 AND COMPACTION. 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.

3.3 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 inches up to maximum depth of 24 inches. The middle third of the granular bedding shall be loosely placed. 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. Plastic Pipe

1. When no bedding class is specified or detailed on the drawings, bedding for PVC and PE pipe shall meet the requirements of ASTM D2321. Bedding, haunching, and initial backfill shall be either Class IB or II material.

D. HDPE Pipe
1. When no bedding class is specified or detailed on the drawings, bedding for HDPE pipe shall be per manufacturer’s recommendations.

3.4 INSTALLATION OF PIPE

A. General:
1. Install conduit in accordance with requirements of governing authorities having jurisdiction, except where more stringent requirements are specified.
2. Submit printed copies of the manufacturer's recommendations for installation procedures of the material being placed, prior to installation.
3. Inspect conduit before installation to detect apparent defects. Mark defective materials with white paint and promptly remove from the Project Site.
4. Lay conduit beginning at the low point of a system, true to grades and alignment indicated, with unbroken continuity of invert.
5. For concrete and PVC pipe, lay pipe with spigot end pointing in the direction of flow.
6. 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.
7. Install gaskets in accordance with manufacturer’s recommendations; use recommended lubricants, cements, and comply with other special installation requirements.
8. Cleaning Conduit:
   a. Clear the interior of conduit of dirt and other superfluous material as the work progresses. Maintain a swab or drag in the line and pull past each joint as it is completed.
   b. Place plugs in the ends of uncompleted conduit at the end of the day or whenever work stops.
   c. Flush lines between manholes if required to remove collected debris.
9. Interior Inspection: Inspect conduit to determine whether line displacement or other damage has occurred.
   a. Make inspections after lines have been installed and approximately 2’ of backfill is in place and at completion of the Project.
   b. If the inspection indicates poor alignment, debris, displaced pipe, infiltration or other defects, take whatever steps are necessary to correct such defects subject to the approval of the Architect/Engineer.
10. Trench backfill shall be per specification section 31 00 00 - Site Earthwork and the project drawings.

3.5 STRUCTURES

A. Cast-In-Place Structures
1. Equipment.
   a. All equipment, tools, and machinery used for hauling materials and performing any part of the work shall be maintained in such condition as to insure completion of the work under way without excessive delays for repairs or replacement.
   b. The mixer shall be of an approved type and size that will produce uniform distribution of the material throughout the mass and shall be capable of producing concrete meeting the requirements of these specifications.
   c. The mixing equipment shall be capable of producing the quantities of concrete necessary to comply with requirements shown on the plans or in these specifications.
   d. For all mixers, an adequate water supply and an accurate method of measuring the water shall be provided.
   e. Delivery of concrete to the worksite and the discharge from the hauling equipment, agitating, or non-agitating, shall be in accordance with the requirements shown on the plans or in the governing specifications.
   f. Specific requirements for batch plants, mixers and other equipment shall be in accordance with section 03 30 00 Cast-In-Place Concrete.
   g. Continuous Volumetric Mixers. For all miscellaneous concrete placements, a mobile, continuous, volumetric mixer may be used.
1) When approved in writing by the Engineer or when specified for use in other Items, these mixers may be used for other types of concrete construction, including structural concrete, if the number of mixers furnished will supply the amount of concrete required for the particular operation in question.

2) These mixers shall be designed to receive all the concrete ingredients, including admixtures, required by the mix design in a continuous uniform rate and mix them to the required consistency before discharging.

h. Portland Cement Concrete Plants. The use of ready-mixed concrete from a commercial source will be permitted for all structural concrete provided that the plant, truck mixers, and mixing equipment conform to the requirements of section 03 30 00 Cast-In-Place Concrete. The use of ready-mix plants and ready-mix concrete for concrete pavement shall be in accordance with section 03 30 00 Cast-In-Place Concrete.

2. Mixing
   a. Mixed concrete which does not conform to specification requirements shall not be placed. Mixing shall be in accordance with section 03 30 00 Cast-In-Place Concrete.
   b. Continuous Volumetric Mixers. Mixing shall be in accordance with mixer manufacturer's recommendations unless otherwise revised by the Engineer.
   c. Mixing of concrete by hand methods or by the use of a small motor driven mixer will be permitted for small placements of approximately two (2) cubic yards or less when authorized by the Engineer. Hand mixed batches shall not exceed a two (2) sack batch in volume. For such placements the mix may be proportioned by approved volumetric methods.

3. Placing, Curing and Finishing
   a. The placing, curing and finishing of concrete, including construction of forms and falsework, curing and finishing, shall be in accordance with section 03 30 00 Cast-In-Place Concrete.

4. Bases shall be cast-in-place concrete. Slab shall be sufficient strength to safely support any H-20 loading.

B. Structure Bases
   1. All structures shall be placed on a base of 9" of 1-1/2 sack/c.y. of cement stabilized sand.

C. Precast Structures
   1. All precast structures shall conform to the requirements of ASTM C478.

D. Catch Basins
   1. Construct catch basins to the sizes and shapes indicated. Use concrete that will attain a 28-day compressive strength of not less than 3,000 psi.
   2. Set cast iron frames and gratings to the elevations indicated.

E. Grade Rings
   1. Grading rings shall be used for all precast structures where required. They shall be a maximum of twelve inches (12") in height, constructed on the top slab on which the frame will be placed. The height of the stack shall be such as is necessary to bring the frame to the proper grade.

3.6 TAP CONNECTIONS
A. Make connections to existing conduits and underground structure, so that the finished work will conform as nearly as practicable to the requirements specified for new work.
B. Use commercially manufactured wyes for branch connections. Field cutting into conduit will not be permitted. Spring wyes into existing line and encase the entire wye, plus 6" overlap, with not less than 6" of 3,000 psi 28-day compressive strength concrete.
C. Branch connections made from the side into existing 12" to 21" conduit shall have a wye sprung into the existing lines, and the entire wye encased with not less than 6" of 3,000 psi 28-day compressive strength concrete.
D. Take care while making tap connections to prevent concrete or debris from entering the existing conduit or structure. Remove any debris, concrete, or other extraneous material which may accumulate.
3.7 BACKFILLING AND COMPACTION
   A. General: Conduit backfill operations of open-cut trenches closely following laying, jointing
      and bedding of pipe, and after initial inspection and testing are completed. Comply with the
      requirements of Section 31 00 00 – Site Earthwork.

3.8 FIELD QUALITY CONTROL
   A. Inspect interior of piping to determine whether line displacement or other damage has
      occurred. Inspect after approximately 24 inches of backfill is in place, and again at
      completion of Project.
      1. Submit separate reports for each system inspection.
      2. Defects requiring correction include the following:
         a. Alignment: Less than full diameter of inside of pipe is visible between structures.
         b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder
            of size not less than 92.5 percent of piping diameter.
         c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
         d. Infiltration: Water leakage into piping.
         e. Exfiltration: Water leakage from or around piping.
      3. Replace defective piping using new materials, and repeat inspections until defects are
         within allowances specified.
      4. Reinspect and repeat.
   B. Test new piping systems, and parts of existing systems that have been altered, extended, or
      repaired, for leaks and defects.
      1. Do not enclose, cover, or put into service before inspection and approval.
      2. Test completed piping systems according to requirements of authorities having
         jurisdiction.
      3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' 
         advance notice.
      4. Submit separate report for each test.
      5. Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities 
         having jurisdiction, UNI-B-6, and the following:
         a. Exception: Piping with soil tight joints unless required by authorities having 
            jurisdiction.
         b. Option: Test plastic piping according to ASTM F1417.
         c. Option: Test concrete piping according to ASTM C924.
      6. Force-Main Storm Drainage Piping: Perform hydrostatic test after thrust blocks, 
         supports, and anchors have hardened. Test at pressure not less than 1-1/2 times the 
         maximum system operating pressure, but not less than 150 psig.
         a. Ductile-Iron Piping: Test according to AWWA C600, "Hydraulic Testing" Section.
         b. PVC Piping: Test according to AWWA M23, "Testing and Maintenance" Chapter.
   C. PVC Piping: Test according to AWWA Leaks and loss in test pressure constitute defects that
      must be repaired.

3.9 CLEANING
   A. Clean interior of piping of dirt and superfluous materials. Flush with water.

END OF SECTION 33 40 00
END OF A/E TECHNICAL SPECIFICATIONS

APPENDIX
ITEMS INCLUDED HEREAFTER ARE NOT PART OF THE A/E TECHNICAL SPECIFICATIONS AND ARE PROVIDED AS REFERENCE ONLY.
TEXAS DEPARTMENT OF STATE HEALTH SERVICES
ASBESTOS ABATEMENT DESIGN SPECIFICATION

Javelina Bathhouse
Lake Corpus Christi State Park
23194 Park Road 25
Mathis, Texas 78368

Prepared for:
Texas Parks and Wildlife Department
4200 Smith School Road
Austin, Texas 78744

Prepared by:
TTL Inc.
June 8, 2020
Project No. 000200901267.00

Texas Department of State Health Services Asbestos Consulting Agency No: 100550
By: Justin Clemens
Licensed Asbestos Consultant: TX DSHS License # 105793, Exp. 05/28/2021
GENERAL

The project site consists of asbestos abatement of the Javelina Bathhouse at Lake Corpus Christi State Park, located at 23194 Park Road 25, Mathis, Texas 78239.

The abatement contractor shall conduct all work in accordance with this specification, owner requirements and applicable Federal, State and Local regulations. Where these specifications and the applicable regulations may conflict, the more stringent shall apply. ACM quantities will be determined by the Abatement Contractor prior to abatement activities.

TTL can designate an Asbestos Project Manager and Asbestos Air Monitor Technician during abatement activities.

This report has been prepared for the exclusive use of Texas Parks & Wildlife Department and its assigned agents. This report and all contents, findings, conclusions, and recommendations expressed herein are not intended for any other purpose than that stated nor is intended to be used by any other party.

SUMMARY

This project consists of the removal of asbestos containing flooring and wall system in the designated residence that were confirmed as ACM in the previous limited asbestos survey. Specific details for the construction of containments and removal activities are found below. This Abatement Design Specification covers the specific activities to be conducted throughout the structure.

SCOPE OF WORK

The Asbestos Abatement Contractor shall provide a copy of the Texas DSHS Asbestos Abatement Notification Form based on this Scope of Work and Design Specification to TTL and Texas Parks & Wildlife Department at the time it is submitted.

1. Containments
   - Areas where full negative air pressure containment are used to remove asbestos containing materials shall be constructed in accordance with Texas DSHS rules, OSHA regulations and the requirements in this Abatement Specification.
   - All other asbestos abatement – to include exterior materials - will be conducted within a regulated area as defined by the Texas DSHS rules, OSHA regulations and the requirements of this Abatement Specification.

2. Personal Protective Equipment (PPE) Requirements:
   - Full PPE should be worn in all Full Containment areas.
   - The Abatement Contractor shall ensure that all workers wear OSHA appropriate PPE always while working within the containment area(s) prior to
clearance.

- The Abatement Contractor assumes all responsibility for PPE compliance and OSHA sampling.

3. Specific setup procedure:

- All interior contents, furnishings and belongings shall be completely removed within a work area prior to beginning abatement activities.
- Those areas where asbestos abatement will be conducted within a negatively pressurized full containment area shall have the work area evaluated and approved by the on-site Project Manager (PM) prior to beginning material removal.
- Those areas where asbestos abatement will be conducted within a regulated area shall have all barricades and warning signs in place, as required, prior to beginning material removal.
- All ACM shall be kept adequately wet using an amended water solution whenever possible.
- Excess ACM debris shall not accumulate within the work site at any given time.
- All ACM waste removed from building interiors shall be properly double bagged and sealed, placed in burlap bags and drums and sealed, or wrapped with two layers of 6-millimeter polyethylene (poly) sheeting.
- All ACM waste – including lined roll off containers – shall be appropriately labeled as asbestos waste in accordance with the Texas DSHS rules, EPA regulations and the requirements of this abatement design specification.
- ACM waste manifest documents will be provided to Texas Parks & Wildlife Department every time ACM waste is transported away from the site.
- All exterior (including the areas with slab/foundation ACM mastic) ACM shall be kept adequately wet following the NESHAP requirement of no visible emissions throughout the duration of the abatement activities.
1. Approximately 20 square feet of gray transite paneling should be removed under full containment.
   - The above asbestos will be abated in the residence – The Abatement Contractor shall remove ACM under full negative air pressure containment.

2. **PERSONAL PROTECTIVE EQUIPMENT:**
   All respiratory PPE shall comply with the OSHA 29CFR 1910.134 and OSHA 1926.1101. The Abatement Contractor is responsible for the proper training and use of all PPE throughout the duration of the abatement.
   1. Provide and use half-face respirators to all personnel working within the containment areas.
   2. Provide and use, at a minimum, HEPA filters labeled with NIOSH and MSHA Certification for “Radionuclides, Dust, Fumes, Mists including Asbestos – Containing Dusts and Mists” and color-coded in accordance with ANSI Z88.2 (1980). In addition, organic vapor cartridges (to protect against organic vapors from mastic removing solvents) shall be provided and used, as necessary. Provide cartridges that have each section of the combination canister labeled with appropriate color code and NIOSH/MSHA certification.
   3. Provide and use disposable protective overalls/suits, protective gloves, e.g., polynitrile, etc., headwear, and proper footwear and any other personal protective equipment as conditions dictate.

3. **MATERIALS**
   1. Polyethylene sheeting of 4-millimeter thickness that is clear, opaque, or black
   2. Polyethylene sheeting of 6-millimeter thickness that is clear, opaque, or black.
   3. Moisture resistant duct tape and spray on glue capable of continuously sealing polyethylene through project abatement duration.
   4. Stiff brooms, hand brushes, scrapers, toothbrushes, rough edge sponges and cleaning cloths shall be utilized during abatement procedures. All equipment shall be new and clean and disposed of as waste at the end of this project.
   5. PVC or equivalent supporting frames shall be utilized to ensure that the containment remains intact during the entire remediation and post-remediation procedure.
   6. Polyethylene bags of 6-millimeter thickness and labeled as asbestos-containing waste.
   7. Airless sprayers to be used for dust control by application of detergent water solution (as directed).
   8. HEPA-filtered vacuum cleaner. All units should be cleaned and sanitized and new filters installed prior to beginning the project.
   9. Ground Fault Circuit Interrupters (GFCI) to be used on all electrical equipment within
Warning signs and tape as required by the Texas DSHS Asbestos Regulations to establish a Regulated Area.

Spray glue may be used in designated areas with permission from the building representative.

ENGINEERING CONTROLS:

The following descriptions for the construction of the containment may not be applicable to all abatement projects; however, the Asbestos Abatement Contractor should refer to this section if any of the following details are specified.

1. **HVAC Systems** – All HVAC equipment in or passing through any containment area(s) shall be shut down, locked and tagged to prevent accidental start-ups. All intake and exhaust openings shall be sealed with at least one (1) layer of 6-millimeter polyethylene sheeting. The seals shall be installed in such a manner as to guarantee that the seals shall remain in place for the duration of the project.

2. **Critical Barriers** – Containment areas within which abatement activities are to be conducted shall be separated from adjacent areas by impermeable barriers with a minimum of two (2) layers of 4-millimeter polyethylene sheeting attached securely in place and completely sealed with tape. All openings between the containment area(s) and adjacent area(s), including but not limited to windows, doorways, elevator openings, corridor entrances, ventilation openings, drains, ducts, grills, grates, diffusers, skylights, etc., shall be sealed. All cabinets, shelving, etc., that have cracks, holes or other openings shall also be sealed.

3. **Movable Objects** – All movable objects shall be removed from the containment area(s), as specified in the Scope of Work. All non-movable objects that remain in the containment area(s) shall be cleaned and covered with at least one (1) layer of 6-millimeter polyethylene sheeting and secured in place.

4. **Floors** – As required, floor sheeting shall consist of at least two (2) layers of 6-millimeter polyethylene sheeting. The sheeting shall be overlapped at least one (1) foot and completely sealed with tape. Flooring shall extend up each perimeter wall no less than one (1) foot and be placed behind wall sheeting.

5. **Walls** – Wall sheeting shall consist of at least one layer of 4-millimeter polyethylene sheeting applied to all walls and doors in a four-foot strip up from the floor and shall be constructed in such a manner to prevent falling during normal use. All wall sheeting seams shall be overlapped at least one (1) foot and completely sealed with tape.

6. **Full Negative Air Pressure Containment Area Ventilation** – Air Filtration Devices with HEPA filtration and in a sufficient number to provide a negative pressure between the containment and outside areas shall be operated continuously from the time containment is established through the time acceptable final clearance air sample results are obtained. All units should be clean and sanitized with new filters installed.
prior to the beginning of the project. All units utilized to provide clean filtered air shall be vented to the exterior of the entire structure whenever possible. Air exhaust locations will be secured from criminal entry by using burglar bars or other satisfactory method during the abatement process and protected against water intrusion during rainfall events. The Abatement Contractor shall maintain the containment area(s) negative air pressurization at no less than 0.02 inches of water column (WC) and monitored continuously during work activities by use of a manometer.

7. De-Contamination System – At a minimum, a worker decontamination enclosure system in the Full Containment area(s) shall be used consisting of three chambers and two air locks. This system should be of sufficient size to allow for the movement of workers, equipment, and waste material, as appropriate.

**EXECUTION/PROCEDURES**

Under no circumstances shall the Abatement Contractor modify the containment to a smaller size than it was initially established.

1. Full Containment Procedures:
   - Isolate the HVAC system throughout the containment area(s).
   - Install critical barriers to isolate the containment area. Construct no less than a three-stage de-contamination system into the containment area(s) with an air-lock between each stage. In addition to the critical barriers separating the affected area from adjacent areas, the Abatement Contractor shall also install critical barriers to isolate all immovable objects that cannot be wet-wiped or that have openings that cannot be cleaned.
   - Install two layers of 4-millimeter polyethylene sheeting on the floors and walls. Floor sheeting shall extend up all walls behind the sheeting at least 12-inches.
   - All polyethylene sheeting seams shall overlap at least 12-inches and should be completely sealed with adequate tape and/or spray glue.
   - Install Air Filtration Devices and make operational ensuring a minimum of four (4) air changes per hour of negative air pressure. Negative air pressure is defined as no less than 0.02 inches WC.

2. Removal Procedures
   - Wallboard walls and ceilings
     a. Pre-clean all materials prior to removal.
     b. Mist wallboard materials during removal with a detergent water solution to reduce dust generation.
     c. Excessive material should not accumulate in the containment area(s) and should be bagged appropriately.
     d. In units without ceiling, follow NESHAP regulations during all removal
activities.

3. Bag-Out Procedures
   - Where possible a single stage decontamination chamber shall be used for bagging out asbestos-containing building materials (ACBM) from the containment area. If this is not feasible, the decontamination entry may be used.
   - Double bagged ACBM shall be wet washed with a soapy water solution and wiped with clean towels then passed into the bag-out chamber. Double bagged materials should be labeled appropriately and then removed from the chamber.
   - Negative air pressure shall be maintained always during the process.

CLEAN-UP PROCEDURES
The following procedures shall be followed at the completion of the abatement activities defined in the Scope of Work and are a part of the final clean up.

1. The Abatement Contractor shall initially remove all debris within the containment area(s) and immediately place into asbestos waste bags.

2. At the completion of the initial clean-up, the Abatement Contractor shall HEPA vacuum and damp wipe all surfaces within the containment area(s) with clean cloth towels and fresh detergent solution.

3. All asbestos containing waste shall be double-bagged and sealed with tape.

4. Upon completion of final clean-up, the PM shall complete a joint evaluation of the containment area(s) with the Abatement Contractor Supervisor. If the containment area(s) is in acceptable condition, a light layer of encapsulate will be applied to all surfaces, as appropriate, throughout.

CLEARANCE PROCEDURES
Post abatement evaluation for the project shall be accomplished with the collection of air samples based on the following protocol. All negative pressure full containments and mini-containments shall remain operational and in place until all work areas have successfully passed sample analysis.

1. After the Work Area is found to be visually clean, the Air Monitoring Technician (AMT)/PM and/or Consultant shall collect a minimum of three (3) air samples under aggressive sampling protocols and analyzed by Phase Contrast Microscopy (PCM) in accordance with NIOSH 7400 Method A in area which abatement has occurred. A minimum air volume of 1,250 liters of air shall be sampled for final clearance air sampling. Final clearance criteria shall be <0.010 fibers per cubic centimeter (f/cc) for all clearance samples collected and analyzed.

If final air clearance criteria are not achieved, the Abatement Contractor shall repeat cleaning and continue decontamination procedures from that point.
If final air clearance criteria are met, the Abatement Contractor shall remove plastic sheeting and decontamination unit associated with the containment.

2. Prior to the collection of air samples, the containment area shall be disturbed using an air blower in a manner consistent with DSHS Regulations.

SPECIAL TERMS AND CONDITIONS

The following special terms and conditions shall apply to this project.

1. All equipment entering containment shall be free of asbestos contamination and visually clean. New filters shall be installed in all HEPA systems if needed to ensure proper performance.

2. No ACM removal shall be done until the containment(s) are established, operational, and evaluated by TTL personnel. No ACM removal in full containment areas shall be done outside of operating negative pressure, HEPA-filtered exhaust containment areas.

3. No encapsulation shall be done until all ACM removal is completed followed by a visual evaluation of the containment(s) by the TTL PM. All clean-up in full containment areas shall be conducted only during operating negative pressure, HEPA-filtered exhaust.

4. Clearance criteria: Final clearance criteria shall be <0.010 f/cc for all clearance samples collected and analyzed. A minimum air volume of 1,250 liters of air shall be sampled for final clearance air sampling.

5. The Abatement Contractor shall re-clean the containment area(s) at his/her expense if the clearance samples or final visual assessment fails. This process of re-cleaning and re-sanitization shall continue at the Abatement Contractor’s expense until a successful clearance is achieved.

6. Sampling Protocol:

   • Base Line Samples – There shall be a minimum of three (3) samples taken of each work area prior to the disturbance of ACM. There is to be a minimum 1,250 liters per sample and these samples are to be archived for 60 days. When there are multiple work areas, the base lines are to be taken just prior to starting in that work area.

   • Ambient Samples – The following areas are the minimum requirements for ambient air samples, or work samples: 1) Adjacent area: one (1) per area; 2) Negative pressure machines: at least one (1) in the negative air exhaust (if there is more than one machine, rotate the samples each time a new cassette or sample is started at each machine); 3) Containment Area: samples will be collected to assure that all areas of the containment are being sampled during a work shift, care must be taken to assure that there are no dead spaces that are not sampled;
4) Bag-out Area: one (1); 5) Decontamination Exit: one (1). These samples are to be analyzed at the end of each shift. Once the start date has been met, ambient air samples must be collected during all containment or glove bag preparation. A minimum of one (1) sample for each adjacent area and – depending upon the size of the work area – at least (1) sample in every work area shall be taken each day. These are to be approximately 1,250 liters per sample each. When feasible there should be a set of samples taken during the morning shift and the evening shift.

- Aggressive Clearance Samples – Depending upon the size of the containment area, no less than three (3) samples shall be taken. All sample volumes shall be no less than 1,250 liters per sample.

- The PM must remain on site while the samples are running unless access to the regulated area can be controlled.

- The PM assigned to this project has the express permission to conduct visual clearance and to take the above specified clearance sampling.

All daily samples (PCM) are to be taken using 25 mm cassettes with 0.8 mixed cellulose ester filter. These samples are to be analyzed per the NIOSH 7400 protocol following the counting rules using a Phase Contrast Microscope.

There is to be a minimum of one (1) blank per box of cassettes and one field blank analyzed. Samples are to be analyzed within 24 hours of the end of each shift and results made available to the Abatement Contractor. Should the results of any samples outside the containment area be above the clearance level of 0.010 f/cc, work is to be suspended, and the consultant notified. All corrective action is to be documented.

These are the minimum air monitoring requirements. If at any time during the project, the PM/AMT see the need for additional sampling they are to proceed and notify the Licensed Asbestos Consultant for approval.

- Personal samples – Individual workers shall be monitored throughout each shift during work activities. Sample analysis shall be provided and posted at the job site daily. These samples are the sole responsibility of the Abatement Contractor.

- All sampling protocols and laboratory analysis shall comply with the US EPA 40 CFR Part 61 Subpart M and the OSHA 29 CFR 1926.1101.

NOTE: It should be noted at the outset that all air monitoring will be conducted by TTL onsite NIOSH certified PM/AMT and PCM samples will be analyzed by the AMT in accordance with TTL’s sub-contractor agreement with RG Environmental Services, PCM Laboratory License Number 300-465, expiration 2/27/2021.
Asbestos Abatement Specifications
EXHIBIT

ASBESTOS ABATEMENT SPECIFICATIONS

JAVELINA BATHHOUSE
LAKE CORPUS CHRISTI STATE PARK
23194 PARK ROAD 25
MATHIS, TEXAS 78368

LEGEND
REMOVE GRAY TRANSITE PANELING IN MECHANICAL CHASE

MEN'S BATHHOUSE

MECHANICAL CHASE

WOMEN'S BATHHOUSE

TPWD No. 1210196A
TEXAS DEPARTMENT OF STATE HEALTH SERVICES
ASBESTOS ABATEMENT DESIGN SPECIFICATION

Javelina Bathhouse
Lake Corpus Christi State Park
23194 Park Road 25
Mathis, Texas 78368

Prepared for:
Texas Parks and Wildlife Department
4200 Smith School Road
Austin, Texas 78744

Prepared by:
TTL Inc.
June 8, 2020
Project No. 000200901267.00

Texas Department of State Health Services Asbestos Consulting Agency No: 100550

By: Justin Clemens
Licensed Asbestos Consultant: TX DSHS License # 105793, Exp. 05/28/2021
GENERAL

The project site consists of asbestos abatement of the Javelina Bathhouse at Lake Corpus Christi State Park, located at 23194 Park Road 25, Mathis, Texas 78239.

The abatement contractor shall conduct all work in accordance with this specification, owner requirements and applicable Federal, State and Local regulations. Where these specifications and the applicable regulations may conflict, the more stringent shall apply. ACM quantities will be determined by the Abatement Contractor prior to abatement activities.

TTL can designate an Asbestos Project Manager and Asbestos Air Monitor Technician during abatement activities.

This report has been prepared for the exclusive use of Texas Parks & Wildlife Department and its assigned agents. This report and all contents, findings, conclusions, and recommendations expressed herein are not intended for any other purpose than that stated nor is intended to be used by any other party.

SUMMARY

This project consists of the removal of asbestos containing flooring and wall system in the designated residence that were confirmed as ACM in the previous limited asbestos survey. Specific details for the construction of containments and removal activities are found below. This Abatement Design Specification covers the specific activities to be conducted throughout the structure.

SCOPE OF WORK

The Asbestos Abatement Contractor shall provide a copy of the Texas DSHS Asbestos Abatement Notification Form based on this Scope of Work and Design Specification to TTL and Texas Parks & Wildlife Department at the time it is submitted.

1. Containments
   - Areas where full negative air pressure containment are used to remove asbestos containing materials shall be constructed in accordance with Texas DSHS rules, OSHA regulations and the requirements in this Abatement Specification.
   - All other asbestos abatement – to include exterior materials - will be conducted within a regulated area as defined by the Texas DSHS rules, OSHA regulations and the requirements of this Abatement Specification.

2. Personal Protective Equipment (PPE) Requirements:
   - Full PPE should be worn in all Full Containment areas.
   - The Abatement Contractor shall ensure that all workers wear OSHA appropriate PPE always while working within the containment area(s) prior to
clearance.

- The Abatement Contractor assumes all responsibility for PPE compliance and OSHA sampling.

3. Specific setup procedure:
   - All interior contents, furnishings and belongings shall be completely removed within a work area prior to beginning abatement activities.
   - Those areas where asbestos abatement will be conducted within a negatively pressurized full containment area shall have the work area evaluated and approved by the on-site Project Manager (PM) prior to beginning material removal.
   - Those areas where asbestos abatement will be conducted within a regulated area shall have all barricades and warning signs in place, as required, prior to beginning material removal.
   - All ACM shall be kept adequately wet using an amended water solution whenever possible.
   - Excess ACM debris shall not accumulate within the work site at any given time.
   - All ACM waste removed from building interiors shall be properly double bagged and sealed, placed in burlap bags and drums and sealed, or wrapped with two layers of 6-millimeter polyethylene (poly) sheeting.
   - All ACM waste – including lined roll off containers – shall be appropriately labeled as asbestos waste in accordance with the Texas DSHS rules, EPA regulations and the requirements of this abatement design specification.
   - ACM waste manifest documents will be provided to Texas Parks & Wildlife Department every time ACM waste is transported away from the site.
   - All exterior (including the areas with slab/foundation ACM mastic) ACM shall be kept adequately wet following the NESHAP requirement of no visible emissions throughout the duration of the abatement activities.
1. Approximately 20 square feet of gray transite paneling should be removed under full containment.
   - The above asbestos will be abated in the residence – The Abatement Contractor shall remove ACM under full negative air pressure containment.

2. **PERSONAL PROTECTIVE EQUIPMENT:**

   All respiratory PPE shall comply with the OSHA 29CFR 1910.134 and OSHA 1926.1101. The Abatement Contractor is responsible for the proper training and use of all PPE throughout the duration of the abatement.

   1. Provide and use half-face respirators to all personnel working within the containment areas.

   2. Provide and use, at a minimum, HEPA filters labeled with NIOSH and MSHA Certification for “Radionuclides, Dust, Fumes, Mists including Asbestos – Containing Dusts and Mists” and color-coded in accordance with ANSI Z88.2 (1980). In addition, organic vapor cartridges (to protect against organic vapors from mastic removing solvents) shall be provided and used, as necessary. Provide cartridges that have each section of the combination canister labeled with appropriate color code and NIOSH/MSHA certification.

   3. Provide and use disposable protective overalls/suits, protective gloves, e.g., polynitrile, etc., headwear, and proper footwear and any other personal protective equipment as conditions dictate.

3. **MATERIALS**

   1. Polyethylene sheeting of 4-millimeter thickness that is clear, opaque, or black.

   2. Polyethylene sheeting of 6-millimeter thickness that is clear, opaque, or black.

   3. Moisture resistant duct tape and spray on glue capable of continuously sealing polyethylene through project abatement duration.

   4. Stiff brooms, hand brushes, scrapers, toothbrushes, rough edge sponges and cleaning cloths shall be utilized during abatement procedures. All equipment shall be new and clean and disposed of as waste at the end of this project.

   5. PVC or equivalent supporting frames shall be utilized to ensure that the containment remains intact during the entire remediation and post-remediation procedure.

   6. Polyethylene bags of 6-millimeter thickness and labeled as asbestos-containing waste.

   7. Airless sprayers to be used for dust control by application of detergent water solution (as directed).

   8. HEPA-filtered vacuum cleaner. All units should be cleaned and sanitized and new filters installed prior to beginning the project.

   9. Ground Fault Circuit Interrupters (GFCI) to be used on all electrical equipment within
the containment.

10. Warning signs and tape as required by the Texas DSHS Asbestos Regulations to establish a Regulated Area.

11. Spray glue may be used in designated areas with permission from the building representative.

ENGINEERING CONTROLS:

The following descriptions for the construction of the containment may not be applicable to all abatement projects; however, the Asbestos Abatement Contractor should refer to this section if any of the following details are specified.

1. HVAC Systems – All HVAC equipment in or passing through any containment area(s) shall be shut down, locked and tagged to prevent accidental start-ups. All intake and exhaust openings shall be sealed with at least one (1) layer of 6-millimeter polyethylene sheeting. The seals shall be installed in such a manner as to guarantee that the seals shall remain in place for the duration of the project.

2. Critical Barriers – Containment areas within which abatement activities are to be conducted shall be separated from adjacent areas by impermeable barriers with a minimum of two (2) layers of 4-millimeter polyethylene sheeting attached securely in place and completely sealed with tape. All openings between the containment area(s) and adjacent area(s), including but not limited to windows, doorways, elevator openings, corridor entrances, ventilation openings, drains, ducts, grills, grates, diffusers, skylights, etc., shall be sealed. All cabinets, shelving, etc., that have cracks, holes or other openings shall also be sealed.

3. Movable Objects – All movable objects shall be removed from the containment area(s), as specified in the Scope of Work. All non-movable objects that remain in the containment area(s) shall be cleaned and covered with at least one (1) layer of 6-millimeter polyethylene sheeting and secured in place.

4. Floors – As required, floor sheeting shall consist of at least two (2) layers of 6-millimeter polyethylene sheeting. The sheeting shall be overlapped at least one (1) foot and completely sealed with tape. Flooring shall extend up each perimeter wall no less than one (1) foot and be placed behind wall sheeting.

5. Walls – Wall sheeting shall consist of at least one layer of 4-millimeter polyethylene sheeting applied to all walls and doors in a four-foot strip up from the floor and shall be constructed in such a manner to prevent falling during normal use. All wall sheeting seams shall be overlapped at least one (1) foot and completely sealed with tape.

6. Full Negative Air Pressure Containment Area Ventilation – Air Filtration Devices with HEPA filtration and in a sufficient number to provide a negative pressure between the containment and outside areas shall be operated continuously from the time containment is established through the time acceptable final clearance air sample results are obtained. All units should be clean and sanitized with new filters installed.
prior to the beginning of the project. All units utilized to provide clean filtered air shall be vented to the exterior of the entire structure whenever possible. Air exhaust locations will be secured from criminal entry by using burglar bars or other satisfactory method during the abatement process and protected against water intrusion during rainfall events. The Abatement Contractor shall maintain the containment area(s) negative air pressurization at no less than 0.02 - inches of water column (WC) and monitored continuously during work activities by use of a manometer.

7. De-Contamination System – At a minimum, a worker decontamination enclosure system in the Full Containment area(s) shall be used consisting of three chambers and two air locks. This system should be of sufficient size to allow for the movement of workers, equipment, and waste material, as appropriate.

EXECUTION/PROCEDURES

Under no circumstances shall the Abatement Contractor modify the containment to a smaller size than it was initially established.

1. Full Containment Procedures:
   - Isolate the HVAC system throughout the containment area(s).
   - Install critical barriers to isolate the containment area. Construct no less than a three-stage de-contamination system into the containment area(s) with an air-lock between each stage. In addition to the critical barriers separating the affected area from adjacent areas, the Abatement Contractor shall also install critical barriers to isolate all immovable objects that cannot be wet-wiped or that have openings that cannot be cleaned.
   - Install two layers of 4-millimeter polyethylene sheathing on the floors and walls. Floor sheeting shall extend up all walls behind the sheeting at least 12-inches.
   - All polyethylene sheeting seams shall overlap at least 12-inches and should be completely sealed with adequate tape and/or spray glue.
   - Install Air Filtration Devices and make operational ensuring a minimum of four (4) air changes per hour of negative air pressure. Negative air pressure is defined as no less than 0.02 inches WC.

2. Removal Procedures
   - Wallboard walls and ceilings
     a. Pre-clean all materials prior to removal.
     b. Mist wallboard materials during removal with a detergent water solution to reduce dust generation.
     c. Excessive material should not accumulate in the containment area(s) and should be bagged appropriately.
     d. In units without ceiling, follow NESHAP regulations during all removal
3. Bag-Out Procedures
   • Where possible a single stage decontamination chamber shall be used for bagging out asbestos-containing building materials (ACBM) from the containment area. If this not feasible, the decontamination entry may be used.
   • Double bagged ACBM shall be wet washed with a soapy water solution and wiped with clean towels then passed into the bag-out chamber. Double bagged materials should be labeled appropriately and then removed from the chamber.
   • Negative air pressure shall be maintained always during the process.

CLEAN-UP PROCEDURES
The following procedures shall be followed at the completion of the abatement activities defined in the Scope of Work and are a part of the final clean up.

1. The Abatement Contractor shall initially remove all debris within the containment area(s) and immediately place into asbestos waste bags.
2. At the completion of the initial clean-up, the Abatement Contractor shall HEPA vacuum and damp wipe all surfaces within the containment area(s) with clean cloth towels and fresh detergent solution.
3. All asbestos containing waste shall be double-bagged and sealed with tape.
4. Upon completion of final clean-up, the PM shall complete a joint evaluation of the containment area(s) with the Abatement Contractor Supervisor. If the containment area(s) is in acceptable condition, a light layer of encapsulate will be applied to all surfaces, as appropriate, throughout.

CLEARANCE PROCEDURES
Post abatement evaluation for the project shall be accomplished with the collection of air samples based on the following protocol. All negative pressure full containments and mini-containments shall remain operational and in place until all work areas have successfully passed sample analysis.

1. After the Work Area is found to be visually clean, the Air Monitoring Technician (AMT)/PM and/or Consultant shall collect a minimum of three (3) air samples under aggressive sampling protocols and analyzed by Phase Contrast Microscopy (PCM) in accordance with NIOSH 7400 Method A in area which abatement has occurred. A minimum air volume of 1,250 liters of air shall be sampled for final clearance air sampling. Final clearance criteria shall be <0.010 fibers per cubic centimeter (f/cc) for all clearance samples collected and analyzed.

   If final air clearance criteria are not achieved, the Abatement Contractor shall repeat cleaning and continue decontamination procedures from that point.
If final air clearance criteria are met, the Abatement Contractor shall remove plastic sheeting and decontamination unit associated with the containment.

2. Prior to the collection of air samples, the containment area shall be disturbed using an air blower in a manner consistent with DSHS Regulations.

SPECIAL TERMS AND CONDITIONS

The following special terms and conditions shall apply to this project.

1. All equipment entering containment shall be free of asbestos contamination and visually clean. New filters shall be installed in all HEPA systems if needed to ensure proper performance.

2. No ACM removal shall be done until the containment(s) are established, operational, and evaluated by TTL personnel. No ACM removal in full containment areas shall be done outside of operating negative pressure, HEPA-filtered exhaust containment areas.

3. No encapsulation shall be done until all ACM removal is completed followed by a visual evaluation of the containment(s) by the TTL PM. All clean-up in full containment areas shall be conducted only during operating negative pressure, HEPA-filtered exhaust.

4. Clearance criteria: Final clearance criteria shall be <0.010 f/cc for all clearance samples collected and analyzed. A minimum air volume of 1,250 liters of air shall be sampled for final clearance air sampling.

5. The Abatement Contractor shall re-clean the containment area(s) at his/her expense if the clearance samples or final visual assessment fails. This process of re-cleaning and re-sanitization shall continue at the Abatement Contractor’s expense until a successful clearance is achieved.

6. Sampling Protocol:
   - Base Line Samples – There shall be a minimum of three (3) samples taken of each work area prior to the disturbance of ACM. There is to be a minimum 1,250 liters per sample and these samples are to be archived for 60 days. When there are multiple work areas, the base lines are to be taken just prior to starting in that work area.
   - Ambient Samples – The following areas are the minimum requirements for ambient air samples, or work samples: 1) Adjacent area: one (1) per area; 2) Negative pressure machines: at least one (1) in the negative air exhaust (if there is more than one machine, rotate the samples each time a new cassette or sample is started at each machine); 3) Containment Area: samples will be collected to assure that all areas of the containment are being sampled during a work shift, care must be taken to assure that there are no dead spaces that are not sampled;
4) Bag-out Area: one (1); 5) Decontamination Exit: one (1). These samples are to be analyzed at the end of each shift. Once the start date has been met, ambient air samples must be collected during all containment or glove bag preparation. A minimum of one (1) sample for each adjacent area and – depending upon the size of the work area – at least (1) sample in every work area shall be taken each day. These are to be approximately 1,250 liters per sample each. When feasible there should be a set of samples taken during the morning shift and the evening shift.

- Aggressive Clearance Samples – Depending upon the size of the containment area, no less than three (3) samples shall be taken. All sample volumes shall be no less than 1,250 liters per sample.
- The PM must remain on site while the samples are running unless access to the regulated area can be controlled.
- The PM assigned to this project has the express permission to conduct visual clearance and to take the above specified clearance sampling.

All daily samples (PCM) are to be taken using 25 mm cassettes with 0.8 mixed cellulose ester filter. These samples are to be analyzed per the NIOSH 7400 protocol following the counting rules using a Phase Contrast Microscope.

There is to be a minimum of one (1) blank per box of cassettes and one field blank analyzed. Samples are to be analyzed within 24 hours of the end of each shift and results made available to the Abatement Contractor. Should the results of any samples outside the containment area be above the clearance level of 0.010 f/cc, work is to be suspended, and the consultant notified. All corrective action is to be documented.

These are the minimum air monitoring requirements. If at any time during the project, the PM/AMT see the need for additional sampling they are to proceed and notify the Licensed Asbestos Consultant for approval.

- Personal samples – Individual workers shall be monitored throughout each shift during work activities. Sample analysis shall be provided and posted at the job site daily. These samples are the sole responsibility of the Abatement Contractor.
- All sampling protocols and laboratory analysis shall comply with the US EPA 40 CFR Part 61 Subpart M and the OSHA 29 CFR 1926.1101.

NOTE: It should be noted at the outset that all air monitoring will be conducted by TTL onsite NIOSH certified PM/AMT and PCM samples will be analyzed by the AMT in accordance with TTL’s sub-contractor agreement with RG Environmental Services, PCM Laboratory License Number 300-465, expiration 2/27/2021.
Asbestos Abatement Specifications
MEN'S BATHHOUSE

MECHANICAL CHASE

WOMEN'S BATHHOUSE

LEGEND

REMOVE GRAY TRANSITE PANELING IN MECHANICAL CHASE

ASBESTOS ABATEMENT SPECIFICATIONS

JAVELINA BATHHOUSE
LAKE CORPUS CHRISTI STATE PARK
23194 PARK ROAD 25
MATHIS, TEXAS 78368
GEOTECHNICAL SUBSURFACE INVESTIGATION AND RECOMMENDATIONS FOR THE PROPOSED RESTROOM FACILITY AND PARKING AREA
LAKE CORPUS CHRISTI STATE PARK
SAN PATRICIO COUNTY, TEXAS

RETL REPORT NUMBER: G120370

PREPARED FOR:

Richter Architects
201 South Upper Broadway
Corpus Christi, Texas 78401

JULY 29, 2020

PREPARED BY:

Rock Engineering & Testing Laboratory, Inc.
6817 Leopard Street
Corpus Christi, Texas 78409
P: (361) 883-4555; F: (361) 883-4711
TBPE FIRM NO. 2101
July 29, 2020

Richter Architects
201 South Upper Broadway
Corpus Christi, Texas, 78401

Attention: Ms. Elizabeth Chu Richter, FAIA

SUBJECT: SUBSURFACE INVESTIGATION, LABORATORY TESTING PROGRAM, AND FOUNDATION AND PAVEMENT RECOMMENDATIONS FOR THE PROPOSED RESTROOM FACILITY AND PARKING AREA
Lake Corpus Christi State Park
San Patricio County, Texas
RETL Job No. – G120370

Dear Ms. Chu Richter,

In accordance with our agreement, we have conducted a subsurface investigation, laboratory testing program, and foundation and pavement evaluation for the above referenced project. The results of this investigation, together with our recommendations, are to be found in the accompanying report, one electronic copy of which is being transmitted for your records and for distribution to the project design team.

Often, because of design and construction details that occur on a project, questions arise concerning soil conditions and Rock Engineering and Testing Laboratory, Inc. (RETL) (TBPE Firm No. 2101), would be pleased to continue its role as the Geotechnical Engineer during project implementation.

RETL also has great interest in providing materials testing and observation services during the construction phase of this project. If you will advise us of the appropriate time to discuss these engineering services, we will be pleased to meet with you at your convenience.

Sincerely,

Mark C. Rock, P.E.
Senior Consultant

ROCK ENGINEERING & TESTING LABORATORY, INC.

Corpus Christi
Office: 361.883.4555
Fax: 361.883.4711
6817 Leopard St.
Corpus Christi, TX 78409

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Round Rock, TX 78664

www.rocktesting.com
SUBSURFACE INVESTIGATION, LABORATORY TESTING PROGRAM, AND FOUNDATION AND PAVEMENT RECOMMENDATIONS FOR THE PROPOSED RESTROOM FACILITY AND PARKING AREA LAKE CORPUS CHRISTI STATE PARK SAN PATRICIO COUNTY, TEXAS

RETL JOB NUMBER: G120370

PREPARED FOR:
RICHTER ARCHITECTS
201 SOUTH UPPER BROADWAY
CORPUS CHRISTI, TEXAS 78401

JULY 29, 2020

PREPARED BY:
ROCK ENGINEERING AND TESTING LABORATORY, INC.
6817 LEOPARD STREET
CORPUS CHRISTI, TEXAS 78409
PHONE: (361) 883-4555; FAX: (361) 883-4711

TEXAS PROFESSIONAL ENGINEERING FIRM
REGISTRATION NO. 2101

Mark C. Rock, P.E.  Darren W. Lantz, P.E.
Senior Consultant  Senior Project Engineer
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**APPENDIX:**
- Site Vicinity Map
- Boring Location Plan
- Boring Logs B-1 and B-2
- Key to Soil Classification and Symbols
INTRODUCTION

This report presents the results of a soil exploration and foundation and pavement analysis for the proposed Restroom Facility and Parking Area located within the Lake Corpus Christi State Park in San Patricio County, Texas. This study was conducted for Richter Architects.

Authorization

The scope of work for this project was performed in accordance with a Rock Engineering and Testing Laboratory, Inc. (RETL) Proposal No. P032020B dated March 23, 2020. The proposal was approved by Ms. Elizabeth Chu Richter, FAIA, representing Richter Architects, on July 10, 2020 and returned to RETL via e-mail transmission.

Purpose and Scope

The purpose of this exploration was to evaluate the soil and groundwater conditions at the site and to provide recommendations suitable for the proposed Restroom Facility and Parking Area.

The scope of the exploration and analysis included the subsurface exploration, field and laboratory testing, engineering analysis and evaluation of the subsurface soils, provision of foundation and pavement recommendations, and preparation of this report. The scope of work for this project was determined by RETL.

The scope of services did not include an environmental assessment. Any statements in this report, or on the boring logs, regarding odors, colors, unusual or suspicious items or conditions are strictly for the information of the client.

General

The exploration and analysis of the subsurface conditions reported herein are considered sufficient in detail and scope to provide foundation and pavement recommendations for the proposed project. The information submitted for the proposed project is based on project details provided by Richter Architects and the soil information obtained at the boring locations. If the designers require additional soil parameters to complete the design of the proposed foundation and pavement systems, and this information can be obtained from the soil data and laboratory tests performed within the scope of work included in our proposal for this project, then RETL will provide the additional information requested as a supplement to this report.

The Geotechnical Engineer states that the findings, recommendations, specifications or professional advice contained herein have been presented after being prepared in a manner consistent with that level of care and skill ordinarily exercised by reputable members of the Geotechnical Engineer’s profession practicing contemporaneously under similar conditions in the locality of the project. RETL operates in general accordance with, “Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction, (ASTM D3740).” No other representations are expressed or implied, and no warranty or guarantee is included or intended.
This study was conducted for Richter Architects and the design team for the specific application to the proposed Restroom Facility and Parking Area to be located within the Lake Corpus Christi State Park in San Patricio County, Texas.

SITE DESCRIPTION

The site of the planned Restroom Facility and Parking Area is located within the Corpus Christi State Park in San Patricio County, Texas. The restroom facility building will be situated on an open grassy knoll. Within the planned building footprint, the site slopes down approximately 3 feet from the south to the north. The site is bordered by existing park roads to the north, east and west, and an existing restroom building to the south. At the time of our field investigation the condition of the ground surface was firm and did not pose any significant difficulties to the drill crews moving their equipment.

FIELD EXPLORATION

Scope

The field exploration, to evaluate the engineering characteristics of the foundation and pavement bearing materials, included reconnaissance of the project site, performing the test boring operations and obtaining disturbed split spoon samples. During the sample recovery operations, the soils encountered were classified and recorded on the boring logs in accordance with “Standard Guide for Field Logging of Subsurface Exploration of Soil and Rock, (ASTM D5434).”

Two borings were performed for the purpose of providing foundation and pavement recommendations for the proposed project. The table below provides the boring identification, boring depth and GPS coordinates.

<table>
<thead>
<tr>
<th>Summary of Boring Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boring Identification</td>
</tr>
<tr>
<td>--------------------------</td>
</tr>
<tr>
<td>B-1</td>
</tr>
<tr>
<td>B-2</td>
</tr>
</tbody>
</table>

Richter Architects determined the number and depth of the borings and RETL performed the drilling operations. Boring B-2 was originally planned to consist of a pavement boring and was therefore initially drilled to a depth of 5 feet. However, based upon the location of the boring and its proximity to the building location, as selected by our client, and the proposed building geometry, RETL remobilized a drilling rig one week after the initial drilling operations in order to extend the boring to a depth of 30 feet.
The GPS coordinates were obtained at the boring locations using a Garmin GPS model eTrex and are provided in this report and on the boring logs.

Upon completion of the drilling operations and obtaining the groundwater observations, the borings were backfilled with excess soils obtained during drilling operations. A Boring Location Plan is provided in the Appendix of this report.

The borings performed for this project were used to determine the classification and strengths of the subsurface soils. The information provided on the boring logs includes boring location, boring depth, soil classification, soil strengths, and laboratory test results. The boring logs are included in the Appendix.

**Drilling and Sampling Procedures**

The test borings within the building area were performed using a drilling rig equipped with a rotary head turning solid stem augers to advance the boreholes. Disturbed soil samples were obtained using split-barrel sampling procedures in general accordance with the procedures for, “Penetration Test and Split-Barrel Sampling of Soils, (ASTM D1586).”

The samples were visually classified, placed in plastic bags, marked according to boring number, depth and any other pertinent field data, stored in special containers and delivered to the laboratory for testing.

**Field Tests and Observations**

**Penetration Tests** – During the sampling procedures with the building borings, standard penetration tests (SPT) were performed to obtain the standard penetration value of the soil at selected intervals. The standard penetration value (N) is defined as the number of blows of a 140-pound hammer, falling 30 inches, required to advance the split-barrel sampler 1 foot into the soil. The sampler is lowered to the bottom of the previously cleaned drill hole and advanced by blows from the hammer. The number of blows is recorded for each of three successive 6-inch penetrations. The “N” value is obtained by adding the second and third 6-inch increment number of blows. An automatic hammer was utilized when performing SPT. An automatic hammer is usually taken as having an efficiency of one. The results of standard penetration tests indicate the relative density of cohesionless soils and comparative consistency of cohesive soils, thereby providing a basis for estimating the relative strength and compressibility of the soil profile components.

**Water Level Observations** – Water level observations were obtained during the test boring operations. Water level observations are noted on the boring logs provided in the Appendix. In relatively pervious soils, such as sandy soils, the indicated depths are usually reliable groundwater levels. In relatively impervious soils, a suitable estimate of the groundwater depth may not be possible, even after several days of observation. Seasonal variations, temperature, land-use, proximity to a creek, river or lake and recent rainfall conditions may influence the depth to the groundwater. The amount of water in open boreholes largely depends on the permeability of the soils encountered at the boring locations.
Ground Surface Elevations – The ground surface elevations at the boring locations were not provided, therefore, depths referred to in this report are from the ground surface at the boring locations during the time of our field investigation.

LABORATORY TESTING PROGRAM

In addition to the field investigation, a laboratory testing program was conducted to determine additional pertinent engineering characteristics of the subsurface materials necessary in analyzing the behavior of the foundation and pavement systems for the proposed project.

The laboratory testing program included supplementary visual classification (ASTM D2487) and water content tests (ASTM D2216) on the samples. In addition, selected samples were subjected to Atterberg limits tests (ASTM D4318) and percent material finer than the #200 sieve tests (ASTM D1140).

The laboratory testing program was conducted in general accordance with applicable ASTM Specifications. The results of these tests are to be found on the accompanying boring logs provided in the Appendix.

SUBSURFACE CONDITIONS

General

The types of foundation and pavement bearing materials encountered in the test borings have been visually classified and are described in detail on the boring logs. The results of the water level observations and field and laboratory tests are presented on the boring logs. Representative samples of the soils were placed in polyethylene bags and are now stored in the laboratory for further analysis, if desired. Unless notified to the contrary, the samples will be disposed of three months after issuance of this report.

The stratification of the soil, as shown on the boring logs, represents the soil conditions at the actual boring locations. Variations may occur between, or beyond, the boring locations. Lines of demarcation represent the approximate boundary between different soil types, but the transition may be gradual, or not clearly defined.

It should be noted that, whereas the test borings were drilled and sampled by experienced drillers, it is sometimes difficult to record changes in stratification within narrow limits. In the absence of foreign substances, it is also difficult to distinguish between discolored soils and clean soil fill.

Soil Conditions

The generalized soil conditions encountered at the project site have been summarized and soil properties including soil classification, strength, and plasticity are provided in the following table.
Soil Profile Table

<table>
<thead>
<tr>
<th>D</th>
<th>Description</th>
<th>LL</th>
<th>PI</th>
<th>C</th>
<th>ϕ</th>
<th>γₑ</th>
<th>-#200</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 3</td>
<td>Silty Clayey SAND</td>
<td>21</td>
<td>5</td>
<td>0</td>
<td>29</td>
<td>110</td>
<td>16 - 24</td>
<td>2 - 9</td>
</tr>
<tr>
<td>3 - 6</td>
<td>Silty Clayey SAND</td>
<td>---</td>
<td>---</td>
<td>0</td>
<td>30</td>
<td>115</td>
<td>---</td>
<td>9 - 15</td>
</tr>
<tr>
<td>6 - 23</td>
<td>Lean/Fat CLAY and CLAYEY Sand</td>
<td>19 - 66</td>
<td>6 - 42</td>
<td>2,200</td>
<td>0</td>
<td>120</td>
<td>29 - 99</td>
<td>14 - 25</td>
</tr>
<tr>
<td>23 - 30</td>
<td>Silty Clayey SAND</td>
<td>19</td>
<td>2</td>
<td>0</td>
<td>31</td>
<td>115</td>
<td>25</td>
<td>9 - 19</td>
</tr>
</tbody>
</table>

Where:

D = Depth in feet below existing grade
LL = Liquid limit (%)
PI = Plasticity index
C = Soil Cohesion, psf (undrained)
ϕ = Angle of Internal Friction, deg. (undrained)
γₑ = Effective soil unit weight, pcf
-#200 = Material passing #200 sieve, %
N = Standard Penetration Test, blows per foot

Exceptions to the above generalized soil profile to exist. Most notable is that at boring location B-2, the surficial silty clayey sands extend to a depth of approximately 11 feet. Detailed descriptions of the soils encountered at the boring locations are provided on the boring logs included in the Appendix.

Groundwater Observations

Groundwater (GW) observations and the depths the borings caved are provided in the following table.

<table>
<thead>
<tr>
<th>Boring</th>
<th>During Drilling</th>
<th>Upon Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-1</td>
<td>GW at 23.5 feet</td>
<td>GW at 20 feet and open</td>
</tr>
<tr>
<td>B-2</td>
<td>GW at 23.5 feet</td>
<td>GW at 20 feet and open</td>
</tr>
</tbody>
</table>

Based on observations made in the field, it appears that groundwater at this site during the time of our field investigation is present near the 20-foot depth. It should be noted that the water level in open boreholes may require several hours to several days to stabilize depending on the permeability of the soils and that groundwater levels at this site may be subject to seasonal conditions, recent rainfall, drought or temperature effects.

OSHA Soil Type Classification

The table below provides a summary of the OSHA Soil Type Classification based on the soils encountered at the boring locations.
RESTROOM FACILITY AND PARKING AREA  
Lake Corpus Christi State Park  
San Patricio County, Texas

<table>
<thead>
<tr>
<th>Depth (feet)</th>
<th>Description</th>
<th>Osha Soil Type Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 11</td>
<td>Non-Cohesive Soil (Sand)</td>
<td>Type C</td>
</tr>
<tr>
<td>11 - 20</td>
<td>Cohesive Soil Above the Water Table</td>
<td>Type B</td>
</tr>
<tr>
<td></td>
<td>(Est. Average Undrained Shear Strength is equal to or greater than 500 psf)</td>
<td></td>
</tr>
</tbody>
</table>

Guidelines for Maximum Allowable Slopes

<table>
<thead>
<tr>
<th>Soil or Rock Type</th>
<th>Max. Allow. Slopes for Excavations &lt; Than 20' Deep</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stable Rock</td>
<td>Vertical</td>
</tr>
<tr>
<td>Type A</td>
<td>¾ Horizontal : 1 Vertical</td>
</tr>
<tr>
<td>Type B</td>
<td>1 Horizontal : 1 Vertical</td>
</tr>
<tr>
<td>Type C</td>
<td>1½ Horizontal : 1 Vertical</td>
</tr>
</tbody>
</table>

Guidelines for maximum allowable slopes were obtained from OSHA documents, but do not take into account any recent revisions or the stability of long-term unprotected slopes. Long term unprotected slopes will likely require much flatter slopes. The guidelines presented herein for slopes do not imply RETL is taking responsibility for construction site safety; this responsibility falls entirely upon the contractor and his responsible person. RETL is assuming that the contractor will comply with all rules, ordinances and other requirements to comply with safe construction practices.

Seismic Site Classification

In accordance with the International Building Code (IBC), “When the soil properties are not known in sufficient detail to determine the site class, Site Class D shall be used unless it is determined that Site Class E or F soil is likely to be present at the site.” Since our field investigations have not included a 100-foot deep boring, by definition the soil properties are not known in sufficient detail. Site Class D soils should have a Standard Penetration Resistance of 15 to 50, and an undrained shear strength between 1,000 and 2,000 pounds per square foot (psf). The predominate soil strengths for the majority of the depth explored at this site generally meet or exceed the typical strength range above and therefore the site should be classified as Seismic Site Class D.
FOUNDATION DISCUSSION

Project Description

Based on information provided to RETL, the planned restroom building will consist of a one-story, standalone structure with an approximate plan area of 3,000 square feet. The building will be located on a sloping site that drops in elevation approximately 3 to 4 feet across the footprint of the building. We understand, based upon conversations with Mr. David Richter, FAIA, representing Richter Architects, that the existing grade in all or a portion of the building area will be lowered approximately 2 feet. However, detailed grading plans were not available at the time of this report. RETL should be provided with the final grading plans once they become available to confirm or, if necessary, revise the recommendations provided in this report. New pavements consisting of a small, pull-out automobile parking area will also be constructed adjacent to the existing park road at the southeast side of the planned restroom facility.

PVR Discussion

The laboratory test results indicate that the subsoils in the active zone at this site are low to moderate in plasticity. The calculated total potential vertical rise (PVR) at this site is estimated to be approximately 1 inch for floor slabs finished within 2 feet of the average existing grade. This PVR value represents the vertical rise that can be experienced by dry subsoils if they are subjected to conditions that allow them to become saturated, such as poor drainage. The actual movement of the subsoils is dependent upon their change in moisture content. RETL should be provided with final grading plans once they become available to assess any potential changes in the anticipated PVR based on planned finish floor elevation of the structure.

The PVR was calculated using the Texas Department of Transportation Method TEX-124E and took into account the depth of the active zone, estimated to extend to a depth of approximately 13 feet at this site, and the Atterberg limits test results of the soils encountered.

The estimated PVR values provided are based on the floor system applying a sustained surcharge load of approximately 1.0 pound per square inch on the subgrade soils resulting in a 6-inch concrete floor slab elevation 1½ feet above the average final exterior grade elevation at the site.

Differential vertical movements can potentially be equal to the expected total movements. Differential vertical movements at this site may be equal to the calculated PVR over a distance equal to the depth of the active zone, within the footprint of a slab-on-grade if dry soil conditions exist and a localized water source such as ponding water or a plumbing leak occurs resulting in non-uniform moisture conditions.
Typically for structures similar to the type planned for construction at this site, 1 inch of PVR is an acceptable amount of movement. Given the calculated PVR at this site is on the order of 1 inch, no site remediation will be required to reduce the PVR. RETL does recommend that after performing overall rough site grading operations to lower the site grade, the upper 6-inches of soil, organics and other deleterious materials be removed and a sufficient amount of properly compacted non-expansive “Select Fill” soils be placed to achieve a finished concrete floor slab elevation 1½-feet above the average final exterior grade.

If up to one inch of soil related movements cannot be tolerated and the highest level of performance is necessary, the structure should be supported on a deep foundation system used in conjunction with a structurally suspended floor slab. In such case, RETL should be contacted for the appropriate recommendations.

**FOUNDATION RECOMMENDATIONS**

**Slab-on-Grade Foundation Recommendations**

A stiffened grid type beam and slab foundation is used to support relatively light structures where the soil conditions are relatively uniform, and where some magnitudes of uplift and settlement can be tolerated. The intent of a stiffened slab-on-grade foundation is to allow the structure and foundation to move up and down freely with soil movements while providing sufficient stiffness to limit differential movements within the superstructure.

A monolithic stiffened grid type beam and slab-on-grade foundation is feasible to support the proposed restroom building if foundation movements of approximately 1 inch can be tolerated. The PVR shall be maintained at approximately 1 inch by performing the recommended site improvements in the “PVR Discussion” and “Site Preparation” sections of this report. It should be noted that rigid exterior walls and interior partitions are subject to distress with the slightest soil related foundation movements, even differential movements as small as 1 inch.

Interior and exterior grade beams should be founded within natural in-situ soils or properly compacted select fill. Load-bearing grade beams should be founded at least 2 feet below the final exterior grade. Grade beams bearing at a depth of 2 feet below the lowest adjacent grade can be designed for a net allowable unit soil bearing pressure of 1,400 psf. Grade beams bearing at a depth of 3 feet below the lowest adjacent grade can be designed for a net allowable unit soil bearing pressure of 1,900 psf. The net allowable unit soil bearing pressures provided utilize a design safety factor of 3. Concentrated loads should be placed at widened grade beam locations, at intersection of grade beams or where haunches can be constructed if loading conditions warrant increased bearing area.

The beams should be a minimum of 12 inches wide to reduce the potential for localized shear failure and the beams should be spaced at a maximum distance of 20 feet, in both directions. The Structural Engineer may vary beam depths and spacing based on experience designing and constructing similar type structures on sites with similar subsurface soil conditions.

The “Design of Slab-On-Ground Foundations,” published by the Wire Reinforcement Institute, Inc. (Aug., 1981), utilizes the design criteria provided in the table below.
WRI Design Criteria

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climatic Rating (Cw)</td>
<td>17</td>
</tr>
<tr>
<td>Effective Plasticity Index</td>
<td>22</td>
</tr>
<tr>
<td>Soil/Climatic Rating Factor (1-C)</td>
<td>0.08</td>
</tr>
<tr>
<td>Maximum Beam Spacing, Both Directions (ft)</td>
<td>20</td>
</tr>
</tbody>
</table>

WRI slab design criteria provided above takes into account that the initial rough grading of the site to lower the area grade is performed to achieve a uniform subgrade elevation in the building area, and additional excavation of the existing soils, organics and other deleterious materials are removed to a depth of 6 inches from the building area, extending out beyond the limits of the building foundation a minimum of 5 feet. The exposed subgrade soils shall then be moisture conditioned and compacted prior to placing the required amount of compacted select fill soils that will result in a finish floor elevation 1½ feet above the final surrounding grades in order to maintain a maximum PVR of approximately 1 inch and to establish a finished floor slab elevation that will provide positive drainage away from the proposed structure.

A soil supported floor slab is subject to vertical movements, as discussed earlier in this report. Even slight differential movements on the order of 1 inch can cause distress to interior wall partitions and rigid exterior walls or facades supported by a shallow slab-on-grade foundation, resulting in cosmetic damage. This amount of movement should be understood and addressed during the design phase of the proposed structure planned for construction at this site.

**PAVEMENT CONSIDERATIONS**

In designing the proposed parking area, the existing subgrade conditions must be considered together with the expected traffic use and loading conditions.

The conditions that influence pavement design can be summarized as follows:

- **Bearing values of the subgrade.** These can be represented by a California Bearing Ratio (CBR) for the design of flexible pavements, or a Modulus of Subgrade Reaction (K) for rigid pavements.
- **Vehicular traffic,** in terms of the number and frequency of vehicles and their range of axle loads.
- **Probable increase in vehicular use over the life of the pavement.**
- **The availability of suitable materials to be used in the construction of the pavement and their relative costs.**
Specific laboratory testing to define the subgrade strength (i.e. CBR/K values) have not been performed for this analysis. Based upon local experience, the estimated CBR and K values for the natural surficial sandy soils encountered at the planned parking lot site is, 10 and 200 pci, respectively.

Since traffic counts and design vehicles have not been provided, it is only possible to provide a non-engineered pavement section suitable for light-duty service based on pavement sections that have provided adequate serviceability for similar type facilities.

The parking area can be designed with either a flexible or rigid pavement.

**Flexible Pavement Recommendations**

The recommended light-duty flexible pavement sections, using locally available materials, is provided in the following table.

<table>
<thead>
<tr>
<th>Flexible Pavement</th>
<th>Light-duty (Passenger Car and Light Pickup Parking Area)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hot Mix Asphaltic Concrete</td>
<td>2 inches</td>
</tr>
<tr>
<td>Crushed Limestone Base Material (TxDOT Item 247 Type A; Gr. 1-2)</td>
<td>6 inches</td>
</tr>
<tr>
<td>Tensar Geogrid TX-5</td>
<td>Yes</td>
</tr>
<tr>
<td>Compacted Subgrade</td>
<td>12 inches</td>
</tr>
</tbody>
</table>

Once all organics and other deleterious materials have been removed and the proper subgrade elevation has been achieved, the exposed subgrade soils shall be proof-rolled to identify any soft or yielding locations. Where identified, the subgrade in those locations shall be undercut and recompacted in-place.

After proof-rolling and any necessary remediation, the newly exposed subgrade should be compacted to a minimum density of 98-percent of the maximum dry unit weight of the raw subgrade soils as determined by a standard Proctor test (ASTM D 698) and at, or above, the optimum moisture content.

Upon completion of the raw subgrade preparation, a single layer of TENSAR Tri-Ax TX-5 punched and drawn geogrid shall be placed on the properly prepared subgrade. The geogrid shall be placed in accordance with the manufacturer’s recommendations.

Crushed limestone base materials in flexible pavement areas should meet the requirements set forth in Texas Standard Specifications 2014; Item 247, Type A, Grade 1-2 and should be placed in maximum 8-inch thick loose lifts and compacted to a minimum density of 98 percent of the maximum dry density as determined by the modified Proctor test (ASTM D1557) and within ± 1½ percent of the optimum moisture content.
Allowances for proper drainage and proper material selection of base materials are most important for performance of pavements. Ruts, birdbaths and poor site drainage allow for quick deterioration of the pavement primarily due to saturation of the underlying base materials and subgrade soils.

Hot mix asphaltic concrete should meet the requirements set forth in TxDOT Item 340; Type D, or C, surface course.

**Rigid Pavement Recommendations**

The use of concrete for paving has become more prevalent in recent years due to a decrease in the material cost of concrete and the long-term maintenance cost benefits of concrete pavement compared to asphaltic pavements. The recommended light-duty rigid pavement section is provided in the following table.

<table>
<thead>
<tr>
<th>Rigid Pavement</th>
<th>Light-duty (Passenger Car and Light Pickup Parking Area)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reinforced Concrete</td>
<td>6 inches</td>
</tr>
<tr>
<td>Compacted Subgrade</td>
<td>12 inches</td>
</tr>
</tbody>
</table>

Once all organics and other deleterious materials have been removed and the proper subgrade elevation has been achieved, the exposed subgrade soils shall be proof-rolled to identify any soft or yielding locations. Where identified, the subgrade in those locations shall be undercut and recompacted in-place.

After proof-rolling and any necessary remediation, the upper 12 inches of exposed subgrade soils shall be compacted to a minimum density of 98 percent of the maximum dry unit weight of the raw subgrade soils as determined by a standard Proctor test (ASTM D698) and at, or above, the optimum moisture content.

The concrete pavement should be properly reinforced and jointed, as per ACI, and should have a minimum 28-day compressive strength of 4,000 psi. Expansion joints should be sealed with an appropriate sealant so that moisture infiltration into the subgrade soils and resultant concrete deterioration at the joints is minimized. The joints should be thoroughly cleaned, and sealant should be installed without overfilling before pavement is opened to traffic.

**Routine Maintenance of Rigid and Flexible Pavement Systems**

The pavement sections provided in this report are designed based on pavement sections constructed on similar subgrade soils and for facilities similar to those planned for construction at this site. The pavements will require routine maintenance such as crack sealing and seal coats for flexible pavements and joint maintenance for rigid pavement sections in order to achieve a desirable life of pavement. Without proper maintenance, moisture infiltration into the base material and subgrade will result in rapid deterioration of the pavement system. RETL recommends that the owner protect their investment by incorporating an aggressive maintenance program.
SITE IMPROVEMENT METHODS

Concrete Flatwork Construction Considerations

The change in moisture content of the plastic clay soils is the primary mechanism resulting in the volumetric changes of the supporting soils. Provisions in the site development should be made in order to maintain relatively uniform moisture contents of the supporting soils. A number of measures may be used to attain a reduction in subsoil moisture content variations, thus reducing the soil’s shrink/swell volume change potential. Some of these measures are outlined below.

- During construction, positive drainage schemes should be implemented to prevent ponding of water on the subgrade.

- Positive drainage should be maintained around the structure and flatwork through roof/gutter systems connected to piping or directed to paved surfaces, transmitting water away from the foundation perimeter and flatwork. In addition, positive grades sloping away from the foundations and flatwork should be designed and implemented. We recommend that effective site drainage plans be devised by others prior to commencement of construction to provide positive drainage away from the site improvements and off the site, both during, and after construction.

- The top 2 feet of utility trenches should be backfilled with low plasticity clays to assure the trenches do not serve as aqueducts that could transport water beneath the structure and flatwork due to excessive surface water infiltration. Clay plugs or collars should also be installed in utility trenches outside of the building pad to prevent water from moving laterally into the building pads.

- Vegetation placed in landscape beds that are adjacent to the structure and flatwork should be limited to plants and shrubs that will not exceed a mature height of 3 feet. Large bushes and trees should be planted away from the slab foundations and flatwork at a distance that will exceed their full mature height and canopy width.

- Individual concrete panels of concrete sitework should be dowelled together to minimize trip hazards as a result of differential movements within the flatwork.

- All efforts should be made to avoid having situations where site flatwork panels are partially supported on properly compacted select fill soils and partially supported on natural in-situ soils which will result in differential movement and may also result in a negative slope back to the building causing ponding of water next to the structures.

- In areas where flatwork is planned for construction and extending 5 feet outside the plan area of the flatwork, all surface organics and deleterious materials shall be removed, the upper 12 inches of exposed subgrade soils should be scarified, moisture conditioned to a minimum of 2-percentage points above the optimum moisture content and then compacted to at least 90 percent and not more than 95 percent of the maximum dry density as determined by the standard Proctor test (ASTM D698). This does not apply to flatwork supporting car or truck traffic.
All project features beyond the scope of those discussed above should be planned and designed similarly to attain a region of relatively uniform moisture content within the foundation and flatwork areas. Poor drainage schemes are generally the primary cause of foundation and flatwork problems.

**CONSTRUCTION CONSIDERATIONS**

**Site Preparation**

In order to maintain the PVR to approximately 1 inch in the building area, the initial rough site grading should be performed to lower the site elevation by cutting to achieve a uniform subgrade elevation in the building area. After rough grading the site to lower the site grades, it will be necessary to remove soils, organics and other deleterious materials to a depth of 6 inches as indicated in the “PVR Discussion” section of this report. The excavation should extend outside the building footprint and any appurtenances (including porches, attached sidewalks, stoops, etc.) for a distance of 5 feet.

Once the excavation operations in the building area are performed, the upper 1 foot of exposed subgrade soils shall be moisture conditioned and recompacted to a minimum density of 95 percent of the maximum dry density as determined by the standard Proctor test (ASTM D698) and the moisture content shall be maintained at, or above, the optimum moisture content. If any soft areas are identified, the soils should be removed and recompacted in place.

Upon completion of the subgrade preparation operations, at least 1½ feet of properly compacted “Select Fill” material should be placed to achieve a finish floor elevation 1½ feet above the average final exterior grades. Properly compacted “Select Fill” soils shall be placed in no greater than 8-inch thick loose lifts and compacted to a minimum density of 95 percent of the maximum dry density, as determined by the standard Proctor test (ASTM D698) and at, or above, the optimum moisture content.

The fill shall be placed in such a manner to provide a uniform fill pad thickness supporting the proposed building. Excavation of grade beams may proceed after placement of the select fill is complete.

**Select Fill**

Imported select fill material used at this site should be homogenous, free from organics and other deleterious materials and should have a maximum liquid limit of 40 percent and a plasticity index (PI) between 7 and 18. The select fill soils shall have a minimum of 35 percent passing the #200 sieve and no soil particles exceeding 1½ inches will be permitted. The fill should be placed in no greater than 8-inch thick loose lifts and then compacted to a minimum density of 95-percent of the maximum dry density, as determined by the standard Proctor test (ASTM D698), and at, or above, the optimum moisture content.
Fine sand soils similar to the silty clayey sand type of soils encountered within the upper 6 to 11 feet at this site may also be utilized as building pad fill soils at this site. Given these soils are very low in plasticity, the integrity of the grade beams could be jeopardized resulting in sloughing of the grade beams, requiring additional labor to clean the grade beams, and the likelihood that concrete quantities overrun theoretical volume calculations. These issues should be considered prior to selecting the very low plasticity sand soils at this site as select fill.

**Earthwork and Foundation Acceptance**

Exposure to the environment may weaken the soils at the foundation and pavement bearing level if the excavations remain open for long periods of time. Therefore, it is recommended that the foundation and pavement excavations be extended to final grade and that the foundation and pavements be constructed as soon as possible to minimize potential damage to the bearing soils.

The foundation and pavement bearing levels should be free of loose soil, ponded water or debris and should be observed prior to concreting or placing pavement constituents by the Geotechnical Engineer, or his designated representative.

Foundation concrete or pavement constituents should not be placed on soils that have been disturbed by rainfall or seepage. If the bearing soils are softened by surface water intrusion, or by desiccation, the unsuitable soils must be removed from the foundation and pavement excavations and be replaced with properly compacted fill prior to placement of concrete or pavement constituents per Engineer’s direction.

The Geotechnical Engineer, or his designated representative, should monitor subgrade preparation and placement of fill. As a guideline, a minimum of one, in-place density test shall be performed on the subgrade soils and each subsequent lift of fill for each 3,000 square feet, or a minimum of three in-place density tests per testing interval, whichever is greater. Any areas not meeting the required compaction should be recompacted and retested until compliance is met.

**Vapor Retarder**

A vapor retarder, with a permeance of less than 0.3 US perms (ASTM E96), should be placed under the concrete floor slab on the properly prepared select fill building pad to reduce the transmission of water vapor from the supporting soil through the concrete slab and to function as a slip sheet to reduce subgrade drag friction. Polyethylene film, or polyolefin, with a minimum thickness of 10 mils (0.25 mm) is typically used for reduced vapor transmission and durability during and after its installation. The vapor retarder should be installed according to the ASTM E1643, “Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.”

All penetrations through the vapor retarder should be sealed to ensure its integrity. The vapor retarder should be taped around all openings to ensure the effectiveness of the barrier. Grade stakes should not be driven through the barrier and care should be taken to avoid punctures during reinforcement and concrete placement.
Placement of slab concrete directly on the vapor retarder increases the risks of surface dusting, blistering and slab curling making good concrete practice critical. A low water to cement ratio concrete mix design, combined with proper and adequate curing procedures, will help ensure a good quality slab.

Where vapor transmission is not a concern, elimination of the vapor retarder may provide improvements in finishing characteristics and reductions in the risks of surface dusting, blistering and slab curling. However, exposure of portions of the subgrade or granular layer, such as at blockouts for columns or utility penetrations to inclement weather during construction may create excessive or deficient moisture conditions beneath portions of the slab that have already been placed.

Blockouts for slab penetrations should be protected if a vapor retarder is omitted. ACI 302.1R-96 “Guide for Concrete Floor and Slab Construction,” recommends that a vapor retarder or vapor barrier be used only when required by the specific application.

Utilities

Utilities that project through the slab or walls should be designed with either some degree of flexibility, or with sleeves, in order to prevent damage to these lines should vertical movement occur.

Expansion and Control Joints

Expansion and control joints should be designed and placed in various portions of the structure. Properly planned placement of these joints will assist in controlling the degree and location of material cracking that normally occurs due to material shrinkage, thermal affects, soil movements and other related structural conditions.

GENERAL COMMENTS

If significant changes are made in the character or location of the proposed Restroom Facility and Parking Area, a consultation should be arranged to review any changes with respect to the prevailing soil conditions. At that time, it may be necessary to submit supplementary recommendations.

It is recommended that the services of RETL be engaged to test and evaluate the soils in the foundation and pavement excavations prior to concreting or placing pavement constituents in order to verify that the bearing soils are consistent with those encountered in the borings. RETL cannot accept any responsibility for any conditions that deviate from those described in this report, nor for the performance of the foundation or pavements if not engaged to also provide construction observation and testing for this project. If it is required for RETL to accept any liability, then RETL must agree with the plans and perform such observation during construction as we recommend.
All sheeting, shoring and bracing of trenches, pits and excavations should be made the responsibility of the contractor and should comply with all current and applicable local, state and federal safety codes, regulations and practices, including the Occupational Safety and Health Administration.
APPENDIX
July 29, 2020
Attn: Ms. Elizabeth Chu Richter, FAIA
RETL Job Number G120370

tpwd no. 1210196a

rock engineering & testing laboratory, inc.
corpus christi san antonio round rock
fax: 361.883.4711 fax: 210.495.8015 fax: 512.284.7764
6817 leopard st. 10856 vandale 7 roundville ln.
corpus christi, tx 78409 san antonio, tx 78216 round rock, tx 78664

www.rocktesting.com

site vicinity map

geotechnical engineering
construction materials engineering & testing
soils • asphalt • concrete

restroom facility and parking area
lake corpus christi state park
san patricio county, texas

site
TPWD No. 1210196A

RESTROOM FACILITY AND PARKING AREA
Lake Corpus Christi State Park
San Patricio County, Texas

July 29, 2020
Attn: Ms. Elizabeth Chu Richter, FAIA
RETL Job Number G120370

ROCK ENGINEERING & TESTING LABORATORY, INC.

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www.rocktesting.com

Round Rock
Office: 512.284.8022
Fax: 512.284.7764
7 Roundville Ln.
Round Rock, TX 78664
## FIELD DATA

<table>
<thead>
<tr>
<th>Soil Symbol</th>
<th>Depth (ft)</th>
<th>Sample Number</th>
<th>Laboratory Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>SS</td>
<td>5</td>
<td>N=9</td>
<td>N - Standard Penetration Test Resistance Qc</td>
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<tr>
<td>SS</td>
<td>5</td>
<td>N=15</td>
<td>P - Pocket Penetrometer Resistance</td>
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<td>N=19</td>
<td>TV - Torvane Shear Strength Test</td>
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<tr>
<td>SS</td>
<td>10</td>
<td>N=17</td>
<td>ATTERBERG LIMITS LL PL PI</td>
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<tr>
<td>SS</td>
<td>15</td>
<td>N=22</td>
<td>DRY DENSITY MINUS NO. 200 SIEVE (%)</td>
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<td>N=20</td>
<td>COMPRRESSIVE STRENGTH (TONS/SQ FT)</td>
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<td>MOISTURE CONTENT (%)</td>
</tr>
<tr>
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<td>20</td>
<td>N=17</td>
<td>LIQUID LIMIT PLASTICITY INDEX</td>
</tr>
<tr>
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<td>N=17</td>
<td>DOUBLE DENSITY (TONS/SQ FT)</td>
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<td>SS</td>
<td>30</td>
<td>N=17</td>
<td>Bulk Density (TONS/SQ FT)</td>
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## DESCRIPTION OF STRATUM

- **Silty Clayey Sand**: dark brown, moist, loose. (SC-SM)
- **Lean Clay**: brown, moist, very stiff. (CL)
- **Clayey Sand**: brown, moist, very stiff. (SC)
- **Silty Clayey Sand**: brown, moist, medium. (SC-SM)

## REMARKS

Drilling operations were performed by RETL at GPS Coordinates N° 27.06377 W° 97.87685

Groundwater (GW) was encountered at a depth of 23.5 feet during drilling. GW at 20 feet and open upon completion.

Boring was terminated at a depth of 30 feet.
### FIELD DATA

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<thead>
<tr>
<th>SOIL SYMBOL</th>
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<th>SAMPLE NUMBER</th>
<th>N. BLOWS/FT</th>
<th>P. TONS/QF</th>
<th>T. TONS/QF</th>
<th>MOISTURE CONTENT (%)</th>
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<td>N = 9</td>
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<td>SS S-9</td>
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<td>N = 19</td>
<td>18</td>
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### LABORATORY DATA

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<thead>
<tr>
<th>DEPTH (FT)</th>
<th>SOIL SYMBOL</th>
<th>MINUS NO. 200 SIEVE (%)</th>
<th>DRY DENSITY (POUNDS/CU FT)</th>
<th>COMPRESSIVE STRENGTH (TONS/SQ FT)</th>
<th>ATTERBERG LIMITS</th>
<th>PLASTICITY INDEX</th>
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<tr>
<td>16</td>
<td>SILTY CLAYEY SAND</td>
<td>dark brown, moist, very loose.</td>
<td>16</td>
<td>Same as above, brown, loose.</td>
<td>Same as above, medium.</td>
<td>SILTY CLAYEY SAND</td>
</tr>
</tbody>
</table>

### REMARKS:

Drilling operations were performed by RETL at GPS Coordinates N° 27.06389 W° 97.87701
### KEY TO SOIL CLASSIFICATION AND SYMBOLS

**UNIFIED SOIL CLASSIFICATION SYSTEM**

<table>
<thead>
<tr>
<th>MAJOR DIVISIONS</th>
<th>SYMBOL</th>
<th>NAME</th>
<th>TERMS CHARACTERIZING SOIL STRUCTURE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GRAVEL AND GRAVELY SOILS</strong></td>
<td>GW</td>
<td>Well Graded Gravels or Gravel-Sand mixtures, little or no fines</td>
<td>SLICKENSIDED - having inclined planes of weakness that are slick and glossy in appearance</td>
</tr>
<tr>
<td></td>
<td>GP</td>
<td>Poorly Graded Gravels or Gravel-Sand mixtures, little or no fines</td>
<td>FISSURED - containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical</td>
</tr>
<tr>
<td></td>
<td>GM</td>
<td>Silty Gravels, Gravel-Sand-Silt mixtures</td>
<td>LAMINATED (VARVED) - composed of thin layers of varying color and texture, usually grading from sand or silt at the bottom to clay at the top</td>
</tr>
<tr>
<td></td>
<td>GC</td>
<td>Clayey Gravels, Gravel-Sand-Clay Mixtures</td>
<td>CRUMBLY - cohesive soils which break into small blocks or crumbs on drying</td>
</tr>
<tr>
<td><strong>SAND AND SANDY SOILS</strong></td>
<td>SW</td>
<td>Well Graded Sands or Gravelly Sands, little or no fines</td>
<td>CALCAREOUS - containing appreciable quantities of calcium carbonate, generally nodular</td>
</tr>
<tr>
<td></td>
<td>SP</td>
<td>Poorly Graded Sands or Gravelly Sands, little or no fines</td>
<td>WELL GRADED - containing wide range in grain sizes and substantial amounts of all intermediate particle sizes</td>
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<tr>
<td></td>
<td>SM</td>
<td>Silty Sands, Sand-Silt Mixtures</td>
<td>POORLY GRADED - predominantly of one grain size uniformly graded or having a range of sizes with some intermediate size missing (gap or skip graded)</td>
</tr>
<tr>
<td></td>
<td>SC</td>
<td>Clayey Sands, Sand-Clay mixtures</td>
<td></td>
</tr>
<tr>
<td><strong>SILTS AND CLAYS LL &gt; 50</strong></td>
<td>ML</td>
<td>Inorganic Silts and very fine Sands, Rock Flour, Silty or Clayey fine Sands or Clayey Silts</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CL</td>
<td>Inorganic Clays of low to medium plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean Clays</td>
<td></td>
</tr>
<tr>
<td></td>
<td>OL</td>
<td>Organic Silts and Organic Silt-Clays of low plasticity</td>
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</tr>
<tr>
<td></td>
<td>MH</td>
<td>Inorganic Silts, Micaceous or Diatomaceous fine Sandy or Silty soils, Elastic Silts</td>
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<tr>
<td></td>
<td>CH</td>
<td>Inorganic Clays of high plasticity, Fat Clays</td>
<td></td>
</tr>
<tr>
<td></td>
<td>OH</td>
<td>Organic Clays of medium to high plasticity, Organic Silts</td>
<td></td>
</tr>
<tr>
<td><strong>HIGHLY ORGANIC SOILS</strong></td>
<td>PT</td>
<td>Peat and other Highly Organic soils</td>
<td></td>
</tr>
</tbody>
</table>

### SYMBOLS FOR TEST DATA

- Groundwater Level (Initial Reading)
- Groundwater Level (Final Reading)
- Shelby Tube Sample
- SPT Samples
- Auger Sample
- Rock Core

### TERMS DESCRIBING CONSISTENCY OF SOIL

<table>
<thead>
<tr>
<th>COARSE GRAINED SOILS</th>
<th>FINE GRAINED SOILS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DESCRIPTIVE TERM</strong></td>
<td><strong>NO. BLOWS/FT. STANDARD PEN. TEST</strong></td>
</tr>
<tr>
<td>Very Loose</td>
<td>0 - 4</td>
</tr>
<tr>
<td>Loose</td>
<td>4 - 10</td>
</tr>
<tr>
<td>Medium</td>
<td>10 - 30</td>
</tr>
<tr>
<td>Dense</td>
<td>30 - 50</td>
</tr>
<tr>
<td>Very Dense</td>
<td>over 50</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Field Classification for "Consistency" is determined with a 0.25" diameter penetrometer.
August 24, 2020

Richter Architects
201 South Upper Broadway
Corpus Christi, Texas, 78401

Attention: Ms. Elizabeth Chu Richter, FAIA

SUBJECT: Supplement No. 1
SUBSURFACE INVESTIGATION, LABORATORY TESTING PROGRAM, AND FOUNDATION AND PAVEMENT RECOMMENDATIONS
FOR THE PROPOSED RESTROOM FACILITY AND PARKING AREA
Lake Corpus Christi State Park
San Patricio County, Texas
RETL Job No. – G120370

Dear Ms. Chu Richter,

During recent communication with the design team, RETL was informed that portions of the south side of the planned building will be partially below grade and the foundation wall will also function as a retaining wall. The retained soil depth will vary from approximately 6 inches to approximately 4½ feet. In addition to the building foundation wall, a cantilevered retaining wall will be constructed for a small mechanical yard located at the southwest corner of the building.

At the request of the design team, RETL is providing this Supplement No. 1 to the original report for this project dated July 29, 2020. This supplement includes recommendations pertaining to retaining wall design and construction. The recommendations provided herein are intended to supplement the recommendations provided in our original report. One electronic copy of Supplement No. 1 is being transmitted herewith for your records and distribution to the design team.

Retaining Wall Recommendations

Equivalent fluid density values for active, passive and at rest conditions were evaluated for various backfill materials. These values for different acceptable backfill soils and their respective USCS soil classification symbols are presented in the table below.

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>USCS Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPWD No. 1210196A</td>
<td></td>
</tr>
</tbody>
</table>
Retaining walls which are allowed to move slightly will develop an “active” earth pressure condition. If the wall is restrained from lateral movements such as when it is fixed at the top, the “at rest” earth pressure condition will be developed.

Design lateral soil loads are provided for moist soil conditions for the specified soils compacted to their maximum densities. It is very important to note that these equivalent fluid densities do not include the effect of seepage, hydrostatic pressures or groundwater. Submerged or saturated soil pressures shall include the weight of the buoyant soils plus hydrostatic loads. In addition, the pressures provided are for a horizontal backfill surface and do not include any surcharge loads due to equipment, vehicular loads, inclined soil loads or future storage near the walls.

It is recommended that the backfill behind the walls should be free draining sands or gravel with less than 10 percent passing the #200 Sieve and provisions are in the design to dissipate hydrostatic pressures behind the wall. Soils with USCS Classification OL, MH, CH, CL and OH are unsuitable for use as backfill.

Backfill for retaining walls shall be compacted to a minimum density of 95 percent of the maximum dry density as determined by the standard Proctor (ASTM D698) and the moisture content shall be maintained at, or above, the optimum moisture content. All compaction operations shall be performed in an attempt to minimize stress on the retaining wall. Compaction operations for each lift of fill soils shall begin at the wall and work back away from the wall in an effort to reduce the pressures on the wall due to construction activities.

We recommend that all below-grade walls be provided with a drainage system. A minimum 4-inch diameter, perforated drainpipe should be used, and placed at foundation level. Granular drainage material, consisting of 1-inch clean crushed rock, classified as GP by ASTM D 2487, with less than 5 percent of the rock passing the No. 200 sieve, should be placed a minimum of 6 inches in all directions around the drainage pipe. Synthetic filter fabric, such as Mirafi 140N or equivalent, should encapsulate the drainpipe and granular drainage material. The pipe should be sloped to drain by gravity or to a sump with a pump for below-grade walls where positive drainage by gravity cannot be achieved. Any interior sumps must be isolated “watertight” from the interior subgrade to prevent the movement of moisture from the sump into the underlying soils.
For the conventional cast-in-place gravity walls that will be constructed, the base of the retaining wall will behave as a strip footing. A strip footing founded at a minimum depth of 2 feet below the final lowest adjacent grade may be designed using an allowable unit bearing pressure of 1,400 psf for dead load and sustained live loads with a safety factor of 3.0. A friction coefficient of 0.3 may be used for determination of sliding friction resistance along the base of the footing. Additionally, we recommend that passive pressures be neglected for the upper 1 foot where the soils are exposed to the environment.

Footings designed using the net allowable unit soil pressure provided could expect total settlements to be approximately 1 inch and differential settlements to be approximately ½ inch. The allowable unit soil pressures may be increased by one-third for maximum transient loads, such as wind loads.

In order to minimize the effects of any slight differential movement that may occur due to variations in the character of the supporting soils, it is recommended that all footings be suitably reinforced to make them as rigid as possible.

The exposed subgrade soils at the footing bearing depth shall be compacted to a minimum density of 95 percent of the maximum dry density as determined by the standard Proctor (ASTM D698) and the moisture content shall be maintained at, or above, the optimum moisture content. The smooth and firm, properly compacted, footing bearing surface shall be protected with a lean concrete to prevent excessive wetting and desiccation of the subgrade soils and to provide a stable subgrade during placement of reinforcing steel.

**Closing**

The recommendations provided in this Supplement No. 1 are intended to supplement the recommendations provided in the original report for this project dated July 29, 2020. Recommendations provided in the original report, that are not specifically addressed, revised or amended herein, shall remain valid and unchanged.

Rock Engineering and Testing Laboratory, Inc. (RETL), Texas Professional Engineering Firm No. – 2101, would be pleased to continue its role as Geotechnical Engineer during the project implementation. If you have any questions, or if we can be of further assistance, please contact us at (361) 883-4555.

Sincerely,

James P. Bauer, P.E.     Darren W. Lantz, P.E.
Corpus Christi Branch Manager    Senior Engineer