Attachment B: Technical Specifications
TS 1.0

All street and drainage work shall conform to the following list (but not limited to) of Governing Specifications from the Texas Department of Transportation Standard Specifications for Construction and Maintenance of Highways, Streets and Bridges, 2014. All cross references made in these items below to other specification items are also part of this Contract.

LIST OF GOVERNING SPECIFICATIONS

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>Preparing Right of Way</td>
</tr>
<tr>
<td>110</td>
<td>Excavation</td>
</tr>
<tr>
<td>160</td>
<td>Topsoil</td>
</tr>
<tr>
<td>162</td>
<td>Sodding for Erosion Control</td>
</tr>
<tr>
<td>247</td>
<td>Flexible Base</td>
</tr>
<tr>
<td>310</td>
<td>Prime Coat</td>
</tr>
<tr>
<td>340</td>
<td>Dense-Graded Hot-Mix Asphalt (Small Quantity)</td>
</tr>
<tr>
<td>360</td>
<td>Concrete Pavement</td>
</tr>
<tr>
<td>479</td>
<td>Adjusting Manholes and Inlets</td>
</tr>
<tr>
<td>500</td>
<td>Mobilization</td>
</tr>
<tr>
<td>502</td>
<td>Barricades, Signs, and Traffic Handling</td>
</tr>
<tr>
<td>506</td>
<td>Temporary Erosion, Sedimentation, and Environmental Controls</td>
</tr>
<tr>
<td>529</td>
<td>Concrete Curb, Gutter, and Combined Curb and Gutter</td>
</tr>
<tr>
<td>530</td>
<td>Intersections, Driveways, and Turnouts</td>
</tr>
<tr>
<td>531</td>
<td>Sidewalks</td>
</tr>
</tbody>
</table>

TS 1.1

For all water and wastewater utility work for this project, all materials and construction procedures shall be approved by New Braunfels Utilities (NBU) and conform to the latest NBU Water Systems Connection and Construction Policy Manual as they are referenced for in the construction drawings and proposal form. All cross references made in this item below to other specification items are also part of this Contract. The following is a list of the Governing Specifications:

<table>
<thead>
<tr>
<th>NBU Item No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>504</td>
<td>Adjusting Structures</td>
</tr>
</tbody>
</table>

TS 1.2

Where conflicts exist between wording in these Technical Specifications and the plans for this project, the wording as shown in these referenced specifications, shall supercede the plans.
TS 1.3  The Contractor must call the Texas One Call System (800) 545-6005 at least 48-hours before digging. The Contractor must notify the City of New Braunfels Engineering Departments at (830)221-4020 and New Braunfels Utilities at (830)629-8400 at 48-hours before digging.

TS 1.4  In advance of construction, the Contractor shall verify the location of all utilities subject to damage or inconvenienced by construction operations. Any unforeseen major utility relocations required by this project, which are not a part of this contract, will be accounted for and budgeted for separately.

TS 1.5  In advance of construction, the Contractor shall prepare photographs of the project work. Those photos must show the condition of the work areas plus an area 10 feet outside the limits of construction for all portions of the project. The Contractor shall provide digital images on a CD. Images to be .jpeg format with the date on the photo. A log of photo locations will accompany the CD. Provide a paper copy of all photos in a binder format. The photo binder must be submitted prior to contractor beginning any work on the project. Cost of this work is a non-separate pay item and is subsidiary to preparing right-of-way.

TS 1.6  Any embankment to be placed shall be in accordance with Item 132, Embankment. Payment for this work shall be considered subsidiary to Item 110, Excavation.

TS 1.7  Contractor shall provide and maintain SWPPP, NOI and NOT as required. This is a non-separate pay item and is subsidiary to preparing right-of-way.
TECHNICAL SPECIFICATIONS
E. SOUTH ST. MAINTENANCE PROJECT

TS 1.0 All street and drainage work shall conform to the following list (but not limited to) of Governing Specifications from the Texas Department of Transportation Standard Specifications for Construction and Maintenance of Highways, Streets and Bridges, 2014. All cross references made in these items below to other specification items are also part of this Contract.

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>Preparing Right of Way</td>
</tr>
<tr>
<td>110</td>
<td>Excavation</td>
</tr>
<tr>
<td>160</td>
<td>Topsoil</td>
</tr>
<tr>
<td>162</td>
<td>Sodding for Erosion Control</td>
</tr>
<tr>
<td>247</td>
<td>Flexible Base</td>
</tr>
<tr>
<td>310</td>
<td>Prime Coat</td>
</tr>
<tr>
<td>340</td>
<td>Dense-Graded Hot-Mix Asphalt (Small Quantity)</td>
</tr>
<tr>
<td>360</td>
<td>Concrete Pavement</td>
</tr>
<tr>
<td>479</td>
<td>Adjusting Manholes and Inlets</td>
</tr>
<tr>
<td>500</td>
<td>Mobilization</td>
</tr>
<tr>
<td>502</td>
<td>Barricades, Signs, and Traffic Handling</td>
</tr>
<tr>
<td>506</td>
<td>Temporary Erosion, Sedimentation, and Environmental Controls</td>
</tr>
<tr>
<td>529</td>
<td>Concrete Curb, Gutter, and Combined Curb and Gutter</td>
</tr>
<tr>
<td>530</td>
<td>Intersections, Driveways, and Turnouts</td>
</tr>
<tr>
<td>531</td>
<td>Sidewalks</td>
</tr>
</tbody>
</table>

TS 1.1 For all water and wastewater utility work for this project, all materials and construction procedures shall be approved by New Braunfels Utilities (NBU) and conform to the latest NBU Water Systems Connection and Construction Policy Manual as they are referenced for in the construction drawings and proposal form. All cross references made in this item below to other specification items are also part of this Contract. The following is a list of the Governing Specifications:

<table>
<thead>
<tr>
<th>NBU Item No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>504</td>
<td>Adjusting Structures</td>
</tr>
</tbody>
</table>

TS 1.2 Where conflicts exist between wording in these Technical Specifications and the plans for this project, the wording as shown in these referenced specifications, shall supercede the plans.
TS 1.3  The Contractor must call the Texas One Call System (800) 545-6005 at least 48-hours before digging. The Contractor must notify the City of New Braunfels Engineering Departments at (830)221-4020 and New Braunfels Utilities at (830)629-8400 at 48-hours before digging.

TS 1.4  In advance of construction, the Contractor shall verify the location of all utilities subject to damage or inconvenienced by construction operations. Any unforeseen major utility relocations required by this project, which are not a part of this contract, will be accounted for and budgeted for separately.

TS 1.5  In advance of construction, the Contractor shall prepare photographs of the project work. Those photos must show the condition of the work areas plus an area 10 feet outside the limits of construction for all portions of the project. The Contractor shall provide digital images on a CD. Images to be .jpeg format with the date on the photo. A log of photo locations will accompany the CD. Provide a paper copy of all photos in a binder format. The photo binder must be submitted prior to contractor beginning any work on the project. Cost of this work is a non-separate pay item and is subsidiary to preparing right-of-way.

TS 1.6  Any embankment to be placed shall be in accordance with Item 132, Embankment. Payment for this work shall be considered subsidiary to Item 110, Excavation.

TS 1.7  Contractor shall provide and maintain SWPPP, NOI and NOT as required. This is a non-separate pay item and is subsidiary to preparing right-of-way.
TECHNICAL SPECIFICATIONS
S. CENTRAL AVENUE MAINTENANCE PROJECT

TS 1.0 All street and drainage work shall conform to the following list (but not limited to) of Governing Specifications from the Texas Department of Transportation Standard Specifications for Construction and Maintenance of Highways, Streets and Bridges, 2014. All cross references made in these items below to other specification items are also part of this Contract.

LIST OF GOVERNING SPECIFICATIONS

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>Preparing Right of Way</td>
</tr>
<tr>
<td>110</td>
<td>Excavation</td>
</tr>
<tr>
<td>160</td>
<td>Topsoil</td>
</tr>
<tr>
<td>162</td>
<td>Sodding for Erosion Control</td>
</tr>
<tr>
<td>247</td>
<td>Flexible Base</td>
</tr>
<tr>
<td>310</td>
<td>Prime Coat</td>
</tr>
<tr>
<td>340</td>
<td>Dense-Graded Hot-Mix Asphalt (Small Quantity)</td>
</tr>
<tr>
<td>420</td>
<td>Concrete Substructures</td>
</tr>
<tr>
<td>479</td>
<td>Adjusting Manholes and Inlets</td>
</tr>
<tr>
<td>500</td>
<td>Mobilization</td>
</tr>
<tr>
<td>502</td>
<td>Barricades, Signs, and Traffic Handling</td>
</tr>
<tr>
<td>506</td>
<td>Temporary Erosion, Sedimentation, and Environmental Controls</td>
</tr>
<tr>
<td>529</td>
<td>Concrete Curb, Gutter, and Combined Curb and Gutter</td>
</tr>
<tr>
<td>530</td>
<td>Intersections, Driveways, and Turnouts</td>
</tr>
<tr>
<td>531</td>
<td>Sidewalks</td>
</tr>
</tbody>
</table>

TS 1.1 For all water and wastewater utility work for this project, all materials and construction procedures shall be approved by New Braunfels Utilities (NBU) and conform to the latest NBU Water Systems Connection and Construction Policy Manual as they are referenced for in the construction drawings and proposal form. All cross references made in this item below to other specification items are also part of this Contract. The following is a list of the Governing Specifications:

<table>
<thead>
<tr>
<th>NBU Item No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>504</td>
<td>Adjusting Structures</td>
</tr>
</tbody>
</table>

TS 1.2 Where conflicts exist between wording in these Technical Specifications and the plans for this project, the wording as shown in these referenced specifications, shall supercede the plans.
TS 1.3 The Contractor must call the Texas One Call System (800) 545-6005 at least 48-hours before digging. The Contractor must notify the City of New Braunfels Engineering Departments at (830)221-4020 and New Braunfels Utilities at (830)629-8400 at 48-hours before digging.

TS 1.4 In advance of construction, the Contractor shall verify the location of all utilities subject to damage or inconvenienced by construction operations. Any unforeseen major utility relocations required by this project, which are not a part of this contract, will be accounted for and budgeted for separately.

TS 1.5 In advance of construction, the Contractor shall prepare photographs of the project work. Those photos must show the condition of the work areas plus an area 10 feet outside the limits of construction for all portions of the project. The Contractor shall provide digital images on a CD. Images to be .jpeg format with the date on the photo. A log of photo locations will accompany the CD. Provide a paper copy of all photos in a binder format. The photo binder must be submitted prior to contractor beginning any work on the project. Cost of this work is a non-separate pay item and is subsidiary to preparing right-of-way.

TS 1.6 Any embankment to be placed shall be in accordance with Item 132, Embankment. Payment for this work shall be considered subsidiary to Item 110, Excavation.

TS 1.7 Contractor shall provide and maintain SWPPP, NOI and NOT as required. This is a non-separate pay item and is subsidiary to preparing right-of-way.
DIVISION I - EARTHWORK

ITEM

100 MOBILIZATION

100.1. DESCRIPTION: Establish and remove offices, plants, and facilities. Move personnel, equipment, and supplies to and from the project or the vicinity of the project site to begin work or complete work on Contract Items.

100.2. MEASUREMENT: This Item will be measured by the lump sum as the work progresses.

100.3. PAYMENT: Partial payments of the lump sum bid for mobilization will be as follows. The adjusted Contract amount for construction Items as used below is defined as the total Contract amount less the lump sum for mobilization.

A. Payment will be made upon presentation of a paid invoice for the payment bond, performance bond, and required insurance. The combined payment for bonds and insurance will be no more than 10% of the mobilization lump sum or 1% of the total Contract amount, whichever is less.

B. Payment will be made upon verification of documented expenditures for plant and facility setup. The combined amount for all these facilities will be no more than 10% of the mobilization lump sum or 1% of the total Contract amount, whichever is less.

C. When 1% of the adjusted Contract amount for construction Items is earned, 50% of the mobilization lump sum bid or 5% of the total Contract amount, whichever is less, will be paid. Previous payments under this Item will be deducted from this amount.

D. When 5% of the adjusted Contract amount for construction Items is earned, 75% of the mobilization lump sum bid or 10% of the total Contract amount, whichever is less, will be paid. Previous payments under the Item will be deducted from this amount.

E. When 10% of the adjusted Contract amount for construction Items is earned, 90% of the mobilization lump sum bid or 10% of the total Contract amount, whichever is less, will be paid. Previous payments under this Item will be deducted from this amount.

F. Payment for the remainder of the lump sum bid for “Mobilization” will be made on the next estimate cycle after the initial retainage estimate or at final acceptance for projects without retainage.

100.4. BID ITEM:

Item 100.1 - Mobilization - lump sum

Item 100.2 - Insurance and Bond - lump sum
ITEM

101 PREPARING RIGHT-OF-WAY

101.1. DESCRIPTION: Prepare the right of way and designated easements for construction operations by removing and disposing of all obstructions when removal of such obstructions is not specifically shown on the plans to be paid by other Items.

101.2. MATERIALS:

A. Obstructions. Obstructions shall be considered to include, but not limited to, remains of houses not completely removed by others, foundations, floor slabs, concrete, brick, lumber, plaster, cisterns, septic tanks, basements, abandoned utility pipes or conduits, equipment or other foundations, fences, retaining walls, outhouses, shacks, and all other debris as well as buried concrete slabs, curbs, gutters, driveways, and sidewalks.

This item shall also include the removal of trees, stumps, bushes, shrubs, brush, roots, vegetation, logs, rubbish, paved parking areas, miscellaneous stone, brick, drainage structures, manholes, inlets, abandoned railroad tracks, scrap iron and all debris, whether above or below ground, except live utility facilities.

It is the intent of this specification to provide for the removal and disposal of all obstructions to the new construction together with other objectionable materials not specifically provided for elsewhere by the plans and specifications.

B. Explosives. This item shall not govern for the demolition of buildings by the use of explosives. Such demolition work shall be governed by the use of a special specification controlling the work.

C. Fences. Unless shown otherwise on the plans, all fences along the right-of-way which are damaged or removed temporarily by the Contractor shall be replaced by the Contractor to an equal or better condition at no additional cost to the City.

D. Hazardous Materials. If the Contractor encounters hazardous substances, industrial waste, other environmental pollutants, underground storage tanks, or conditions conducive to environmental damage, Contractor shall immediately stop work in the area affected and report the condition to the Owner's representative in writing. Contractor shall not be responsible for or required to conduct any investigation, site monitoring, containment, cleanup, removal, restoration or other remedial work of any kind or nature (the “remedial work”) under any applicable level, state or federal law, regulation or ordinance, or any judicial order. If the Contractor agrees in writing to commence and/or prosecute some or all of the remedial work, all costs and expenses, to include any extension of the contract time, of such remedial work shall be paid by Owner to Contractor as additional compensation.

101.3. EQUIPMENT: Provide applicable equipment to conduct work as described in this specification or as specified on the plans.

101.4. CONSTRUCTION: Protect designated features on the right of way and prune trees and shrubs as directed. Do not park equipment, service equipment, store materials, or disturb the root area under the branches of trees designated for preservation. When shown on the plans, treat cuts on trees with an approved tree wound dressing within 20 min. of making a pruning cut or otherwise
causing damage to the tree. Follow all local and state regulations when burning. If burning of brush is approved, pile and burn at approved locations. When working in state or national forests or parks, coordinate work with state and federal authorities. Testing, removal, and disposal of hazardous materials will be in accordance with 101.2.D, “Hazardous Materials.”

Clear areas shown on the plans of all obstructions, except those landscape features that are to be preserved. Such obstructions include but are not limited to those identified in 101.2.A, “Obstructions” and other items as specified on the plans. Remove vegetation and other landscape features not designated for preservation. Removal of live utility facilities is not included in this Item. Remove culverts, storm sewers, manholes, and inlets in proper sequence to maintain traffic and drainage.

Unless otherwise indicated on the plans, all underground obstructions shall be removed to the following depths:

- In areas receiving embankment, remove obstructions not designated for preservation to 2 ft. below natural ground.
- In areas to be excavated, remove obstructions to 2 ft. below the excavation level.
- In all other areas, remove obstructions to 1 ft. below natural ground.

When allowed by the plans or directed, cut trees and stumps off to ground level.

Holes remaining after removal of all obstructions, objectionable materials, vegetation, etc. shall be backfilled and tamped and the entire area bladed, to prevent ponding of water and to provide drainage. Backfill materials deemed unacceptable by the Engineer shall be removed and replaced at no additional cost to the City. In areas that are to be immediately excavated, backfilling and blading may be eliminated if approved by the Engineer. Areas to be used as borrow sites and material sources shall have all obstructions, objectionable materials, vegetation, etc., removed to the complete extent necessary to prevent such objectionable matter from becoming mixed with the material to be used in the construction.

Where a conduit is shown to be replaced, it shall be removed in its entirety and all connections to the existing conduit shall be extended to the new line. Where an existing conduit is to be cut and plugged, the line shall be cut back not less that 2 feet and a plug of concrete not less that 2 feet long shall be poured and held in the end of the pipe or the plug may be accomplished by using a precast stopper grouted into place.

Material to be removed will be designated as “salvageable” or “non-salvageable” on the plans prior to bidding by the Contractor. All “salvageable” material will remain the property of the City and will be stored at the site as directed by the Engineer. All “non-salvageable” materials and debris removed shall become the property of the Contractor and shall be removed from the site and shall be disposed of properly and in accordance with local, state, and federal requirements.

All asphaltic material shall be deposited of or recycled at a facility authorized to accept the asphalt for such purposes.

Dispose of wells in accordance with TxDOT Item 103, “Disposal of Wells.”

101.5. MEASUREMENT: “Preparing Right-of-Way” for new construction will be measured by the lump sum.
101.6. **PAYMENT**: This item will be paid for at the contract lump sum price bid for “Preparing Right-of-Way,” which price shall be full compensation for work herein specified, including the furnishing of all materials, equipment, tools, labor, and incidentals necessary to complete the work. The lump sum price will be pro-rated based on the number of phases in the project. A phase will be eligible for payment when street excavation is completed for that phase.

101.7. **BID ITEM:**

Item 101.1 - Preparing Right-of-Way - lump sum
ITEM

103 REMOVE CONCRETE

103.1. DESCRIPTION: This item shall govern the breaking up, removing, and satisfactorily disposing of existing concrete, as classified, at locations shown on the plans or as directed by the Engineer. Existing concrete not shown on the plans, located beneath the natural ground surface, not indicated by the Engineer or not obvious to the naked eye will not be covered under this item. Such materials will be removed as needed and paid for under Item 104 “Street Excavation,” Item 105 “Channel Excavation,” or Item 306 “Structural Excavation.”

103.2. CLASSIFICATION: Existing concrete to be removed under this item will be classified as follows:

A. Concrete Curb. “Concrete Curb” will include curb, curb and gutter, and low curb at driveways, and combinations thereof. The removal of monolithic concrete curb or dowelled concrete curb will be included in the concrete pavement measurement.

B. Concrete Traffic Barrier. “Concrete Traffic Barrier” will include permanent concrete barrier used for channeling or dividing traffic that is not considered salvageable.

C. Sidewalks and Driveways. “Sidewalks and Driveways” will include concrete sidewalks and driveways.

D. Miscellaneous Concrete. “Miscellaneous Concrete” will include all other items that are not noted above or covered by other items.

103.3. EQUIPMENT: Provide the machinery, tools and equipment necessary for proper prosecution of the work. All machinery, tools and equipment used shall be maintained in a satisfactory and workmanlike manner.

103.4. CONSTRUCTION:

A. General. The existing concrete shall be broken up, removed, and disposed of by the Contractor in accordance with federal, state, and local regulations.

B. Partial Removal of Concrete. When only a portion of the existing concrete is to be removed, care shall be exercised to avoid damage to that portion to remain in place. The existing concrete shall be cut to neat lines shown on the plans or as established by the Engineer, by sawing with an appropriate type circular concrete saw to a minimum depth of ½-inch. Any existing concrete which is damaged or destroyed beyond the neat lines so established shall be replaced at the Contractor's expense. Where reinforcement is encountered in the removed portions of the concrete, a minimum of 1-foot shall be cleaned of all old concrete and left in place to tie into the new concrete construction.

103.5. MEASUREMENT: Measurement for this item will be conducted as follows:

A. Concrete Curb. Concrete curb removed as prescribed above will be measured by the linear foot in its original position regardless of the thickness and reinforcing steel encountered.

B. Concrete Traffic Barrier. Concrete Traffic Barrier as prescribed above will be measured by the linear foot in its original position regardless of the type or size encountered.
C. **Concrete Sidewalk and Driveway.** Concrete sidewalks and driveways removed as prescribed above will be measured by the square foot in its original position regardless of the thickness of the concrete and reinforcing steel encountered.

D. **Miscellaneous Concrete.** Miscellaneous Concrete will be measured by the square foot in its original position regardless of the thickness of the concrete and reinforcing steel encountered.

103.6. **PAYMENT:** This item will be paid for at the contract unit price bid for “Remove Concrete Curb,” “Remove Concrete Traffic Barrier,” “Remove Concrete Sidewalks and Driveways,” or “Remove Miscellaneous Concrete” which price shall be full compensation for all work herein specified, including the furnishing of all materials, equipment, tools, labor and incidentals necessary to complete the work.

103.7. **BID ITEM:**

- Item 103.1 - Remove Concrete Curb - per linear foot
- Item 103.2 - Remove Concrete Traffic Barrier - per linear foot
- Item 103.3 - Remove Sidewalks and Driveways - per square foot
- Item 103.4 - Remove Miscellaneous Concrete - per square foot
ITEM

104 STREET EXCAVATION

104.1. DESCRIPTION: Excavate and properly dispose all excavated material, of whatever character, within the limits of the work and construct, compact, shape and finish earthwork on the entire length of the street, approaches, and/or sidewalk in accordance with specification requirements herein outlined and in conformity with the required lines, grades, and typical cross sections, shown on the plans or directed by the Engineer.

104.2. MATERIALS: All excavation shall be unclassified and shall include all materials encountered regardless of their nature or the manner in which they are removed, except those covered by other pay items.

A. Hazardous Materials. If the Contractor encounters hazardous substances, industrial waste, other environmental pollutants, underground storage tanks, or conditions conducive to environmental damage, Contractor shall immediately stop work in the area affected and report the condition to the Owner's representative in writing. Contractor shall not be responsible for or required to conduct any investigation, site monitoring, containment, cleanup, removal, restoration or other remedial work of any kind or nature (the “remedial work”) under any applicable level, state or federal law, regulation or ordinance, or any judicial order. If the Contractor agrees in writing to commence and/or prosecute some or all of the remedial work, all costs and expenses, to include any extension of the contract time, of such remedial work shall be paid by Owner to Contractor as additional compensation.

B. Existing Structures/Obstructions. Removal of structures and other obstructions prior to excavation and finishing of all other earthwork described herein shall be completed and paid for in accordance with Item 101, “Preparing Right-of-Way” unless otherwise stated on the plans.

C. Existing Asphal tic Materials. All asphaltic material shall be disposed of or recycled at a facility authorized to accept the material for such purposes.

104.3. EQUIPMENT: Provide applicable equipment to conduct work as described in this specification or as specified on the plans.

104.4. CONSTRUCTION: The subgrade shall be shaped in conformity to the lines and grades established by the Engineer by removal of existing material or addition of approved material. Material removed in one area may be utilized in the addition of material to the subgrade in another area if approved by the Engineer. All material required for completion of the subgrade shall be subject to approval by the Engineer.

Unsuitable excavation or excavation in excess of that needed for construction shall be known as “Waste” and shall become the property of the Contractor and it shall become his sole responsibility to dispose of this material off the limits of the right-of-way. Proper disposal shall be in conformance with, but not limited to, the following provisions:

- Do not deposit excavated material within jurisdictional wetlands, and
• Obtain appropriate permits and apply provisions pertaining to soil erosion and stream pollution, when necessary, to meet federal and/or local regulations, rules, and procedures.

A. Rock Cuts. Excavate to finished subgrade elevation using equipment appropriate for the conditions encountered. Manipulate and compact subgrade in accordance with Section 104.4.C., “Compaction,” unless excavation is to clean homogenous rock at finished subgrade elevation. If excavation extends below finished subgrade, use approved material compacted in accordance with Section C to replace undercut material at no additional cost. All unstable or otherwise objectionable material shall be removed from the subgrade and replaced with approved material in loose lifts not to exceed 12 inches in depth. Removal and replacement of unstable material will be paid by the Engineer.

B. Earth Cuts. All earth cuts shall be scarified to a uniform depth of at least 6-inches below the required finished subgrade elevation. All holes, ruts, and depressions shall be filled with approved material in loose lifts not to exceed 12 inches in depth. Compact the scarified subgrade in accordance with Section 104.4.C., “Compaction.”

If the Engineer determines that the subgrade is unsuitable, the contractor shall remove the unsuitable material to the limits directed by the Engineer and replace it with suitable material. Removal and replacement of unsuitable material will be paid by the Engineer.

C. Compaction. Subgrade materials shall be compacted to the required density and moisture content as shown below, unless otherwise shown on the plans:

<table>
<thead>
<tr>
<th>Subgrade Material</th>
<th>Density</th>
<th>Moisture Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>PI ≤ 20</td>
<td>≥ 95% of Max Dry Density</td>
<td>- 2% of Opt. or greater</td>
</tr>
<tr>
<td>PI &gt; 20</td>
<td>≥ 95% of Max Dry Density</td>
<td>≥ Opt. Moisture</td>
</tr>
</tbody>
</table>

The maximum dry density and optimum moisture content shall be determined in accordance with TxDOT Test Method Tex-114-E. Tests for in place density shall be made in accordance with TxDOT Test Method Tex-115-E and within 24 hours after compacting operations are completed. If the material fails to meet the density specified, it shall be re-worked as necessary to obtain the density required.

For materials with a PI > 20, just prior to placing any base materials or stabilization, the top 3 inches of compacted subgrade shall be tested for density and moisture content. If tests show the density to be more than 2% below the specified minimum or the moisture content to be more than 3% above or below the optimum, the course shall be reworked as necessary to obtain the specified compaction and moisture content.

If the material used to replace undercuts or unsuitable material contains more than 30% oversize fraction (i.e. 30% or more retained on the ¾-inch sieve) or is gap-graded (many large particles with limited small particles), the maximum density determined by Tex-114-E may not be appropriate for field compaction. If this situation is encountered, the Engineer may elect to accept the material without density testing. With the approval of the Engineer, place layers in loose lifts not to exceed 12 inches. Before and during rolling operations, bring each layer to the moisture content directed. Compact each layer until there is no evidence of further consolidation. Maintain a level layer to aid in uniform compaction. If the required stability or finish is lost for any reason, recompact and refinish the subgrade at no additional expense to the City.
The contractor is also responsible for compaction of trenches installed as a part of this specification.

D. Tolerances. The surface of the subgrade shall be finished to the lines and grades as established. Any deviation in excess of ½-inch in cross section and in a length of 16-feet measured longitudinally shall be corrected by loosening, adding, or removing material, reshaping and compacting by sprinkling and rolling in accordance with Section 104.4.C., “Compaction.” Sufficient subgrade shall be prepared in advance to insure satisfactory prosecution of the work.

E. Quality Control. After each layer of embankment or select material is complete, tests as necessary will be made by the Engineer. If the material fails to meet the density specified, the course shall be reworked, as necessary, to obtain the specified compaction.

Should the subgrade, due to any reason or cause, lose the required stability, density/moisture as described in Section 104.4.C., “Compaction” or finish before the pavement is placed, it shall be recompacted in accordance with Section C and refinished at the sole expense of the Contractor. Excessive loss of moisture in the subgrade shall be prevented by sprinkling, sealing or covering with a subsequent layer of asphaltic or other approved material.

104.5. MEASUREMENT: All accepted street excavation will be measured in its original position and the volume computed in cubic yards by the method of average end areas. Cross-sectional areas shall be computed to the established line of the subgrade, to a vertical line behind the curb, as indicated on the plans from the subgrade to the top of the proposed curb and then to the lines for parkway slopes as shown on the cross-sections of the plans.

Excavation and replacement of unsuitable materials below finish subgrade elevations will be measured by the cubic yard with the amount agreed upon by the Contractor and City prior to acceptance.

104.6. PAYMENT: This item will be paid for at the contract unit price bid for “Street Excavation,” which price shall be full compensation for all work herein specified, including the furnishing of all materials, equipment, tools, labor, and incidentals necessary to complete the work.

Authorized removal and replacement of unsuitable material in excess of the bid quantity shall be paid for at the unit bid item price for street excavation.

104.7. BID ITEM:

Item 104.1 - Street Excavation - per cubic yard
ITEM

202 PRIME COAT

202.1. DESCRIPTION: This item shall govern for the application of asphaltic material on the completed base course and/or other areas in accordance with this specification and as directed by the Engineer. Apply blotter material as required.

202.2. MATERIALS: Provide materials in accordance with the following requirements:

A. Bituminous. Unless the type and grade are shown on the plans, utilize an MC-30 or AE-P asphalt cement in accordance with Item 300, “Asphalts, Oils, and Emulsions” of the Standard Specifications of the Texas Department of Transportation for prime coat. Where Emulsified Asphalts are used, the amount of emulsified asphalt as a percentage by volume of the total mixture shall be within the limits shown on the plans, or shall be of a percentage as directed by the Engineer.

B. Blotter. Unless otherwise shown on the plans or approved, use either base course sweepings obtained from cleaning the base or sand as blotter materials.

202.3. EQUIPMENT: Provide applicable equipment in accordance with this specification or as specified on the plans.

A. Distributor. Furnish a distributor that will apply the asphalt material uniformly at the specified rate or as directed.

1. Transverse Variance Rate. When a transverse variance rate is shown on the plans, confirm that the nozzles outside the wheel paths will output a predetermined percentage more of asphalt material by volume than the nozzles over the wheel paths.

2. Calibration.

a. Transverse Distribution. Furnish a distributor test report, no more than 1 year old, documenting that the variation in output for individual nozzles of the same size does not exceed 10% when tested at the greatest shot width in accordance with Tex-922-K, “Calibrating Asphalt Distribution Equipment,” Part III.

Include the following documentation on the test report:

• the serial number of the distributor,

• a method that identifies the actual nozzle set used in the test, and

• the fan width of the nozzle set at a 12 inch bar height.

When a transverse variance rate is required, perform the test using the type and grade of asphalt material to be used on the project. The Engineer may verify the transverse rate and distribution at any time. If verification does not meet the requirements, correct deficiencies and furnish a new test report.

Calibrate the distributor within the previous 3 years of the date first used on the project. The Engineer may verify calibration accuracy in accordance with Tex-922-K, “Calibrating Asphalt Distribution Equipment,” Part II.

C. **Computerized Distributor.** When paying for asphalt material by weight, the Engineer may allow use of the computerized distributor display to verify application rates. Verify application rate accuracy at a frequency acceptable to the Engineer.

D. **Broom.** Furnish rotary, self-propelled brooms.

E. **Rollers.** Rollers provided shall meet the requirements for their type as shown in Item 210, “Rollers.”

F. **Asphalt Storage and Handling Equipment.** When the plans or the Engineer allows storage tanks, furnish a thermometer in each tank to indicate the asphalt temperature continuously.

Keep equipment clean and free of leaks. Keep asphalt material free of contamination.

G. **Digital Measuring Instrument.** Furnish a vehicle with a calibrated digital-measuring instrument accurate to ±6 ft. per mile.

### 202.4. CONSTRUCTION:

A. **General.** Apply the mixture when the air temperature is 60ºF and above, or above 50ºF and rising. Measure the air temperature in the shade away from artificial heat. The Engineer will determine when weather conditions are suitable for application.

Do not permit traffic, hauling, or placement of subsequent courses over freshly constructed prime coats. Maintain the primed surface until placement of subsequent courses or acceptance of the work.

B. **Surface Preparation.** Prepare the surface by sweeping or other approved methods. When directed, before applying bituminous material, lightly sprinkle the surface with water to control dust and ensure absorption.

C. **Application.**

1. **Bituminous.** The Engineer will select the application temperature within the limits recommended in Item 300, “Asphalts, Oils, and Emulsions.” Apply material within 15ºF of the selected temperature.

Unless otherwise shown on the plans, prime coat shall be applied at a rate not to exceed 0.20 gallon per square yard of surface. The prime coat shall be applied evenly and smoothly, under a pressure necessary for proper distribution.

When emulsified asphalts are used as prime coat, agitate the water and emulsified asphalt to produce a uniform blend. Evenly distribute, at the rate specified, to locations shown on the plans or as directed. Regulate the percentage of emulsified asphalt in the mixture and distribute successive applications to achieve the specified rate, if necessary.

During the application of prime coat, care shall be taken to prevent splattering of adjacent pavement, curb and gutters or structures. When directed, roll the freshly applied prime coat with a pneumatic-tire roller to ensure penetration.
2. **Blotter.** Spread blotter material before allowing traffic to use a primed surface. When “Prime Coat and Blotter” is shown on the plans as a bid item, apply blotter material to primed surface at the rate shown in the plans or as directed. When “Prime Coat” is shown on the plans as a bid item, apply blotter to spot locations or as directed to accommodate traffic movement through the work area. Remove blotter material before placing the surface. Dispose of blotter material according to applicable state and federal requirements.

**202.5. MEASUREMENT:** The asphaltic material for prime coat will be measured at the point of delivery on the project in gallons at the applied temperature. The quantity to be paid for shall be the number of gallons of asphaltic material used, as directed, in the accepted prime coat to the pay limits as shown on the plans. When emulsions are used, only that percentage of emulsified asphalt as a percentage by volume of the total mixture shall be paid for by the gallon of asphaltic material used in the accepted prime coat. Water used will not be measured for payment.

**202.6. PAYMENT:** The work performed and materials furnished in accordance with this Item and measured as provided under “Measurement” will be paid for at the unit price bid for “Prime Coat” or “Prime Coat and Blotter” of the type and grade of bituminous material specified. This price is full compensation for cleaning and sprinkling the area to be primed; materials, including blotter material; and rolling, equipment, labor, tools, and incidentals.

**202.7. BID ITEM:**

- Item 202.1 - Prime Coat - per gallon
- Item 202.2 - Prime Coat and Blotter - per gallon
ITEM

203 TACK COAT

203.1. DESCRIPTION: Apply asphaltic material on the completed base course after the prime coat has sufficiently cured, existing pavement, bituminous surface, or in the case of a bridge, on the prepared floor slab in accordance with these specifications and/or as directed by the Engineer.

203.2. MATERIALS: The asphaltic material used for Tack Coat shall meet the requirements for “Asphalt Cement”, “Cut-Back Asphalt” or “Emulsified Asphalt” in Item No. 300, “Asphalts, Oils and Emulsions” of the Texas Department of Transportation Standard Specifications. The asphaltic material used for Tack Coat shall be the type or grade shown in the referring specification, or on the plans, or as directed/approved by the Engineer.

203.3. EQUIPMENT: Provide equipment that conforms to the requirements of Item 202, “Prime Coat,” Part 3, “Equipment.”

203.4. CONSTRUCTION: Before the tack coat is applied, the surface shall be cleaned thoroughly with a vacuum sweeper to the satisfaction of the Engineer. The asphaltic material shall be applied on the clean surface by an approved type of self-propelled pressure distributor evenly and smoothly under a pressure necessary for proper distribution.

The tack coat shall be applied at the rate specified by the referring specification or on the plans. Unless otherwise stated or allowed by the Engineer the application rate shall not exceed 0.10 gallon per square yard of surface.

Where the pavement mixture will adhere to the surface on which it is to be placed without the use of a tack coat, the tack coat may be eliminated by the Engineer. All contact surfaces of curbs and structures and all joints shall be painted with a thin uniform coat of the asphaltic material used for tack coat. During the application of tack coat, care shall be taken to prevent splattering of adjacent pavement, curb and gutters or structures.

203.5. MEASUREMENT: The asphaltic material for tack coat will be measured at point of delivery on the project in gallons at the applied temperature. The quantity to be paid for shall be the number of gallons of asphaltic material used, as directed, in the accepted tack coat. Water used with Emulsions will not be measured for payment.

203.6. PAYMENT: The work performed and materials furnished as prescribed by this item will be paid for at the contract unit price bid per gallon for “Tack Coat” which price shall be full compensation for cleaning the surface, for furnishing, heating, hauling and distributing the tack coat as specified; for all freight involved; and for all manipulations, labor, tools, equipment, and incidentals necessary to complete the work.

203.7. BID ITEM:

Item 203.1 - Tack Coat - per gallon
ITEM

205 HOT MIX ASPHALTIC CONCRETE PAVEMENT

205.1. DESCRIPTION: Construct a leveling-up course, a surface course or any combination of these courses as shown on the plans, each to be composed of a compacted mixture of mineral aggregate and asphaltic material. The pavement shall be constructed on the newly constructed subgrade or base course, existing pavement, bituminous surface or in the case of bridges, on the prepared floor slab, as herein specified and in accordance with the details shown on the plans.

205.2. MATERIALS: Materials used in Hot Mix Asphaltic Concrete Pavement shall meet the requirements as set forth herein. If shown on the plans, materials may also meet the requirements as described in Item 340, “Dense-Graded Hot-Mix Asphalt (Method)” or Item 341, “Dense-Graded Hot-Mix Asphalt (QC/QA)” of the Texas Department of Transportation Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges.

Unless otherwise shown on the plans, provide aggregates that meet the aggregate quality requirements of TxDOT’s Bituminous Rated Source Quality Catalog (BRSQC). Unapproved sources may be used if accepted by the Engineer and approved prior to use.

Furnish aggregates from sources that conform to the requirements shown in Table 1 herein, and as specified in this Section, unless otherwise shown on the plans. Provide aggregate stockpiles that meet the definition in this Section for either a coarse aggregate or fine aggregate. When reclaimed asphalt pavement (RAP) is used, provide RAP stockpiles in accordance with this Section. Aggregate from RAP is not required to meet Table 1 requirements unless otherwise shown on the plans.

Document all test results on a mixture design report and submit to the Engineer for approval. The Engineer may perform tests on independent or split samples to verify Contractor mix design results. Stockpile aggregates for each source and type separately. Determine aggregate gradations for mixture design and production testing based on the washed sieve analysis given in TxDOT standard laboratory test procedure Tex-200-F, Part II. Do not add material to an approved stockpile from other sources, unless otherwise approved by the Engineer.

Unless otherwise shown on the plans, reclaimed asphalt pavement (RAP) may be used in asphalt pavement maintenance or rehabilitation applications and shall be limited to a maximum of 20% RAP for surface or wearing courses and 30% RAP for courses below the surface or wearing course. Higher percentages of RAP may be used if requested in writing and approved by the Engineer prior to use.

A. Coarse Aggregate. Coarse aggregate stockpiles must have no more than 20% passing the #8 sieve. Provide aggregates with a surface aggregate classification (SAC) as shown below:

<table>
<thead>
<tr>
<th>Street Classification</th>
<th>Minimum Surface Aggregate Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary and Secondary Arterials</td>
<td>A</td>
</tr>
<tr>
<td>Collector and Local Type B Streets</td>
<td>B</td>
</tr>
<tr>
<td>Local Type A Street With Bus Traffic</td>
<td>B</td>
</tr>
<tr>
<td>Local Type A Street Without Bus Traffic</td>
<td>C</td>
</tr>
</tbody>
</table>
SAC requirements apply only to aggregates used on the surface of travel lanes, unless otherwise shown on the plans. Blending aggregates to meet SAC criteria is allowable. Class B aggregate meeting all other requirements in Table 1 may be blended with a Class A aggregate in order to meet requirements for Class A materials. When blending Class A and B aggregates to meet a Class A requirement, ensure that at least 50% by weight of the material retained on the No. 4 sieve comes from the Class A aggregate source. Blend by volume if the bulk specific gravities of the Class A and B aggregates differ by more than 0.300. When blending, do not use Class C or D aggregates. For blending purposes, coarse aggregate from RAP will be considered as Class B aggregate.

B. Reclaimed Asphalt Pavement (RAP). RAP is defined as a salvaged, pulverized, broken or crushed asphalt pavement. The RAP to be used in the mix shall be crushed or broken to the extent that 100% will pass the two inch sieve.

The stockpiled RAP shall not be contaminated by dirt or other objectionable materials. Unless otherwise shown on the plans, stockpiled, crushed RAP shall have a decantation of 5% or less and a plasticity index of eight (8) or less, when tested in accordance with TxDOT standard laboratory test procedures Tex-406-A, Part I, and Tex-106-E, respectively. This requirement applies to stockpiles from which the asphalt has not been removed by extraction. When RAP is used, determine asphalt content and gradation for mixture design purposes.

C. Fine Aggregate. Fine aggregates may consist of manufactured sands, screenings and field sands. Supply fine aggregates that are free from organic impurities. Field sands and other uncrushed aggregates shall be limited to 15% of the total aggregate.

If 10% or more of the fine aggregate stockpile is retained on the No. 4 sieve, test the stockpile and verify that it meets the requirements in Table 1 for coarse aggregate angularity (TxDOT standard laboratory test procedure Tex-460-A) and flat and elongated particles (TxDOT standard laboratory test procedure Tex-280-F).

D. Asphalt Binder. Unless shown on the plans, provide the type and grade of performance-graded asphalt binder in accordance with TxDOT Item 300.2.J. “Performance-Graded Binders” and as specified below:

<table>
<thead>
<tr>
<th>Street Classification</th>
<th>Minimum PG Asphalt Cement Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Surface Courses</td>
</tr>
<tr>
<td>Primary and Secondary Arterials</td>
<td>PG 76-22</td>
</tr>
<tr>
<td>Collector and Local Type B Streets</td>
<td>PG 70-22</td>
</tr>
<tr>
<td>Local Type A Street With Bus Traffic</td>
<td>PG 64-22</td>
</tr>
<tr>
<td>Local Type A Street Without Bus Traffic</td>
<td></td>
</tr>
</tbody>
</table>

E. Mineral Filler. Mineral filler consists of finely divided mineral matter such as agricultural lime, crusher fines, hydrated lime, cement, or fly ash. Mineral filler is allowed unless otherwise shown on the plans. Do not use more than 2% hydrated lime or cement, unless otherwise shown on the plans. The plans may require or disallow specific mineral fillers. When used, provide mineral filler that:

- is sufficiently dry, free-flowing, and free from clumps and foreign matter;
• does not exceed 3% linear shrinkage when tested in accordance with Tex-107-E; and
• meets the gradation requirements of Table 3 herein.

F. Baghouse Fines. Fines collected by the baghouse or other dust collecting equipment may be reintroduced into the mixing drum.

G. Tack Coat. Unless otherwise shown on the plans or approved, furnish CSS-1H, SS-1H, or a PG binder with a minimum high-temperature grade of PG 58 for tack coat binder and in accordance with Item 203, “Tack Coat.” Do not dilute emulsified asphalts at the terminal, in the field, or at any other location before use.

H. Additives. When shown on the plans, use the type and rate of additive specified. Other additives that facilitate mixing or improve the quality of the mixture may be allowed when approved. If lime or a liquid antistripping agent is used, add in accordance with TxDOT Item 301, “Asphalt Antistripping Agents.” Do not add lime directly into the mixing drum of any plant where lime is removed through the exhaust stream, unless the plant has a baghouse or dust collection system that reintroduces the lime back into the drum.

Table 1
Aggregate Quality Requirements

<table>
<thead>
<tr>
<th>Property</th>
<th>TxDOT Standard Laboratory Test Procedure</th>
<th>Surface Courses</th>
<th>Binder, Level Up, &amp; Base Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coarse Aggregate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deleterious Material, %, max</td>
<td>Tex-217-F, Part I</td>
<td>1.0</td>
<td>1.5</td>
</tr>
<tr>
<td>Decantation, %, max</td>
<td>Tex-217-F, Part II</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Micro-Deval Abrasion, %, max</td>
<td>Tex-461-A</td>
<td>Screening Only</td>
<td>Screening Only</td>
</tr>
<tr>
<td>Los Angeles Abrasion, %, max</td>
<td>Tex-410-A</td>
<td>35</td>
<td>40</td>
</tr>
<tr>
<td>Magnesium Sulfate Soundness, 5 cycles, %, max</td>
<td>Tex-411-A</td>
<td>25</td>
<td>30</td>
</tr>
<tr>
<td>Coarse Aggregate Angularity, 2 crushed faces, %, min</td>
<td>Tex-460-A, Part I</td>
<td>95¹</td>
<td>85¹</td>
</tr>
<tr>
<td>Flat and Elongated Particles @ 5:1, %, max</td>
<td>Tex-280-F</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Fine Aggregate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Linear Shrinkage, %, max</td>
<td>Tex-107-E</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Combined Aggregate²</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand Equivalent, %, min</td>
<td>Tex-203-F</td>
<td>45</td>
<td>45</td>
</tr>
</tbody>
</table>

Note 1: Applies to Gravel Only
Note 2: Aggregate without mineral filler, RAP, or additives combined as used in the job-mixed formula (JMF)

Table 2
Gradation Requirements for Fine Aggregates

<table>
<thead>
<tr>
<th>Sieve Size, in</th>
<th>% Passing by Weight or Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8</td>
<td>100</td>
</tr>
<tr>
<td>#8</td>
<td>70 – 100</td>
</tr>
<tr>
<td>#200</td>
<td>0 – 30</td>
</tr>
</tbody>
</table>

Table 3
Gradation Requirements for Mineral Filler

<table>
<thead>
<tr>
<th>Sieve Size, in</th>
<th>% Passing by Weight or Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>#8</td>
<td>100</td>
</tr>
<tr>
<td>#200</td>
<td>55 – 100</td>
</tr>
</tbody>
</table>
205.3. **EQUIPMENT:** All equipment for the handling of all materials, mixing, placing and compacting of the mixture shall be maintained in good repair and operating condition and subject to the approval of the Engineer. Any equipment found to be defective and potentially having a negative effect on the quality of the paving mixture or ride quality will not be allowed.

A. **Spreading and Finishing Machine.** The spreading and finishing machine shall be approved by the Engineer and shall meet the requirements indicated below.

1. **Screed Unit.** The spreading and finishing machine shall be equipped with a heated compacting screed. It shall produce a finished surface meeting the requirements of the typical cross sections and the surface test.

   Extensions added to the screed shall be provided with the same compacting action and heating capability as the main screed unit, except for use on variable depth tapered areas and/or as approved by the Engineer.

   The spreading and finishing machine shall be equipped with an approved automatic dual longitudinal screed control system and automatic transverse screed control system. The longitudinal controls shall be capable of operating from any longitudinal grade reference including a stringline, ski, mobile stringline, or matching shoe.

   The Contractor shall furnish all equipment required for grade reference. It shall be maintained in good operating condition by personnel trained in the use of this type of equipment.

   The grade reference used by the Contractor may be of any type approved by the Engineer. The contractor shall set the grade reference to have sufficient support so that the maximum deflection shall not exceed 1/16 inch between supports.

2. **Tractor Unit.** The tractor unit shall be equipped with a hydraulic hitch sufficient in design and capacity to maintain contact between the rear wheels of the hauling equipment and the pusher rollers of the finishing machine while the mixture is being unloaded.

   No portion of the weight of hauling equipment, other than the connection, shall be supported by the asphalt paver. No vibrations or other motions of the loading equipment, which could have a detrimental effect on the riding quality of the completed pavement, shall be transmitted to the paver.

   The use of any vehicle which requires dumping directly into the finishing machine and which the finishing machine cannot push or propel to obtain the desired lines and grades without resorting to hand finishing will not be allowed.

B. **Material Transfer Equipment.** Equipment to transfer mixture from the hauling units or the roadbed to the spreading and finishing machine will be allowed unless otherwise shown on the plans. A specific type of material transfer equipment shall be required when shown on the plans.

C. **Motor Grader.** The motor grader, when used, shall meet the requirements as shown in Item 220, “Blading.”

D. **Rollers.** Rollers provided shall meet the requirements for their type as shown in Item 210, “Rolling.”
205.4. **CONSTRUCTION:** It shall be the responsibility of the Contractor to design, produce, transport, place and compact the specified paving mixture in accordance with the requirements herein. The Engineer will perform verification testing as needed. Provide quality control (QC) testing as needed to meet the requirements of this Item. Provide a certified Level I-A specialist at the plant during production hours. Provide a certified Level I-B specialist to conduct placement tests.

A. **Quality Control Plan (QCP).** Unless otherwise shown on the plans, develop and follow a QCP. Obtain approval from the Engineer for changes to the QCP made during the project. The Engineer may suspend operations if the Contractor fails to comply with the QCP.

Submit a written QCP to the Engineer and receive the Engineer’s approval of the QCP before beginning production. Include the following items in the QCP.

1. **Project Personnel.** Provide:

   a. a list of individuals that will conduct tests as well their associated certifications (i.e. Level IA, IB, and II certifications), including when certifications will expire for each individual; and

   b. a list of individuals responsible for QC with authority to take corrective action and the contact information for each individual listed.

2. **Material Delivery and Storage.** Provide:

   a. the sequence of material processing, delivery, and minimum quantities to assure continuous plant operations;

   b. aggregate stockpiling procedures to avoid contamination and segregation;

   c. frequency, type, and timing of aggregate stockpile testing to assure conformance of material requirements before mixture production; and

   d. procedure for monitoring the quality and variability of asphalt binder.

3. **Production.** Detail:

   a. loader operation procedures to avoid contamination in cold bins;

   b. procedures for calibrating and controlling cold feeds;

   c. procedures to eliminate debris or oversized material;

   d. procedures for adding and verifying rates of each applicable mixture component (e.g., aggregate, asphalt binder, RAP, lime, liquid antistrip);

   e. procedures for reporting job control and acceptance test results; and

   f. procedures to avoid segregation and drain-down in the silo.

4. **Loading and Transporting.** Provide:

   a. the type and application method for release agents; and
b. truck loading procedures to avoid segregation.

5. Placement and Compaction. Provide:

a. the proposed agenda for mandatory pre-paving meeting including date and location;

b. the type and application method for release agents in the paver and on rollers, shovels, lutes, and other utensils;

c. procedures for the transfer of mixture into the paver while avoiding segregation and preventing material spillage;

d. the process to balance production, delivery, paving, and compaction to achieve continuous placement operations;

e. the paver operations (e.g., operation of wings, height of mixture in auger chamber) to avoid physical and thermal segregation and other surface irregularities; and

f. procedures to construct quality longitudinal and transverse joints.

B. Mixture Design. Use a Level II specialist certified by a TxDOT-approved hot-mix asphalt certification program to develop the mixture design. Have the Level II specialist sign the design documents. Unless otherwise shown on the plans, use the typical weight design example given in TxDOT standard laboratory test procedure Tex-204-F, Part I or Part III, to design a mixture meeting the requirements listed in Tables 1 through 5. At the request of the Engineer, furnish representative samples of all materials used in the mixture design for verification. If the design cannot be verified by the Engineer, furnish another mixture design. The Contractor may submit a new mixture design at anytime during the project. The Engineer will approve all mixture designs before the Contractor can begin production.

Provide the Engineer with a mixture design report that includes the following items:

- the combined aggregate gradation, source, specific gravity, and percent of each material used;
- results of all applicable tests;
- the mixing and molding temperatures;
- all applicable correlation and correction factors;
- the signature of the Level II person or persons who performed the design;
- the date the mixture design was performed; and
- a unique identification number for the mixture design.

The Hamburg Wheel Test is not required, unless otherwise shown on the plans. When required through plan note, the minimum number of passes shown in Table 6 shall be met, unless otherwise approved by the Engineer. The contractor will be responsible for submitting the results of the Hamburg Wheel test to the Engineer with the other mixture design data. Use an approved laboratory to perform the Hamburg Wheel test. The TxDOT Construction
Division maintains a list of approved laboratories that may be referenced. Hamburg Wheel Testing will not be performed or required for any Type “F” mixtures.

Table 4

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>A Coarse Base</th>
<th>B Fine Base</th>
<th>C Coarse Surface</th>
<th>D Fine Surface</th>
<th>E Fine Mixture</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-⅛&quot;</td>
<td>98.0–100.0</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>1&quot;</td>
<td>78.0–94.0</td>
<td>98.0–100.0</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>¾&quot;</td>
<td>64.0–85.0</td>
<td>84.0–98.0</td>
<td>95.0–100.0</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>½&quot;</td>
<td>50.0–70.0</td>
<td>—</td>
<td>—</td>
<td>98.0–100.0</td>
<td>—</td>
</tr>
<tr>
<td>¾&quot;</td>
<td>—</td>
<td>60.0–80.0</td>
<td>70.0–85.0</td>
<td>85.0–100.0</td>
<td>98.0–100.0</td>
</tr>
<tr>
<td>#4</td>
<td>30.0–50.0</td>
<td>40.0–60.0</td>
<td>43.0–63.0</td>
<td>50.0–70.0</td>
<td>70.0–90.0</td>
</tr>
<tr>
<td>#8</td>
<td>22.0–36.0</td>
<td>29.0–43.0</td>
<td>32.0–44.0</td>
<td>35.0–46.0</td>
<td>35.0–50.0</td>
</tr>
<tr>
<td>#30</td>
<td>8.0–23.0</td>
<td>13.0–28.0</td>
<td>14.0–28.0</td>
<td>15.0–29.0</td>
<td>12.0–27.0</td>
</tr>
<tr>
<td>#50</td>
<td>3.0–19.0</td>
<td>6.0–20.0</td>
<td>7.0–21.0</td>
<td>7.0–20.0</td>
<td>6.0–19.0</td>
</tr>
<tr>
<td>#200</td>
<td>2.0–7.0</td>
<td>2.0–7.0</td>
<td>2.0–7.0</td>
<td>2.0–7.0</td>
<td>2.0–7.0</td>
</tr>
</tbody>
</table>

Design Voids in the Mineral Aggregate (VMA), % minimum

|           | 12.0 | 13.0 | 14.0 | 15.0 | 16.0 |

Plant-Produced Voids in the Mineral Aggregate (VMA), % minimum

|           | 11.0 | 12.0 | 13.0 | 14.0 | 15.0 |

Table 5

<table>
<thead>
<tr>
<th>Property</th>
<th>TxDOT Standard Laboratory Test Procedure</th>
<th>Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target laboratory-molded density, %</td>
<td>Tex-207-F</td>
<td>96.5</td>
</tr>
</tbody>
</table>

Surface or Wearing Courses

<table>
<thead>
<tr>
<th></th>
<th>Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>96.5</td>
<td>Base, Binder, and Level Up Courses</td>
</tr>
<tr>
<td>97.0</td>
<td>Primary and Secondary Arterials</td>
</tr>
<tr>
<td>97.5</td>
<td>Collectors, Local Type B Streets, and Local Type A Street With Bus Traffic</td>
</tr>
<tr>
<td>98.0</td>
<td>Local Type A Street Without Bus Traffic</td>
</tr>
</tbody>
</table>

Boil test¹ Tex-530-C

¹ Used to establish baseline for comparison to production results. May be waived when approved.

Table 6

<table>
<thead>
<tr>
<th>High-Temperature Binder Grade</th>
<th>Minimum # of Passes² @ 0.5&quot; Rut Depth, Tested @ 122°F</th>
</tr>
</thead>
<tbody>
<tr>
<td>PG 64 or lower</td>
<td>5,000</td>
</tr>
<tr>
<td>PG 70</td>
<td>10,000</td>
</tr>
<tr>
<td>PG 76 or higher</td>
<td>20,000</td>
</tr>
</tbody>
</table>

¹ Tested in accordance with Tex-242-F.

² May be decreased if shown on the plans.

C. Job-Mix Formula. The laboratory mixture design shall be submitted to the Engineer for approval prior to production and placement. The submittal shall provide the laboratory
designed mixture target properties and data that demonstrate the contractor’s ability to produce the mixture within the tolerances specified in Table 7 herein either through a trial batch or by submittal of previous production data from a City or TxDOT project.

Once approved, the contractor may begin production and placement of the approved JMF. Results from Lot 1 of the JMF may be used to modify the optimum mixture properties as long as the tested properties are within the tolerances specified in Table 7 herein. Further adjustments to the JMF may be allowed by the Engineer during production and placement, if warranted. JMF adjustment requests must be made in writing to the Engineer and the mixture must conform to the master gradation limits for the mixture type and be within the operational limits of Table 7 noted above for the initial JMF approved by the Engineer.

<table>
<thead>
<tr>
<th>Description</th>
<th>Test Method</th>
<th>Allowable Difference from Current JMF Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual % Retained for #8 Sieve or Larger</td>
<td>Tex-200-F or Tex-236-F</td>
<td>±5.0(^1)</td>
</tr>
<tr>
<td>Individual % Retained for Sieves Smaller than #8 and Larger than #200</td>
<td>Tex-236-F</td>
<td>±3.0(^1)</td>
</tr>
<tr>
<td>% Passing the #200 Sieve</td>
<td>Tex-236-F</td>
<td>±2.0(^1)</td>
</tr>
<tr>
<td>Asphalt Content, %</td>
<td>Tex-207-F</td>
<td>±0.3(^2)</td>
</tr>
<tr>
<td>Laboratory-Molded Density, %</td>
<td>Tex-207-F</td>
<td>±1.0</td>
</tr>
<tr>
<td>VMA, % minimum</td>
<td>Note 3</td>
<td></td>
</tr>
</tbody>
</table>

Note 1: When within these tolerances, mixture production gradations may fall outside the master grading limits; however, the % passing the #200 sieve will be considered out of tolerance when outside the master grading limits.

Note 2: Tolerance between Laboratory Mix and Plant Trial Batch may exceed ±0.3.

Note 3: Test and verify that Table 4 requirements are met.

D. Production. Do not heat the asphalt binder above the temperatures specified in TxDOT Item 300, “Asphalts, Oils, and Emulsions,” or outside the manufacturer’s recommended values. Do not store an asphaltic mixture for a period long enough to affect the quality of the mixture, nor in any case longer than 12 hr.

Notify the Engineer of the target discharge temperature and produce the mixture within 25°F of the target. Monitor the temperature of the material in the truck before shipping to ensure that it does not exceed 350°F. The Engineer will not pay for, or allow placement of, any mixture produced at more than 350°F. Control the mixing time and temperature so that moisture is removed from the mixture before discharging from the plant. If requested, determine the moisture content by oven-drying in accordance with TxDOT standard laboratory test procedure Tex-212-F, Part II, and verify that the mixture contains no more than 0.2% of moisture by weight. Obtain the sample immediately after discharging the mixture into the truck, and perform the test promptly.

Perform a new trial batch when the plant or plant location is changed. The Engineer may suspend production for noncompliance with this Item. Take corrective action and obtain approval to proceed after any production suspension for noncompliance.

E. Tack Coat. The surface upon which the tack coat is to be placed shall be cleaned thoroughly to the satisfaction of the Inspector. The surface shall be given a uniform application of tack coat using asphaltic materials of this specification. Unless otherwise shown on the plans, tack
coat shall be applied with an approved sprayer at a rate directed by the Engineer between 0.04 and 0.10 gallon residual asphalt per square yard of surface.

F. **Transporting Asphalitic Concrete.** The asphalitic mixture shall be hauled to the work site in vehicles previously cleaned of all foreign material and with beds that do not discharge or lose materials during the haul. Trucks that do not meet the satisfaction of the Engineer or Inspector will not be allowed to deliver materials to City projects. The dispatching of the vehicles shall be arranged so that all material is delivered, placed, and rolled during daylight hours unless otherwise shown on the plans. In cool weather, or for long hauls, covering and insulating of the truck bodies may be required. If necessary, to prevent the mixture from adhering to the inside of the truck body, the inside of the truck may be given a light coating of release agent satisfactory to the Engineer.

G. **Placement.**

1. **Weather Conditions.** Place mixture, when placed with a spreading and finishing machine, or the tack coat when the roadway surface temperature is 60°F or higher unless otherwise approved. Measure the roadway surface temperature with a handheld infrared thermometer. Place mixtures only when weather conditions and moisture conditions of the roadway surface are suitable in the opinion of the Engineer.

   The asphalitic mixture, when placed with a motor grader, shall not be placed when the surface temperature is below 65°F and is falling, but may be placed when the surface temperature is above 55°F and is rising. The maximum depth of asphalt mixture placed with a motor grader will not exceed 5 inches of compacted material.

   Mat thicknesses of 1-½ inches and less shall not be placed when the temperature of the surface on which the mat is to be placed is below 60°F.

   It is further provided that the tack coat or asphalitic mixture shall be placed only when the humidity, general weather conditions, temperature and moisture condition of the base are suitable.

2. **Placement Temperature.** If, after being discharged from the mixer and prior to placing, the temperature of the asphalitic mixture falls below 200°F, all or any part of the load may be rejected and payment will not be made for the rejected material.

3. **Placement Operations.** Placement and laydown operations shall be in conformance with this section and Section 205.4.H. - “Quality Control and Acceptance.”

   Prepare the surface by removing raised pavement markers and objectionable material such as moisture, dirt, sand, leaves, and other loose impediments from the surface before placing mixture. Remove vegetation from pavement edges.

   The asphalitic mixture shall be dumped and spread on the approved prepared surface with the spreading and finishing machine. Place the mixture to meet the typical section requirements and produce a smooth, finished surface with a uniform appearance and texture. In addition, the placing of the asphalitic mixture shall be completed without tearing, shoving, gouging or segregating the mixture and without producing streaks in the mat.
Unloading into the finishing machine shall be controlled so that bouncing or jarring the spreading and finishing machine shall not occur and the required lines and grades shall be obtained without resorting to hand finishing.

When approved by the Engineer, level-up courses may be spread with a motor grader.

Construction joints of successive courses of asphaltic material shall be offset at least 6 inches. Construction joints on surface courses shall coincide with lane lines, or as directed by the Engineer.

The spreading and finishing machine shall be operated at a uniform forward speed consistent with the plant production rate, hauling capability, and roller train capacity to result in a continuous operation. The speed shall be slow enough that stopping between trucks is not ordinarily required. If, in the opinion of the Inspector, sporadic delivery of material is adversely affecting the mat, the Inspector may require paving operations to cease until acceptable methods are provided to minimize starting and stopping of the paver.

The hopper flow gates of the spreading and finishing machine shall be adjusted to provide an adequate and consistent flow of material. These shall result in enough material being delivered to the augers so that they are operating approximately 85 percent of the time or more. The augers shall provide means to supply adequate flow of material to the center of the paver. Augers shall supply an adequate flow of material for the full width of the mat, as approved by the Engineer. Augers should be kept approximately one-half to three-quarters full of mixture at all times during the paving operation.

When the asphaltic mixture is placed in a narrow strip along the edge of an existing pavement, or used to level up small areas of an existing pavement, or placed in small irregular areas where the use of a finishing machine is not practical, the finishing machine may be eliminated when authorized by the Engineer.

Adjacent to flush curbs, gutters and structures, the surface shall be finished uniformly high so that when compacted, it will be slightly above the edge of the curb or structure.

If a pattern of surface irregularities or segregation is detected, the Contractor shall make an investigation into the causes and immediately take the necessary action. With the approval of the Inspector, placement may continue for no more than one full production day from the time the Contractor is first notified and while corrective actions are being taken. If the problem still exists after that time, paving shall cease until the Contractor further investigates the causes and the Engineer approves further corrective action to be taken.

Place mixture within the compacted lift thickness shown in Table 8, unless otherwise shown on the plans or allowed.

Use the guidelines in Table 9 to establish the temperature of mixture delivered to the paver.
Table 8  
Compacted Lift Thickness and Required Core Height

<table>
<thead>
<tr>
<th>Mixture Type</th>
<th>Compacted Lift Thickness (Minimum (in.))</th>
<th>Compacted Lift Thickness (Maximum (in.))</th>
<th>Minimum Untrimmed Core Height (in.) Eligible for Testing</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>3.00</td>
<td>6.00</td>
<td>2.00</td>
</tr>
<tr>
<td>B</td>
<td>2.50</td>
<td>5.00</td>
<td>1.75</td>
</tr>
<tr>
<td>C</td>
<td>2.00</td>
<td>4.00</td>
<td>1.50</td>
</tr>
<tr>
<td>D</td>
<td>1.50</td>
<td>3.00</td>
<td>1.25</td>
</tr>
<tr>
<td>F</td>
<td>1.25</td>
<td>2.50</td>
<td>1.25</td>
</tr>
</tbody>
</table>

Table 9  
Suggested Minimum Mixture Placement Temperature

<table>
<thead>
<tr>
<th>High-Temperature Binder Grade</th>
<th>Minimum Placement Temperature (Before Entering Paver)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PG 64 or lower</td>
<td>260°F</td>
</tr>
<tr>
<td>PG 70</td>
<td>270°F</td>
</tr>
<tr>
<td>PG 76</td>
<td>280°F</td>
</tr>
<tr>
<td>PG 82 or higher</td>
<td>290°F</td>
</tr>
</tbody>
</table>

4. **Compaction.** The pavement shall be compacted thoroughly and uniformly with the necessary rollers to obtain the compaction and cross section of the finished paving mixture meeting the requirements of the plans and specifications.

The edges of the pavement along curbs, headers and similar structures, and all places not accessible to the roller, or in such positions as will not allow thorough compaction with the rollers, shall be thoroughly compacted with lightly oiled tamps.

Rolling with a trench roller will be required on widened areas, in trenches and other limited areas where satisfactory compaction cannot be obtained with the approved rollers.

a. **In-Place Compaction Control.** Use density control unless ordinary compaction control is specified on the plans. Use the control strip method given in Tex-207-F, Part IV, to establish the rolling pattern for density controlled areas.

Where specific density or air void requirements are waived, furnish and operate compaction equipment as approved.

Do not use pneumatic-tire rollers if excessive pickup of fines by roller tires occurs. Unless otherwise directed, use only water or an approved release agent on rollers, tamps, and other compaction equipment. Keep diesel, gasoline, oil, grease, and other foreign matter off the mixture.

When rolling with the three-wheel, tandem or vibratory rollers, it is recommended that rolling start by first rolling the joint with the adjacent pavement and then continue by rolling longitudinally at the sides and proceed toward the center of the pavement, overlapping on successive trips by at least 1 foot. Alternate trips of the roller should be slightly different in length. On super-elevated curves, rolling should begin at the low side and progress toward the high side.

When rolling with vibratory steel-wheel rollers, equipment operation shall be in accordance with Item 210, “Rolling”, and the manufacturer's recommendations, unless otherwise directed by the Engineer. Vibratory rollers shall not be left vibrating.
while not rolling or when changing directions. In addition, vibratory rollers shall not be allowed in the vibrating mode on mats with a plan depth of less than 1-1/2 inches, unless approved by the Engineer.

The motion of the rollers shall be slow enough to avoid other than usual initial displacement of the mixture. If any displacement occurs, it shall be corrected to the satisfaction of the Inspector. Ensure pavement is fully compacted before allowing rollers to stand on the pavement.

(1) Ordinary Compaction Control. One three-wheel roller, one pneumatic-tire roller, and one tandem roller shall be furnished for each compaction operation except as provided below or approved by the Engineer. The use of a tandem roller may be waived by the Engineer when the surface is already adequately smooth and further steel-wheel rolling is shown to be ineffective. With approval of the Engineer, the Contractor may substitute a vibratory roller for the three-wheel roller and/or the tandem roller. Use of at least one pneumatic-tire roller is required unless approved by the Engineer. Additional or heavier rollers shall be furnished if required by the Engineer.

Rolling patterns shall be established by the Contractor to achieve the maximum compaction. The selected rolling pattern shall be followed unless changes in the mixture or placement conditions occur which affect compaction. When changes in the mixture or placement conditions occur, a new rolling pattern shall be established.

(2) Density Compaction Control. Place and compact asphaltic concrete materials in accordance with the method specified in Section 205.4.H, “Quality Control and Acceptance.”

5. Compaction Cessation Temperature. Regardless of the method required for in-place compaction control, all rolling for compaction shall be completed before the mixture temperature drops below 175°F.

6. Opening to Traffic. Allow the compacted pavement to cool to 160°F or lower before opening to traffic unless otherwise directed. When directed, sprinkle the finished mat with water or limewater to expedite opening the roadway to traffic.

If the surface ravels, flushes, ruts or deteriorates in any manner prior to final acceptance of the work, it will be the Contractor's responsibility to correct this condition at their expense, to the satisfaction of the Inspector and in conformance with the requirements of this specification.

H. Quality Control and Acceptance. Control and acceptance of hot mixed asphaltic concrete pavement shall be followed as specified herein or as directed on the plans. The contractor shall conduct production and placement operations in accordance with the method specified. All testing will be conducted in accordance with the testing methods shown in Table 10.
<table>
<thead>
<tr>
<th>Description</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gradation including % passing the #200 sieve</td>
<td>Tex-200-F or Tex-236-F</td>
</tr>
<tr>
<td>Laboratory-molded density</td>
<td></td>
</tr>
<tr>
<td>VMA</td>
<td>Tex-207-F</td>
</tr>
<tr>
<td>Laboratory-molded bulk specific gravity</td>
<td></td>
</tr>
<tr>
<td>In-Place air voids</td>
<td></td>
</tr>
<tr>
<td>Segregation (density profile)</td>
<td>Tex-207-F, Part V</td>
</tr>
<tr>
<td>Longitudinal joint density</td>
<td>Tex-207-F, Part VII</td>
</tr>
<tr>
<td>Moisture content</td>
<td>Tex-212-F, Part II</td>
</tr>
<tr>
<td>Theoretical maximum specific (Rice) gravity</td>
<td>Tex-227-F</td>
</tr>
<tr>
<td>Asphalt content</td>
<td>Tex-236-F</td>
</tr>
<tr>
<td>Hamburg Wheel test</td>
<td>Tex-242-F</td>
</tr>
<tr>
<td>Thermal profile</td>
<td>Tex-244-F</td>
</tr>
<tr>
<td>Asphalt binder sampling and testing¹</td>
<td>Tex-500-C</td>
</tr>
<tr>
<td>Boil test¹</td>
<td>Tex-530-C</td>
</tr>
</tbody>
</table>

¹. The Engineer may waive the sampling and testing requirements at their discretion.

1. **Production Sampling and Testing.** For a given project, sample asphaltic concrete materials at the production facility every 500 tons for each mixture type supplied or as directed by the Engineer. Unless otherwise shown on the plans, a production facility that supplies the same mixture to multiple City projects on the same day will not be required to sample and test at the required frequency for every project. A single test report may be used on two or more projects to represent the quality of the mixture for that day’s production.

During production, do not exceed the operational tolerances in Table 7. Stop production if testing indicates tolerances are exceeded on:

- 3 consecutive tests on any individual sieve,
- 4 consecutive tests on any of the sieves, or
- 2 consecutive tests on asphalt content.

Suspend production and shipment of mixture if the asphalt content deviates from the current JMF by more than 0.5% for any test.

Begin production only when test results or other information indicate, to the satisfaction of the Engineer, that the next mixture produced will be within Table 7 tolerances.

The Contractor shall perform a Hamburg Wheel test at the direction of the Engineer at any time during production, including when the boil test indicates a change in quality from the materials submitted for the initial JMF. If the production sample fails the Hamburg Wheel test criteria in Table 6, suspend production until further Hamburg Wheel tests meet the specified values. The Engineer may require up to the entire sublot of any mixture failing the Hamburg Wheel test to be removed and replaced at the Contractor’s expense.

If the Hamburg Wheel test results in a “remove and replace” condition, the Contractor may request that the Engineer confirm the results by retesting the failing material. An Independent laboratory retained by the Engineer will perform the Hamburg Wheel tests.
and determine the final disposition of the material in question based on the initial test results.


a. In-Place Density. For every 500 tons of compacted asphaltic material or as directed by the Engineer, test the in-place density. The in-place density shall be in the range of 92.0% to 97.0% of the maximum density. Do not increase the asphalt content of the mixture to increase pavement density.

Unless otherwise shown on the plans, obtain 2 roadway specimens at each location selected by the Engineer for in-place density determination. Unless otherwise determined, the Engineer will witness the coring operation and measurement of the core thickness. Unless otherwise approved, obtain the cores within 1 working day after placement is completed. Obtain two 6 inch diameter cores side-by-side from within 1 foot of the location provided by the Engineer. For Type C, D and F mixtures, 4 inch diameter cores are allowed. Mark the cores for identification.

Visually inspect each core and verify that the current paving layer is bonded to the underlying layer. If an adequate bond does not exist between the current and underlying layer, take corrective action to insure that an adequate bond will be achieved during subsequent placement operations.

Immediately after obtaining the cores, dry the core holes and tack the sides and bottom. Fill the hole with the same type of mixture and properly compact the mixture. Repair core holes with other methods when approved.

If the core heights exceed the minimum untrimmed values listed in Table 8, trim the cores within 1 working day following placement operations unless otherwise approved. If the core height before trimming is less than the minimum untrimmed value shown in Table 8, decide whether or not to include the pair of cores in the density determination for that sublot. If the cores are to be included in density determination, trim the cores. If the cores will not be included in density determination, store untrimmed cores for the Engineer.

The Engineer will measure density in accordance with Tex-207-F and Tex-227-F. Before drying to a constant weight, cores may be predried using a vacuum device, or by other methods approved by the Engineer, to remove excess moisture. The Engineer will use the average density of the 2 cores to calculate the in-place density at the selected location.

If the in-place density in the compacted mixture is below 92% or greater than 97%, change the production and placement operations to bring the in-place density within requirements. The Engineer may suspend production until the in-place density is brought to the required level, and may require a test section as described below, before proceeding.

At the onset of production, or after production and placement operations have been altered to bring the in-place density into conformance, construct a test section of 1 lane-width and at most 0.2 miles in length to demonstrate that compaction to between 92.0% and 97.0% in-place density can be obtained. Continue this procedure until a test section with the correct density can be produced. The Engineer will allow only 2
test sections per day. When a test section producing satisfactory in-place air void content is placed, resume full production.

(1) **Shoulders and Ramps.** Shoulders and ramps are subject to in-place density testing, unless otherwise shown on the plans.

(2) **Miscellaneous Areas.** Miscellaneous areas include areas that are not generally subject to primary traffic, such as driveways, mailbox turnouts, crossovers, gores, spot level-up areas, and other similar areas. Miscellaneous areas also include level-ups and thin overlays if the layer thickness designated on the plans is less than the compacted lift thickness shown in Table 8.

Miscellaneous areas will not be included in the in-place density testing. Compact areas that are not subject to in-place air void determination in accordance with ordinary compaction control.

b. **Segregation (Density Profile).** If shown on the plans, test for segregation using density profiles in accordance with Tex-207-F, Part V. Provide the Engineer with the results of the density profiles as they are completed. Areas defined as “Miscellaneous Areas,” are not subject to density profile testing.

If density profiles are required by the plans, perform a density profile every time the screed stops, on areas that are identified by either the Contractor or the Engineer as having thermal segregation, and on any visibly segregated areas. If the screed does not stop, and there are no visibly segregated areas or areas that are identified as having thermal segregation, perform a minimum of 1 profile per 500 tons of compacted material or as directed by the Engineer.

Reduce the test frequency to a minimum of 1 profile per 2,000 tons of compacted material, or as directed by the Engineer, if 4 consecutive profiles are within established tolerances. Continue testing at this frequency unless a profile fails, at which point resume testing at a minimum frequency of 1 per 500 tons or as directed by the Engineer. The Engineer may further reduce the testing frequency based on a consistent pattern of satisfactory results.

Unless otherwise shown on the plans, the density profile is considered failing if it exceeds the tolerances in Table 11. No production or placement bonus will be paid for any subplot that contains a failing density profile. The Engineer may make as many independent density profile verifications as deemed necessary. The Engineer’s density profile results will be used when available.

Investigate density profile failures and take corrective actions during production and placement to eliminate the segregation. Suspend production if 2 consecutive density profiles fail, unless otherwise approved. Resume production after the Engineer approves changes to production or placement methods.
Table 11
Segregation (Density Profile) Acceptance Criteria

<table>
<thead>
<tr>
<th>Mixture Type</th>
<th>Maximum Allowable Density Range (Highest to Lowest)</th>
<th>Maximum Allowable Density Range (Average to Lowest)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type A &amp; Type B</td>
<td>8.0 pcf</td>
<td>5.0 pcf</td>
</tr>
<tr>
<td>Type C, Type D, &amp; Type F</td>
<td>6.0 pcf</td>
<td>3.0 pcf</td>
</tr>
</tbody>
</table>

c. **Longitudinal Joint Density.**

(1) **Informational Tests.** While establishing the rolling pattern, perform joint density evaluations and verify that the joint density is no more than 3.0 pounds per cubic foot below the density taken at or near the center of the mat. Adjust the rolling pattern if needed to achieve the desired joint density. Perform additional joint density evaluations at least once per sublot unless otherwise directed.

(2) **Record Tests.** If shown on the plans, for each 500 tons of compacted material or as directed by the Engineer, perform a joint density evaluation at each pavement edge that is or will become a longitudinal joint. Determine the joint density in accordance with Tex-207-F, Part VII. Record the joint density information and submit results to the Engineer. The evaluation is considered failing if the joint density is more than 3.0 pounds per cubic foot below the density taken at the core random sample location and the correlated joint density is less than 90.0%. The Engineer may make independent joint density verifications at the random sample locations. The Engineer’s joint density test results will be used when available.

Investigate joint density failures and take corrective actions during production and placement to improve the joint density. Suspend production if 2 consecutive evaluations fail unless otherwise approved. Resume production after the Engineer approves changes to production or placement methods.

d. **Recovered Asphalt DSR.** The Engineer may take production samples or cores from suspect areas of the project to determine recovered asphalt properties. Asphalt binders with an aging ratio greater than 3.5 do not meet the requirements for recovered asphalt properties and may be deemed defective when tested and evaluated by the Engineer. The aging ratio is the dynamic shear rheometer (DSR) value of the extracted binder divided by the DSR value of the original unaged binder (including RAP binder). DSR values are obtained according to AASHTO T 315 at the specified high temperature performance grade of the asphalt. The binder from RAP will be included proportionally as part of the original unaged binder. The Engineer may require removal and replacement of the defective material at the Contractor’s expense. The asphalt binder will be recovered for testing from production samples or cores using Tex-211-F.

e. **Irregularities.** Immediately take corrective action if surface irregularities, including but not limited to segregation, rutting, raveling, flushing, fat spots, mat slippage, color, texture, roller marks, tears, gouges, streaks, or uncoated aggregate particles, are detected.

The Engineer may allow placement to continue for at most 1 day of production while taking appropriate action. If the problem still exists after that day, suspend paving until the problem is corrected to the satisfaction of the Engineer.
At the expense of the Contractor and to the satisfaction of the Engineer, remove and replace any mixture that does not bond to the existing pavement or that has other surface irregularities identified above.

3. **Individual Loads of Hot Mix.** The Engineer can reject individual truckloads of hot mix. When a load of hot mix is rejected for reasons other than temperature, the Contractor may request that the rejected load be tested. Make this request within 4 hr. of rejection. The Engineer will sample and test the mixture. If test results are within the operational tolerances shown in Table 7, payment will be made for the load. If test results are not within operational tolerances, no payment will be made for the load and the Engineer may require removal.

4. **Ride Quality.** When required by the plans, measure ride quality in accordance with TxDOT Standard Specification Item 585, “Ride Quality for Pavement Surfaces.” Surface Test Type A or B as well as Pay Schedule 1, 2, or 3 shall also be indicated on the plans.

205.5. **MEASUREMENT:** Hot Mix Asphaltic Concrete Pavement shall be measured by square yard, complete in place, for the thickness specified on the plans. Limits of payment will be from face of curb to face of curb. Pavement area shall not exceed the limits shown on the plans without written authorization.

205.6. **PAYMENT:** The work performed and materials furnished, as described by this item and measured as provided herein, shall be paid for at the contract unit bid price per square yard specified on the plans of “Hot Mix Asphaltic Concrete Pavement,” which price shall be full compensation for furnishing and placing all materials, and for all labor, tools, equipment, and incidentals necessary to complete the work. The prime coat and tack coat, when required, shall be paid under the provisions of Item Nos. 202 and 203, respectively.

Trial batches will not be paid for unless they are incorporated into pavement work approved by the Engineer.

Pay adjustment for ride quality, when required on the plans, will be determined in accordance with TxDOT Standard Specification Item 585, “Ride Quality for Pavement Surfaces.”

205.7. **BID ITEM:**

- Item 205.1 - Hot Mix Asphaltic Pavement Type A - per square yard __ inches pavement thickness
- Item 205.2 - Hot Mix Asphaltic Pavement Type B - per square yard __ inches pavement thickness
- Item 205.3 - Hot Mix Asphaltic Pavement Type C - per square yard __ inches pavement thickness
- Item 205.4 - Hot Mix Asphaltic Pavement Type D - per square yard __ inches pavement thickness
- Item 205.5 - Hot Mix Asphaltic Pavement Type F - per square yard __ inches pavement thickness
ITEM

207 SINGLE COURSE BITUMINOUS SLURRY SEAL

207.1. DESCRIPTION: The work covered by this specification includes the design, testing, construction and quality control required for the proper application of slurry seal surface.

207.2. APPLICABLE SPECIFICATIONS AND TEST METHODS:

A. Agencies.

AASHTO: American Association of State Highways and Transportation Officials
ASTM: American Society for Testing and Materials
ISSA: International Slurry Surfacing Association

B. Aggregate and Mineral Filler.

<table>
<thead>
<tr>
<th>AASHTO</th>
<th>ASTM</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>T2</td>
<td>D75</td>
<td>Sampling Mineral Aggregates</td>
</tr>
<tr>
<td>T27</td>
<td>C136</td>
<td>Sieve Analysis of Aggregates</td>
</tr>
<tr>
<td>T11</td>
<td>C117</td>
<td>Materials Finer than No. 200 in Mineral Aggregates</td>
</tr>
<tr>
<td>T176</td>
<td>D2419</td>
<td>Sand Equivalent Value of Soils and Fine Aggregate</td>
</tr>
<tr>
<td>T84</td>
<td>C128</td>
<td>Specific Gravity and Absorption of Fine Aggregate</td>
</tr>
<tr>
<td>T19</td>
<td>C29</td>
<td>Unit Weight of Aggregate</td>
</tr>
<tr>
<td>T96</td>
<td>C131</td>
<td>Resistance to Abrasion of Small-Size Coarse Aggregate by Use of the Los Angeles Machine</td>
</tr>
<tr>
<td>T37</td>
<td>D546</td>
<td>Sieve Analysis of Mineral Filler</td>
</tr>
<tr>
<td>T104</td>
<td>C88</td>
<td>Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate</td>
</tr>
<tr>
<td>N/A</td>
<td>D242</td>
<td>Mineral Filler for Bituminous Paving Mixtures</td>
</tr>
<tr>
<td>T127</td>
<td>C183</td>
<td>Sampling Hydraulic Cement</td>
</tr>
</tbody>
</table>

C. Emulsified Asphalt.

<table>
<thead>
<tr>
<th>AASHTO</th>
<th>ASTM</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>T40</td>
<td>D140</td>
<td>Sampling Bituminous Materials</td>
</tr>
<tr>
<td>T59</td>
<td>D244</td>
<td>Testing Emulsified Asphalt</td>
</tr>
<tr>
<td>M140</td>
<td>D977</td>
<td>Specification for Emulsified Asphalt</td>
</tr>
<tr>
<td>M280</td>
<td>D2397</td>
<td>Mixing, Setting and Water Resistance Test To Identify A Quick-Set Emulsified Asphalt</td>
</tr>
</tbody>
</table>

D. Residue From Emulsion.

<table>
<thead>
<tr>
<th>AASHTO</th>
<th>ASTM</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>T59</td>
<td>D244</td>
<td>Residue by Evaporation</td>
</tr>
<tr>
<td>T49</td>
<td>C2397</td>
<td>Penetration 3.5 oz (100 gm) at 5 Seconds 77°F (25°C)</td>
</tr>
</tbody>
</table>
E. Slurry Seal System.

<table>
<thead>
<tr>
<th>ASTM</th>
<th>ISSA</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/A</td>
<td>TB 101</td>
<td>Guide for Sampling Slurry Mix for Extraction Test</td>
</tr>
<tr>
<td>N/A</td>
<td>TB 106</td>
<td>Measurement of Slurry Seal Consistency</td>
</tr>
<tr>
<td>N/A</td>
<td>TB 109</td>
<td>Test Method for Measurement of Excess Asphalt in Bituminous Mixtures by Use of a Loaded-Wheel Tester</td>
</tr>
<tr>
<td>N/A</td>
<td>TB 111</td>
<td>Outline Guide Design Procedure for Slurry Seal</td>
</tr>
<tr>
<td>N/A</td>
<td>TB 112</td>
<td>Method of Estimate Slurry Seal Spread Rates and To Measure Pavement Macrotecture</td>
</tr>
<tr>
<td>N/A</td>
<td>TB 114</td>
<td>Wet Stripping Test for Cured Slurry Seal Mixes</td>
</tr>
<tr>
<td>N/A</td>
<td>TB 115</td>
<td>Determination of Slurry Seal Compatibility</td>
</tr>
<tr>
<td>N/A</td>
<td>TB 39</td>
<td>Method of Classified Emulsified Asphalt, Aggregate Mixtures by Modified Cohesion Test Measurement of Set and Cure Characteristics</td>
</tr>
<tr>
<td>D3910</td>
<td>N/A</td>
<td>Design, Testing, and Construction of Slurry Seal</td>
</tr>
<tr>
<td>D2172</td>
<td>N/A</td>
<td>Quantitative Extraction of Bitumen for Bituminous Paving Mixtures</td>
</tr>
</tbody>
</table>

207.3. MATERIALS: Provide materials in conformance with the following Items and requirements:

A. General. The slurry seal shall consist of a mixture of an approved emulsified asphalt, mineral aggregate, mineral filler, water and specified additives, proportioned, mixed and uniformly spread over a properly prepared surface. The completed slurry seal shall leave a homogenous mat, adhere firmly to the prepared surface and have a skid resistant surface texture.

B. Asphalt Emulsion. The emulsion shall be SS-1H or CRS-2H in conformance with TxDOT Item 300, Section 2.D. “Emulsified Asphalt” with a 4% Latex additive milled into the emulsion by the emulsion manufacturer. All shipments of latex modified emulsion shall be accompanied by a shipping ticket and a certificate of compliance which shall be provided to the Engineer.

<table>
<thead>
<tr>
<th>AASHTO</th>
<th>ASTM</th>
<th>Title</th>
<th>Specification Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>T59</td>
<td>D244</td>
<td>Residue After Distillation</td>
<td>60% Minimum</td>
</tr>
<tr>
<td>T49</td>
<td>C2397</td>
<td>Penetration at 77°F (25°C)</td>
<td>40 – 90</td>
</tr>
</tbody>
</table>

C. Mineral Aggregate. Provide a crushed aggregate from a single source meeting the requirements of Table 1 and Table 2. Unless otherwise shown on the plans, furnish aggregate with a minimum “B” Surface Aggregate Classification (SAC) as defined in TxDOT’s Bituminous Rated Source Quality Catalog (BRSQC). Include the amount of mineral filler added to the mix in determining the total minus No. 200 aggregate fraction.
Table 1

Aggregate Gradation Requirements
Tex-200-F, Part II (Washed)

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Type I</th>
<th>Type II</th>
<th>Type III</th>
</tr>
</thead>
<tbody>
<tr>
<td>½”</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3/8”</td>
<td>0</td>
<td>0</td>
<td>0 – 1</td>
</tr>
<tr>
<td>#4</td>
<td>0 – 10</td>
<td>6 – 14</td>
<td></td>
</tr>
<tr>
<td>#8</td>
<td>0 – 10</td>
<td>10 – 35</td>
<td>35 – 55</td>
</tr>
<tr>
<td>#16</td>
<td>10 – 35</td>
<td>30 – 55</td>
<td>54 – 75</td>
</tr>
<tr>
<td>#30</td>
<td>35 – 60</td>
<td>50 – 70</td>
<td>65 – 85</td>
</tr>
<tr>
<td>#50</td>
<td>58 – 75</td>
<td>70 – 82</td>
<td>75 – 90</td>
</tr>
<tr>
<td>#100</td>
<td>70 – 85</td>
<td>79 – 90</td>
<td>82 – 93</td>
</tr>
<tr>
<td>#200</td>
<td>80 – 90</td>
<td>85 – 95</td>
<td>85 – 95</td>
</tr>
</tbody>
</table>

Table 2

Aggregate Quality Requirements

<table>
<thead>
<tr>
<th>Property</th>
<th>TxDOT Standard Laboratory Test Method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnesium sulfate soundness, %, max.¹</td>
<td>Tex-411-A</td>
<td>30</td>
</tr>
<tr>
<td>Sand equivalent value, %, min.</td>
<td>Tex-203-F</td>
<td>70</td>
</tr>
<tr>
<td>Los Angeles abrasion, %, max</td>
<td>Tex-410-A</td>
<td>30</td>
</tr>
</tbody>
</table>

¹. Use design gradation for the soundness test.

D. **Mineral Filler.** Provide mineral filler that is free of lumps and foreign matter consisting of non-air-entrained cement meeting the requirements of DMS-4600, “Hydraulic Cement,” or hydrated lime meeting the requirements of DMS-6350, “Lime and Lime Slurry.” The type and amount of mineral filler needed shall be determined by a laboratory mix design and will be considered as part of the aggregate gradation. An increase or decrease of less than one percent (1%) may be permitted when the micro-surfacing is being placed if it is found to be necessary for better consistency or set times.

E. **Water.** Provide water that is potable and free of harmful soluble salts.

F. **Other Additives.** Use approved additives as recommended by the emulsion manufacturer in the emulsion mix or in any of the component materials when necessary to adjust mix time in the field.

G. **F. Job-Mix Formula (JMF).** Provide a mix design conforming to the proportions shown in Table 3 and meeting the requirements shown in Table 4. The mix design is subject to verification using laboratory produced mixes or trial batch mix before approval.

Provide emulsion and aggregate that are compatible so that the mixing process will completely and uniformly coat the aggregate. Design the mix so that the mixture will have sufficient working life to allow for proper placement at the predicted ambient temperature and humidity.
### Table 3

#### JMF Proportions

<table>
<thead>
<tr>
<th>Material</th>
<th>Proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residual Asphalt</td>
<td>Type I - 10.0 to 16.0% by wt. of dry aggregate</td>
</tr>
<tr>
<td></td>
<td>Type II &amp; III – 6.0 to 9.0% by wt. of dry aggregate</td>
</tr>
<tr>
<td>Mineral Filler (Hydraulic Cement or Hydrated Lime)</td>
<td>0.5 to 3.0% by wt. of dry aggregate</td>
</tr>
<tr>
<td>Field Control Additive</td>
<td>As required to provide control of break and cure</td>
</tr>
<tr>
<td>Water</td>
<td>As required to provide proper consistency</td>
</tr>
</tbody>
</table>

### Table 4

#### JMF Requirements

<table>
<thead>
<tr>
<th>Property</th>
<th>TxDOT Standard Laboratory Test Method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wet track abrasion, g/sq. ft., max. wear value</td>
<td>Tex-240-F, Part IV</td>
<td>75</td>
</tr>
<tr>
<td>Gradation (aggregate and mineral filler)</td>
<td>Tex-200-F, Part II (Washed)</td>
<td>Table 1</td>
</tr>
<tr>
<td>Mix time, controlled to 120 sec.</td>
<td>Tex-240-F, Part I</td>
<td>Pass</td>
</tr>
</tbody>
</table>

### H. Rate of Application.

The slurry seal mixture shall be of the proper consistency at all times, so as to provide the application rate required by the surface condition. Suggested application rates are based upon the weight of dry aggregate in the mixture. Application rates are affected by the unit weight of the aggregate.

Unless a specific aggregate type and application rate are shown in the plans, the following recommended aggregate types and average single application rates are suggested for the various street classifications and situations:

<table>
<thead>
<tr>
<th>Aggregate Type</th>
<th>Suggested Placement Locations</th>
<th>Suggested Application Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type I</td>
<td>Local Type A w/o Bus Traffic</td>
<td>8 - 12 lb/yd²</td>
</tr>
<tr>
<td>Type II</td>
<td>Local Type A and B Streets</td>
<td>10 - 20 lb/yd²</td>
</tr>
<tr>
<td>Type III</td>
<td>Collectors and Arterials</td>
<td>15 - 30 lb/yd²</td>
</tr>
<tr>
<td></td>
<td>Wheel Ruts</td>
<td>See Section 239.4.K., “Ruts”</td>
</tr>
</tbody>
</table>

### 207.4. EQUIPMENT:

All methods employed in performing the work and all equipment, tools, and machinery used for handling the material and executing any part of the work shall be subject to the approval of the Engineer before the work is started, and whenever found unsatisfactory they shall be changed and improved as required. All equipment, tools, machinery and containers used must be kept clean and maintained in a satisfactory condition.

### A. Mixing Equipment.

Furnish a self-propelled slurry seal mixing machine with:

- self-loading devices to promote continuous laying operations;
- sufficient storage capacity for mixture materials;
- individual volume or weight controls that will proportion each material to be added to the mix;
- continuous flow mixing with a revolving multi-blade mixer capable of discharging the mixture on a continuous flow basis;
- opposite side driving stations;
• full hydrostatic control of the forward and reverse speed during operation;
• a water pressure system and nozzle-type spray bar immediately ahead of the spreader box and capable of spraying the roadway for the width of the spreader box;
• a mechanical-type spreader box equipped with paddles or other devices capable of agitating and spreading the materials throughout the box;
• a spreader box with devices capable of providing lateral movement or side shift abilities; and
• a spreader box with a front seal and adjustable rear strike-off. Provide an adjustable secondary rear strike-off, if required.

Calibrate and properly mark each control device that proportions the individual materials. Equip the aggregate feed with a revolution counter or similar device capable of determining the quantity of aggregate used at all times. Provide a positive-displacement-type emulsion pump with a revolution counter or similar device capable of determining the quantity of emulsion used at all times. Provide an approved mineral filler feeding system capable of uniformly and accurately metering the required material.

B. Scales. Scales used for weighing aggregates and emulsion must meet all requirements of TxDOT Item 520, “Weighing and Measuring Equipment.” The weighing equipment for aggregates may be either a suspended hopper or a belt scale.

C. Asphalt Storage and Handling Equipment. When storage tanks are used, furnish a thermometer in each tank to indicate the asphalt temperature continuously. Keep equipment clean and free of leaks. Keep asphalt materials free from contamination.

D. Cleaning Equipment. Power brooms and blowers, air compressors, vacuum sweepers, water flushing equipment, and hand brooms shall be suitable for cleaning the pavement surface and cracks therein.

E. Auxiliary Equipment. Hand squeegees, shovels and other equipment shall be provided as necessary to perform the work.

207.5. CONSTRUCTION:

A. General. Produce, transport, and place slurry seal as specified in this Item or on the plans. The slurry mixture shall be of the desired consistency as it leaves the mixer and no additional elements shall be added. No lumping, balling, or unmixed aggregate shall be permitted. No segregation of the emulsion and aggregate fines from the coarse aggregate will be permitted.

If the coarse aggregate settles to the bottom of the mix, the slurry will be removed from the pavement. Care shall be taken not to overload the spreader box, which shall be towed at a slow and uniform rate not to exceed 5 miles per hour. The action of the squeegee in the spreader box shall permit free flow of the slurry into all surface voids and cracks. A sufficient amount of slurry seal shall be fed to the box to keep a full supply against the full width of the squeegee. The mixture shall not be permitted to overflow the front sides of the spreader box. Adjacent lanes shall be lapped at the edges a minimum dimension which will provide complete sealing at the overlap.
The fresh mix shall be protected by barricades and markers to permit drying. In areas where the spreader box cannot be used, the slurry shall be applied by means of hand squeegees. Any joints or cracks that are not filled by the slurry mixture shall be corrected by use of hand squeegees. Upon completion of the work, the slurry seal shall have no holes, bare spots, or cracks through which liquids or foreign matter could penetrate to the underlying pavement. The finished surface shall present a uniform and skid resistant appearance satisfactory to the Engineer. All wasted and unused material and all debris shall be removed from the site prior to final acceptance. Ensure that the finished surface has a uniform texture and the slurry seal mat is fully adhered to the underlying pavement.

B. Temporary Material Storage.

1. **Aggregate Storage.** Stockpile materials in a manner that will prevent segregation or contamination. Remix stockpiles with suitable equipment when necessary to eliminate segregation. Use a scalping screen while transferring aggregates to the mixing machine to remove oversize material.

2. **Mineral Filler Storage.** Store the mineral filler in a manner that will keep it dry and free from contamination.

3. **Asphalt Material Storage.** Keep asphalt materials free from contamination.

C. Weather Limitations. Place the material when the atmospheric temperature is at least 50°F and rising and the surface temperature is at least 50°F. Cease placement when the atmospheric temperature is below 60°F and falling, when weather is foggy or rainy, or when rain is imminent as determined by the Engineer. Cease placement 24 hr. before forecasted temperatures below 32°F.

No slurry shall be applied under the following conditions:

1. While puddles of water remain on the pavement surface to be sealed.

2. When the weather is foggy.

3. If there is a chance of rain before it can be cured properly.

Slurries that cure by evaporation should not be laid during periods of abnormally high humidity.

Any uncured slurry that is washed away from the roadway by rain or other water sources into yards, driveways, sidewalks, parkways, etc., shall be removed and cleaned by the Contractor at his expense. Open or underground drainage systems shall be removed and cleaned as directed by the Engineer at the Contractor's expense.

D. Surface Preparation. The Engineer shall approve the surface preparation prior to surfacing. No dry aggregate either spilled from the lay-down machine or existing on the road, will be permitted.

1. **Surface Cleaning.** Thoroughly clean the surface of all vegetation, loose aggregate, and soil. Remove existing raised pavement markers. When existing surface conditions require, provide a water spray immediately ahead of the spreader box. Apply water at a rate that will dampen the entire surface without any free-flowing water ahead of the
spreader box. If water is used, cracks shall be allowed to dry thoroughly before applying slurry seal.

2. **Protection.** Manholes, valve boxes, drop inlets and other service entrances shall be protected from the slurry seal by a suitable method. The Contractor shall cover all raised pavement markers in a manner to protect and insure the integrity of the markers prior to placing the slurry seal and shall remove such covers after the completion of microsurfacing so that the markers will remain fully functional. Any markers damaged by the Contractor’s operations shall be repaired or replaced at no cost to the City.

3. **Tack Coat.** The Engineer may require a tack coat if the surface to be covered is extremely dry and raveled, or is concrete or brick. If required by the Engineer, the tack coat should consist of one part emulsified asphalt/three parts water. The emulsified asphalt should be the same as used in the mix. The distributor shall be capable of applying the dilution evenly at a rate of 0.05 to 0.10 gal/yd². The tack coat shall be allowed to cure before application of the slurry seal.

4. **Crack Pre-Treatment.** If shown on the plans, pre-treat the cracks in the surface with an acceptable crack sealer prior to the application of the micro-surfacing.

E. **Material Transfer.** Minimize construction joints by providing continuous loading of material while placing slurry seal. Ensure that oversized material has been removed prior to transferring the aggregates to the mixing machine.

F. **Placing.** Spread the mixture uniformly to the lines and grades shown on the plans or as directed by means of a mechanical type spreader box. Shift the spreader box when necessary to maintain proper alignment. Clean the spreader box as necessary to minimize clumps. Set and maintain the spreader box skids to prevent chatter in the finished mat. Prevent loss of material from the spreader box by maintaining contact between the front seal and the road surface. Adjust the rear seal to provide the desired spread. Adjust the secondary strike-off, if present, to provide the desired surface texture.

G. **Curing.** Protect the finished mat from traffic until the mix cures and will not be damaged by traffic. Adjust mixture properties according to humidity conditions and ambient air temperatures to allow uniformly moving traffic on completed travel lanes within 1 hr. after placement with no damage to the surface. Protect other locations subject to sharp turning or stopping and starting traffic for longer periods when necessary.

H. **Production Testing.** Provide access to the mixing unit discharge stream for sampling purposes. Produce a slurry seal mixture that will meet the tolerances specified in Table 5. Remove and replace or use other approved means to address material that does not meet these requirements, at no additional cost.

---

**Table 5**

<table>
<thead>
<tr>
<th>Property</th>
<th>TxDOT Standard Laboratory Test Method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asphalt content, % by wt.</td>
<td>Tex-236-F1 or asphalt meter readings</td>
<td>Design target ±0.5% and within limits of Table 1</td>
</tr>
</tbody>
</table>
| Gradation, % retained | Tex-200-F, Part II (washed)¹      | #8 sieve and larger: ±5 from design gradation. 
|                  |                                       | #16 sieve and smaller: ±3 from design gradation.²     |

¹. Dried to constant wt. at 230°F ±10°F.
². Material passing #200 sieve including the mineral filler must conform to the limitations of the master gradation shown in Table 1.

---

June 2008  Item 207 Single Course Bituminous Slurry Seal
I. **Workmanship.** Remove and replace slurry material exhibiting evidence of poor workmanship at no additional cost.

1. **Finished Surface.** Provide a finished surface that has a uniform texture free from excessive scratch marks, tears, or other surface irregularities. Marks, tears, or irregularities are considered excessive if:
   - more than 1 is at least ¼ inch wide and at least 10 feet long in any 100 feet of machine pull,
   - more than 3 are at least ½ inch wide and more than 6 inches long in any 100 feet of machine pull, or
   - any are 1 inch wide or wider and more than 4 inches in length.

2. **Construction Joints.** Place longitudinal joints on lane lines unless otherwise directed. Provide longitudinal and transverse joints that are uniform and neat in appearance. Provide construction joints that have limited buildup and that have no gaps between applications. Joints with buildup will be considered acceptable if:
   - no more than ½ inch vertical space exists between the pavement surface and a 4 foot straightedge placed perpendicular to the longitudinal joint and
   - no more than ¼ inch vertical space exists between the pavement surface and a 4 foot straightedge placed perpendicular to the transverse joint.

3. **Edges.** Provide an edge along the roadway centerline, lane lines, shoulder, edge of pavement, or curb line that is uniform and neat in appearance. The edge is considered acceptable when:
   - it varies no more than ±3 inches from a 100 foot straight line on a tangent section and
   - it varies no more than ±3 inches from a 100 foot arc on a curved section.

J. **Miscellaneous Areas.** Use a single-batch-type lay-down machine or other approved method to place materials on ramps or other short sections. Lightly dampen the surface before placing the mix. Provide 100% coverage that is uniform in appearance and comparable to that produced by the spreader box.

207.6. **MEASUREMENT:** Slurry seal will be measured by the ton or square yard of the composite single course bituminous slurry seal as shown in the plans. The composite slurry seal mixture is defined as the asphalt emulsion, aggregate, and mineral filler.

A. **Aggregate.** The quantity of aggregate used in the accepted portion of work will be measured by net ticket weight of each individual load of aggregate based on dry weight of aggregate. Weigh the aggregate at the project stockpile site unless otherwise approved. Use either a suspended hopper scale or a belt scale meeting the requirements of TxDOT Item 520, “Weighing and Measuring Equipment.” The calculated weight of mineral filler based on the accepted portion of work will be used for measurement and included in the total aggregate weight.
B. **Asphalt Emulsion With Latex Additive.** The quantity of asphalt emulsion with latex in the accepted portion of work will be measured by the ton of material based on the accepted load tickets issued from the manufacturer. At the completion of the project, any unused emulsion will be weighed back and deducted from the accepted asphalt emulsion quantity delivered.

207.7. **PAYMENT:** The work performed and materials furnished in accordance with this Item and measured as provided under “Measurement” will be paid for at the unit price bid per ton or square yard for “Slurry Seal.” This price is full compensation for preparing the existing surface (including removing existing raised pavement markers); furnishing, hauling, preparing, and placing materials; and equipment, labor, tools, and incidentals.

207.8. **BID ITEM:**

- Item 207.1 - Single Course Bituminous Slurry Seal - per square yard
- Item 207.2 - Single Course Bituminous Slurry Seal - per ton
ITEM

208 SALVAGING, HAULING & STOCKPILING RECLAIMABLE ASPHALTIC PAVEMENT

208.1. DESCRIPTION: Salvage, by milling existing asphalt concrete pavement or asphalt-stabilized base, haul, and stockpile existing asphalt material.

208.2. EQUIPMENT: The Engineer may require demonstration of the equipment’s capabilities.

A. Milling (Planing) Machine. Use milling (planning) machines that:
   1. have a minimum 6 foot cutting width except for work areas less than 6 feet wide;
   2. are self-propelled with sufficient power, traction, and stability to maintain an accurate depth of cut and slope;
   3. can cut in 1 continuous operation:
      a. 4 inches of asphalt concrete pavement,
      b. 1 inch of concrete pavement,
      c. or a combination of 2 inches of asphalt concrete pavement and ½ inch of concrete pavement;
   4. use dual longitudinal controls capable of operating on both sides automatically from any longitudinal grade reference, which includes string line, ski, mobile string line, or matching shoe;
   5. use transverse controls with an automatic system to control cross slope at a given rate;
   6. use integral loading and reclaiming devices to allow cutting, removal, and discharge of the material into a truck in one operation; and
   7. include devices to control dust created by the cutting action.

B. Manual System. Use a manual system that can achieve a uniform depth of cut, flush to all inlets, valve covers, manholes, and other appurtenances within the paved area. Use of a manual system is allowed for areas restricted to self-propelled access and for detail pavement removal.

C. Sweeper. Unless otherwise approved, use a street sweeper to remove cuttings and debris from the planed or textured pavement. Equip the sweeper with a water tank, dust control spray assembly, both a pick-up and a gutter broom, and a debris hopper.

208.3. CONSTRUCTION: Remove dirt, raised pavement markings, and other debris, as directed. Unless otherwise shown on the plans, ensure that 95% of the reclaimed material passes a 2 inch sieve. Do not contaminate asphalt material during its removal, transportation, or storage. Repair pavement to remain that is damaged by the removal operations. Work performed under this item shall be prosecuted in such a manner as to cause minimum inconvenience to traffic or to the owners of adjacent property.
A. Grade Reference. When required, place grade reference points at maximum intervals of 50 feet. Use the control points to set the grade reference. Support the grade reference so the maximum deflection does not exceed 1/16 inch between supports.

B. Milling (Planing). Vary the speed of the machine to leave a grid or other pattern type with discontinuous longitudinal reach. Remove the pavement surface for the length, depth, and width shown on the typical section and to the established line and grades. Remove pavement to vertical lines adjacent to curbs, gutters, inlets, manholes, or other obstructions. Do not damage appurtenances or underlying pavement.

Provide a milled (planed) surface that has a uniform textured appearance and riding surface. Surface should be free from gouges, continuous longitudinal grooves, ridges, oil film, and other imperfections of workmanship. Leave a uniform surface of concrete pavement free of asphalt materials when removing an asphalt concrete pavement overlay.

When an overlay on the milled (planed) pavement is not required, provide a minimum texture depth of not less than 0.05 inch. Stop milling (planing) operations when surface texture depth is not sufficient.

When located within 4 inches of steep curbs, water valves, draw grates, bridge joints, etc., asphaltic concrete that cannot be removed by the milling (planing) machine shall be removed by a manual system conforming to 208.2.B. “Manual System” or other methods acceptable to the Engineer.

When milling (planing) over a bridge deck, the milling depth shall not exceed 3/16 inch into the original deck surface of the bridge. Do not damage armor joints, sealed expansion joints, and other appurtenances.

Provide a pavement surface that, after milling (planing), has a smooth riding quality and is true to the established line, grade, and cross section. Provide a pavement surface that does not vary more than 1/8 inch in 10 feet. Evaluate this criterion with a 10 foot straightedge placed parallel to the centerline of the roadway. Deviations will be measured from the top of the texture. Correct any point in the surface not meeting this requirement.

Sweep pavement and gutter. The pavement and curb surfaces shall be cleaned of all debris and left in a neat and presentable condition.

C. Edge Treatments. At the end of the day and for areas under traffic, slope vertical or near vertical longitudinal faces in the pavement surface in accordance with the requirements in the plans. Taper transverse faces to provide an acceptable ride.

D. Salvaged Materials. The loose material resulting from the operation shall become the property of the contractor. If the material is designated to remain the property of the City, it shall be as stockpiled by the Contractor at locations as shown on the plans. Prepare the stockpile site by removing vegetation and trash and by providing proper drainage. Keep salvaged paving material free from contamination during its removal, transportation, and storage. Place different types or quality of salvaged asphalt paving material into separate stockpiles. Silt fencing around stockpile areas shall be provided in accordance with Item 542, “Temporary Sediment Control Fence.”

The plans or the Engineer may allow or require the use of salvaged material for other Items in the Contract.
Dispose of unsalvageable material in accordance with applicable federal, state, and local regulations.

208.4. **MEASUREMENT:** Measurement under this bid item shall include removal of asphaltic concrete pavement by the cubic yard (loose vehicle measurement) of material, or by the square yard in its original position at a depth as shown on the plans.

208.5. **PAYMENT:** The work performed in accordance with this Item and measured as provided under “Measurement” will be paid for at the unit price bid per cubic yard for “Salvaging, Hauling and Stockpiling Reclaimable Asphaltic Pavement” or at the Unit price bid per square yard for “Salvaging, Hauling and Stockpiling Reclaimable Asphaltic Pavement” of the depth specified. This price shall be full compensation for cleaning and removing existing pavement; for any necessary stockpile area preparation; for loading, crushing or breaking, hauling and stockpiling of the material; and for furnishing all materials, labor, tools, equipment, supplies and all incidentals necessary to satisfactorily complete the work.

When plans call for the installation of silt fencing protection around stockpile areas, the fencing will be measured and paid for under Item No. 542.

208.6. **BID ITEM:**

Item 208.1 - Salvaging, Hauling, and Stockpiling Reclaimable Asphaltic Pavement (___inches depth) - per square yard

Item 208.2 - Salvaging, Hauling, and Stockpiling Reclaimable Asphaltic Pavement - per cubic yard (loose vehicle measurement)
ITEM

209 CONCRETE PAVEMENT

209.1. DESCRIPTION: Construct hydraulic cement concrete pavement with or without curbs on the concrete pavement.

209.2. MATERIALS:

A. Hydraulic Cement Concrete. Provide hydraulic cement concrete in accordance with Item 300, “Concrete,” except that strength over-design is not required. Provide Class P concrete designed to meet a minimum average compressive strength of 3,500 psi at 7-days or a minimum average compressive strength of 4,400 psi at 28-days. Test in accordance with TxDOT standard laboratory test procedure Tex-448-A or Tex-418-A.

When shown on the plans or allowed, provide Class HES concrete for very early opening of small pavement areas or leave-outs to traffic. Design Class HES to meet the requirements of Class P and a minimum average compressive strength of 2,600 psi in 24-hours, unless other early strength and time requirements are shown on the plans or allowed. No strength over-design is required. Type III cement is allowed for Class HES concrete.

Use Class A or P concrete for curbs that are placed separately from the pavement. Provide concrete that is workable and cohesive, possesses satisfactory finishing qualities, and conforms to the mix design and mix design slump.

B. Reinforcing Steel. Unless shown on the plans, provide Grade 60 deformed steel for bar reinforcement in accordance with Item 301, “Reinforcing Steel.” Provide approved positioning and supporting devices (baskets and chairs) capable of securing and holding the reinforcing steel in proper position before and during paving in accordance with 209.B.3, “Positioning and Support Devices for Reinforcement and Joint Assemblies.” Provide corrosion protection when shown on the plans.

1. Dowels. Provide smooth, straight dowels of the size shown on the plans, free of burrs, and conforming to the requirements of Item 301, “Reinforcing Steel.” Coat dowels with a thin film of grease or other approved de-bonding material. Provide dowel caps on the lubricated end of each dowel bar used in an expansion joint. Provide dowel caps filled with a soft compressible material with enough range of movement to allow complete closure of the expansion joint.

2. Tie Bars. Provide straight deformed steel tie bars. Provide either multiple-piece tie bars or single-piece tie bars as shown on the plans. Provide multiple-piece tie bars composed of 2 pieces of deformed reinforcing steel with a coupling capable of developing a minimum tensile strength of 125% of the design yield strength of the deformed steel when tensile-tested in the assembled configuration. Provide a minimum length of 33 diameters of the deformed steel in each piece. Use multiple-piece tie bars from the list of “Prequalified Multiple Piece Tie Bar Producers” maintained by the TxDOT Construction Division, or submit samples for testing in accordance with TxDOT standard laboratory test procedure Tex-711-I. A laboratory test report from an independent laboratory that has conducted Tex-711-I on the unapproved multiple piece tie bar may also be submitted to the Engineer for consideration.
C. **Positioning and Support Devices for Reinforcement and Joint Assemblies.** These devices shall be of sufficient structural quality to prevent movement of the dowels or steel reinforcement during concrete placement and finishing. Devices shall be of a type approved by the Engineer.

Positioning and supporting devices (chairs) for steel reinforcement bars shall be either plastic or metal and of sufficient number to maintain the position of the bars within the allowable tolerances.

Metal positioning and supporting devices for expansion and contraction joint assemblies (such as welded wire bar chairs, bar stakes, etc.) where used shall be as shown on the plans or may be similar devices of equivalent or greater strength, approved by the Engineer. The support devices shall secure the joint assembly and dowels within the allowable tolerances while providing no restraint against joint movement. Dowels used in joint assemblies shall be secured in parallel position by a transverse metal brace of the type and design shown on the plans, or may be secured by other devices approved by the Engineer. The devices shall provide positive mechanical connection between the brace and each unit (other than by wire tie) and prevent transverse movement of each load transmission device.

D. **Curing Materials.** Provide Type 2 membrane curing compound conforming to TxDOT DMS-4650, “Hydraulic Cement Concrete Curing Materials and Evaporation Retardants.” Provide SS-1 emulsified asphalt conforming to TxDOT Item 300, “Asphalts, Oils, and Emulsions,” for concrete pavement to be overlaid with asphalt concrete under this Contract unless otherwise shown on the plans or approved. Provide materials for other methods of curing conforming to the requirements of Item 307, “Concrete Structures.”

E. **Epoxy.** Provide Type III epoxy in accordance with TxDOT DMS-6100, “Epoxies and Adhesives,” for installing all drilled-in reinforcing steel.

F. **Evaporation Retardant.** Provide evaporation retardant conforming to TxDOT DMS-4650, “Hydraulic Cement Concrete Curing Materials and Evaporation Retardants.”

G. **Joint Sealants and Fillers.** Provide Class 5 or Class 8 joint-sealant materials and fillers unless otherwise shown on the plans or approved and other sealant materials of the size, shape, and type shown on the plans in accordance with TxDOT DMS-6310, “Joint Sealants and Fillers.”

209.3. **EQUIPMENT:** Furnish and maintain all equipment in good working condition. Use measuring, mixing, and delivery equipment conforming to the requirements of Item 300, “Concrete.” Obtain approval for other equipment used.

A. **Placing, Consolidating, and Finishing Equipment.** Provide approved self-propelled paving equipment that uniformly distributes the concrete with minimal segregation and provides a smooth machine-finished consolidated concrete pavement conforming to plan line and grade. Provide an approved automatic grade control system on slip-forming equipment. Provide approved mechanically operated finishing floats capable of producing a uniformly smooth pavement surface. Provide equipment capable of providing a fine, light water fog mist.

Provide mechanically operated vibratory equipment capable of adequately consolidating the concrete. Provide immersion vibrators on the paving equipment at sufficiently close intervals to provide uniform vibration and consolidation of the concrete over the entire width and depth of the pavement and in accordance with the manufacturer’s recommendations. Provide
immersion vibrator units that operate at a frequency in air of at least 8,000 cycles per minute. Provide enough hand-operated immersion vibrators for timely and proper consolidation of the concrete along forms, at joints and in areas not covered by other vibratory equipment. Surface vibrators may be used to supplement equipment-mounted immersion vibrators. Provide tachometers to verify the proper operation of all vibrators.

For small or irregular areas or when approved, the paving equipment described in this Section is not required.

B. Forming Equipment.

1. Pavement Forms. Provide metal side forms of sufficient cross-section, strength, and rigidity to support the paving equipment and resist the impact and vibration of the operation without visible springing or settlement. Use forms that are free from detrimental kinks, bends, or warps that could affect ride quality or alignment. Provide flexible or curved metal or wood forms for curves of 100 foot radius or less.

2. Curb Forms. Provide curb forms for separately placed curbs that are not slipformed that conform to the requirements of Item 500, “Concrete Curb, Gutter, and Concrete Curb and Gutter.”

C. Reinforcing Steel Inserting Equipment. Provide inserting equipment that accurately inserts and positions reinforcing steel in the plastic concrete parallel to the profile grade and horizontal alignment in accordance to plan details.

D. Texturing Equipment.

1. Carpet Drag. Provide a carpet drag mounted on a work bridge or a moveable support system. Provide a single piece of carpet of sufficient transverse length to span the full width of the pavement being placed and adjustable so that a sufficient longitudinal length of carpet is in contact with the concrete being placed to produce the desired texture. Obtain approval to vary the length and width of the carpet to accommodate specific applications. Use an artificial grass-type carpet having a molded polyethylene pile face with a blade length of ⅝ to 1 inch, a minimum weight of 70 oz. per square yard, and a strong, durable, rot-resistant backing material bonded to the facing.

2. Tining Equipment. Provide a self-propelled transverse metal tine device equipped with 4 to 6 inch steel tines and with cross-section approximately 1/32 inch thick by 1/12 inch wide, spaced at 1 inch, center-to-center. Hand-operated tining equipment that produces an equivalent texture may be used only on small or irregularly shaped areas or, when permitted, in emergencies due to equipment breakdown.

E. Curing Equipment. Provide a self-propelled machine for applying membrane curing compound using mechanically pressurized spraying equipment with atomizing nozzles. Provide equipment and controls that maintain the required uniform rate of application over the entire paving area. Provide curing equipment that is independent of all other equipment when required to meet the requirements of Article 209.4.I, “Curing.” Hand-operated pressurized spraying equipment with atomizing nozzles may be used on small or irregular areas or when permitted.
F. **Sawing Equipment.** Provide power-driven concrete saws to saw the joints shown on the plans. Provide standby power-driven concrete saws during concrete sawing operations. Provide adequate illumination for nighttime sawing.

G. **Grinding Equipment.** When required, provide self propelled powered grinding equipment that is specifically designed to smooth and texture concrete pavement using circular diamond blades. Provide equipment with automatic grade control capable of grinding at least a 3 foot width longitudinally in each pass without damaging the concrete.

H. **Testing Equipment.** Provide testing equipment regardless of job-control testing responsibilities in accordance with Item 300, “Concrete,” unless otherwise shown in the plans or specified.

I. **Coring Equipment.** When required, provide coring equipment capable of extracting cores in accordance with the requirements of TxDOT standard laboratory test procedure Tex-424-A.

J. **Miscellaneous Equipment.** Furnish both 10 foot and 15 foot steel or magnesium long-handled standard straightedges. Furnish enough work bridges, long enough to span the pavement, for finishing and inspection operations. Furnish date stencils to impress pavement placement dates into the fresh concrete, with numerals approximately 2 inches high by 1 inch wide by ¼ inch deep.

209.4. **CONSTRUCTION:** Obtain approval for adjustments to plan grade-line to maintain thickness over minor subgrade or base high spots while maintaining clearances and drainage. Maintain subgrade or base in a smooth, clean, compacted condition in conformity with the required section and established grade until the pavement concrete is placed. Keep subgrade or base damp with water sufficiently in advance of placing pavement concrete. Adequately light the active work areas for all nighttime operations. Provide and maintain tools and materials to perform testing.

A. **Paving and Quality Control Plan.** Unless otherwise shown on the plans, submit a paving and quality control plan for approval before beginning pavement construction operations. Include details of all operations in the concrete paving process, including longitudinal construction joint layout, sequencing, curing, lighting, early opening, leave-outs, sawing, inspection, testing, construction methods, other details and description of all equipment. List certified personnel performing the testing. Submit revisions to the paving and quality control plan for approval.

B. **Job-Control Testing.** Unless otherwise shown on the plans, perform all fresh and hardened concrete job-control testing at the specified frequency. Provide job-control testing personnel meeting the requirements of Item 300, “Concrete.” Provide and maintain testing equipment, including strength testing equipment at a location acceptable to the Engineer. Use of a commercial laboratory is acceptable. Maintain all testing equipment calibrated in accordance with pertinent test methods. Make strength-testing equipment available to the Engineer for verification testing.

Provide the Engineer the opportunity to witness all tests. The Engineer may require a retest if not given the opportunity to witness. Furnish a copy of all test results to the Engineer daily. Check the first few concrete loads for slump, air, and temperature on start-up production days to check for concrete conformance and consistency. Sample and prepare strength test specimens (2 specimens per test) on the first day of production and for each 3,000 square yards or fraction thereof of concrete pavement thereafter. Prepare at least 1 set of strength-test specimens for each production day. Perform slump, air, and temperature tests each time.
strength specimens are made. Monitor concrete temperature to ensure that concrete is consistently within the temperature requirements. The Engineer will direct random job-control sampling and testing. Immediately investigate and take corrective action as approved if any Contractor test result, including tests performed for verification purposes, does not meet specification requirements.

When job-control testing by the Contractor is waived by the plans, the Engineer will perform the testing; however, this does not waive the Contractor’s responsibility for providing materials and work in accordance with this Item.

1. **Job-Control Strength.** Unless otherwise shown on the plans or permitted by the Engineer, use 7-day job-control concrete strength testing in accordance with TxDOT standard laboratory test procedure Tex-418-A.

   For 7-day job-control by compressive strength, use a compressive strength of 3,200 psi or a lower job-control strength value proven to meet a 28-day compressive strength of 4,400 psi as correlated in accordance with TxDOT standard laboratory test procedure Tex-427-A.

   Job control of concrete strength may be correlated to an age other than 7-days in accordance with TxDOT standard laboratory test procedure Tex-427-A when approved. Job-control strength of Class HES concrete is based on the required strength and time.

   When a job-control concrete strength test value is more than 10% below the required job-control strength or when 3 consecutive job-control strength values fall below the required job-control strength, investigate the strength test procedures, the quality of materials, the concrete production operations, and other possible problem areas to determine the cause. Take necessary action to correct the problem, including redesign of the concrete mix if needed. The Engineer may suspend concrete paving if the Contractor is unable to identify, document, and correct the cause of low strength test values in a timely manner. If any job-control strength is more than 15% below the required job-control strength, the Engineer may evaluate the structural adequacy of the pavements. When directed, remove and replace pavements found to be structurally inadequate at no additional cost.

2. **Split-Sample Verification Testing.** When indicated on the plans, perform split-sample verification testing with the Engineer on random samples taken and split by the Engineer at a rate of at least 1 for every 10 job-control samples. The Engineer will evaluate the results of split-sample verification testing. Immediately investigate and take corrective action as approved when results of split-sample verification testing differ more than the allowable differences shown in Table 1, or when the average of 10 job-control strength results and the Engineer’s split-sample strength result differ by more than 10%.
### Table 1
Verification Testing Limits

<table>
<thead>
<tr>
<th>Test Method</th>
<th>Allowable Differences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature, Tex-422-A</td>
<td>2°F</td>
</tr>
<tr>
<td>Slump, Tex-415-A</td>
<td>1 inch</td>
</tr>
<tr>
<td>Air content, Tex-414-A or Tex-416-A</td>
<td>1%</td>
</tr>
<tr>
<td>Compressive strength, Tex-418-A</td>
<td>10%</td>
</tr>
</tbody>
</table>

1. TxDOT standard laboratory test procedures

C. Reinforcing Steel and Joint Assemblies. Accurately place and secure in position all reinforcing steel as shown on the plans and in accordance with the requirements herein. Place dowels at mid-depth of the pavement slab, parallel to the surface. Place dowels for transverse contraction joints parallel to the pavement edge. Tolerances for location and alignment of dowels will be shown on the plans. Stagger the longitudinal reinforcement splices to avoid having more than \( \frac{1}{3} \) of the splices within a 2 foot longitudinal length of each lane of the pavement. Use multiple-piece tie bars or drill and epoxy grout tie bars at longitudinal construction joints. Verify that tie bars that are drilled and epoxied into concrete at longitudinal construction joints develop a pullout resistance equal to a minimum of \( \frac{3}{4} \) of the yield strength of the steel after 7-days. Test 15 bars using ASTM E-488, except that alternate approved equipment may be used. All 15 tested bars must meet the required pullout strength. If any of the test results do not meet the required minimum pullout strength, perform corrective measures to provide equivalent pullout resistance. Repair damage from testing. Acceptable corrective measures include but are not limited to installation of additional or longer tie bars.

1. Manual Placement. Secure reinforcing bars at alternate intersections with wire ties or locking support chairs. Tie all splices with wire.

2. Mechanical Placement. If mechanical placement of reinforcement results in steel misalignment or improper location, poor concrete consolidation, or other inadequacies, complete the work using manual methods.

D. Joints. Install joints as shown on the plans. Joint sealants are not required on concrete pavement that is to be overlaid with asphaltic materials. Clean and seal joints in accordance with TxDOT Item 438, “Cleaning and Sealing Joints and Cracks (Rigid Pavement and Bridge Decks).” Repair excessive spalling of the joint saw groove using an approved method before installing the sealant. Seal all joints before opening the pavement to all traffic. When placing of concrete is stopped, install a rigid transverse bulkhead, accurately notched for the reinforcing steel and shaped accurately to the cross-section of the pavement.

1. Placing Reinforcement at Joints. Where the plans require an assembly of parts at pavement joints, complete and place the assembly at the required location and elevation with all parts rigidly secured in the required position. Accurately notch joint materials for the reinforcing steel.

2. Transverse Construction Joints.

   a. Jointed Concrete Pavement. When the placing of concrete is intentionally stopped, install and rigidly secure a complete joint assembly and bulkhead in the planned transverse contraction joint location. When the placing of concrete is unintentionally
stopped, install a transverse construction joint either at a planned transverse contraction joint location or mid-slab between planned transverse contraction joints. For mid-slab construction joints, install tie bars of the size and spacing used in the longitudinal joints.

b. **Curb Joints.** Provide joints in the curb of the same type and location as the adjacent pavement. Use expansion joint material of the same thickness, type, and quality required for the pavement and of the section shown for the curb. Extend expansion joints through the curb. Construct curb joints at all transverse pavement joints. For non-monolithic curbs, place reinforcing steel into the plastic concrete pavement as shown on the plans unless otherwise approved. Form or saw the weakened plane joint across the full width of concrete pavement and through the monolithic curbs. Construct curb joints in accordance with Item 500, “Concrete Curb, Gutter, and Curb and Gutter.”

E. **Placing and Removing Forms.** Use clean and oiled forms. Secure forms on a base or firm subgrade that is accurately graded and that provides stable support without deflection and movement by form riding equipment. Pin every form at least at the middle and near each end. Tightly join and key form sections together to prevent relative displacement.

Set side forms far enough in advance of concrete placement to permit inspection. Check conformity of the grade, alignment, and stability of forms immediately before placing concrete, and make all necessary corrections. Use a straightedge or other approved method to test the top of forms to ensure that the ride quality requirements for the completed pavement will be met. Stop paving operations if forms settle or deflect more than \( \frac{1}{8} \) inch under finishing operations. Reset forms to line and grade, and refinish the concrete surface to correct grade.

Avoid damage to the edge of the pavement when removing forms. Repair damage resulting from form removal and honeycombed areas with a mortar mix within 24 hours after form removal unless otherwise approved. Clean joint face and repair honeycombed or damaged areas within 24 hours after a bulkhead for a transverse construction joint has been removed unless otherwise approved. When forms are removed before 72 hours after concrete placement, promptly apply membrane curing compound to the edge of the concrete pavement.

Forms that are not the same depth as the pavement but are within 2 inches of that depth are permitted if the subbase is trenched or the full width and length of the form base is supported with a firm material to produce the required pavement thickness. Promptly repair the form trench after use. Use flexible or curved wood or metal forms for curves of 100 foot radius or less.

F. **Concrete Delivery.** Clean delivery equipment as necessary to prevent accumulation of old concrete before loading fresh concrete. Use agitated delivery equipment for concrete designed to have a slump of more than 5 inches. Segregated concrete is subject to rejection. Place agitated concrete within 60 minutes after batching. Place non-agitated concrete within 45 minutes after batching. In hot weather or under conditions causing quick setting of the concrete, times may be reduced by the Engineer. Time limitations may be extended if the Contractor can demonstrate that the concrete can be properly placed, consolidated, and finished without the use of additional water.
G. **Concrete Placement.** Do not allow the pavement edge to deviate from the established paving line by more than ½ inch at any point. Place the concrete as near as possible to its final location, and minimize segregation and re-handling. Where hand spreading is necessary, distribute concrete using shovels. Do not use rakes or vibrators to distribute concrete.

1. **Pavement.** Consolidate all concrete by approved mechanical vibrators operated on the front of the paving equipment. Use immersion-type vibrators that simultaneously consolidate the full width of the placement when machine finishing. Keep vibrators from dislodging reinforcement. Use hand-operated vibrators to consolidate concrete in areas not accessible to the machine-mounted vibrators. Do not operate machine-mounted vibrators while the paving equipment is stationary. Vibrator operations are subject to review.

2. **Date Imprinting.** Imprint dates in the fresh concrete indicating the date of the concrete placement. Make impressions approximately 1 foot from the outside longitudinal construction joint or edge of pavement and approximately 1 foot from the transverse construction joint at the beginning of the placement day. Orient the impressions to be read from the outside shoulder in the direction of final traffic. Impress date in DD MM YY format. Imprinting of the Contractor name or logo in similar size characters to the date is allowed.

3. **Curb.** Where curbs are placed separately, conform to the requirements of Item 500, “Concrete Curb, Gutter, and Curb and Gutter.”

4. **Temperature Restrictions.** Place concrete that is between 40°F and 95°F when measured in accordance with TxDOT standard laboratory test procedure Tex-422-A at the time of discharge, except that concrete may be used if it was already in transit when the temperature was found to exceed the allowable maximum. Take immediate corrective action or cease concrete production when the concrete temperature exceeds 95°F. Do not place concrete when the ambient temperature in the shade is below 40°F and falling unless approved. Concrete may be placed when the ambient temperature in the shade is above 35°F and rising or above 40°F. When temperatures warrant protection against freezing, protect the pavement with an approved insulating material capable of protecting the concrete for the specified curing period. Submit for approval proposed measures to protect the concrete from anticipated freezing weather for the first 72-hours after placement. Repair or replace all concrete damaged by freezing.

H. **Spreading and Finishing.** Unless otherwise shown on the plans, finish all concrete pavements with approved self-propelled equipment. Use power-driven spreaders, power-driven vibrators, power-driven strike-off, and screed, or approved alternate equipment. Use the transverse finishing equipment to compact and strike off the concrete to the required section and grade without surface voids. Use float equipment for final finishing. Use concrete with a consistency that allows completion of all finishing operations without addition of water to the surface. Use the minimal amount of water fog mist necessary to maintain a moist surface. Reduce fogging if float or straightedge operations result in excess slurry.

1. **Finished Surface.** Perform sufficient checks with long-handled 10 foot and 15 foot straightedges on the plastic concrete to ensure that the final surface is within the tolerances specified in Surface Test A in TxDOT standard test procedure Item 585, “Ride Quality for Pavement Surfaces.” Check with the straightedge parallel to the centerline.
2. **Maintenance of Surface Moisture.** Prevent surface drying of the pavement before application of the curing system by means that may include water fogging, the use of wind screens and the use of evaporation retardants. Apply evaporation retardant at the rate recommended by the manufacturer. Reapply the evaporation retardant as needed to maintain the concrete surface in a moist condition until curing system is applied. Do not use evaporation retardant as a finishing aid. Failure to take acceptable precautions to prevent surface drying of the pavement will be cause for shut down of pavement operations.

3. **Surface Texturing.** Complete final texturing before the concrete has attained its initial set. Drag the carpet longitudinally along the pavement surface with the carpet contact surface area adjusted to provide a satisfactory coarsely textured surface. Prevent the carpet from getting plugged with grout. Do not perform carpet dragging operations while there is excessive bleed water.

A metal-tine texture finish is required for all areas with a posted speed limit in excess of 45 mph. A metal-tine texture finish is required unless otherwise shown on the plans for areas with a posted speed limit less than 45 mph. Immediately following the carpet drag, apply a single coat of evaporation retardant at a rate recommended by the manufacturer. Provide the metal-tine finish immediately after the concrete surface has set enough for consistent tining. Operate the metal-tine device to obtain grooves spaced at 1 inch, approximately 3/16 inch deep, with a minimum depth of 1/8 inch, and approximately 1/12 inch wide. Do not overlap a previously tined area. Use manual methods to achieve similar results on ramps and other irregular sections of pavements. Repair damage to the edge of the slab and joints immediately after texturing. Do not tine pavement that will be overlaid or that is scheduled for blanket diamond grinding or shot blasting.

When carpet drag is the only surface texture required by the plans, ensure that adequate and consistent micro-texture is achieved by applying sufficient weight to the carpet and keeping the carpet from getting plugged with grout, as directed by the Engineer. Target a carpet drag texture of .04 inch, as measured by Tex-436-A Correct any location with a texture less than .03 inch by diamond grinding or shot blasting. The Engineer will determine the test locations at points located transversely to the direction of traffic in the outside wheel path.

4. **Small or Irregular Placements.** Where machine placements and finishing of concrete pavement are not practical, use hand equipment and procedures that produce a consolidated and finished pavement section to the line and grade.

5. **Emergency Procedures.** Use hand-operated equipment for applying texture, evaporation retardant, and cure in the event of equipment breakdown.

I. **Curing.** Keep the concrete pavement surface from drying as described in Section 209.4.H.2, “Maintenance of Surface Moisture,” until the curing material has been applied. Maintain and promptly repair damage to curing materials on exposed surfaces of concrete pavement continuously for at least 3 curing days. A curing day is defined as a 24 hour period when either the temperature taken in the shade away from artificial heat is above 50°F for at least 19 hours or when the surface temperature of the concrete is maintained above 40°F for 24 hours. Curing begins when the concrete curing system has been applied. Stop concrete paving if curing compound is not being applied promptly and maintained adequately. Other methods of curing in accordance with Item 307, “Concrete Structures,” may be used when specified or approved.
1. **Membrane Curing.** Spray the concrete surface uniformly with 2 coats of membrane curing compound at an individual application rate of not more than 180 square feet per gallon. Do not allow the concrete surface to dry before applying the curing compound. Use a towel or absorptive fabric to remove any standing pools of bleed water that may be present on the surface before applying the curing compound. Apply the first coat within 10 min. after completing texturing operations. Apply the second coat within 30 minutes after completing texturing operations.

Before and during application, maintain curing compounds in a uniformly agitated condition, free of settlement. Do not thin or dilute the curing compound.

Where the coating shows discontinuities or other defects or if rain falls on the newly coated surface before the film has dried enough to resist damage, apply additional compound at the same rate of coverage to correct the damage. Ensure that the curing compound coats the sides of the texturing grooves.

2. **Asphalt Curing.** When an asphaltic concrete overlay is required, apply a uniform coating of asphalt curing at a rate of 90 to 180 square feet per gallon as required. Apply curing immediately after texturing and just after the free moisture (sheen) has disappeared. Obtain approval to add water to the emulsion to improve spray distribution. Maintain the asphalt application rate when using diluted emulsions. Maintain the emulsion in a mixed condition during application.

3. **Curing Class HES Concrete.** For all Class HES concrete pavement, provide membrane curing in accordance with Section 209.4.1.1, “Membrane Curing,” followed promptly by water curing until opening strength is achieved but not less than 24 hours.

**J. Sawing Joints.** Saw joints to the depth shown on the plans as soon as sawing can be accomplished without damage to the pavement regardless of time of day or weather conditions. Some minor raveling of the saw cut is acceptable. Use a chalk line, string line, sawing template, or other approved method to provide a true joint alignment. Provide enough saws to match the paving production rate to ensure sawing completion at the earliest possible time to avoid uncontrolled cracking. Reduce paving production if necessary to ensure timely sawing of joints. Promptly restore membrane cure damaged within the first 72 hours of curing.

**K. Protection of Pavement and Opening to Traffic.** Testing for early opening is the responsibility of the Contractor regardless of job-control testing responsibilities unless otherwise shown in the plans or directed. Testing result interpretation for opening to traffic is subject to the approval of the Engineer.

1. **Protection of Pavement.** Erect and maintain barricades and other standard and approved devices that will exclude all vehicles and equipment from the newly placed pavement for the periods specified. Before opening to traffic, protect the pavement from damage due to crossings using approved methods. Where a detour is not readily available or economically feasible, an occasional crossing of the roadway with overweight equipment may be permitted for relocating equipment only but not for hauling material. When an occasional crossing of overweight equipment is permitted, temporary matting or other approved methods may be required.
Maintain an adequate supply of sheeting or other material to cover and protect fresh concrete surface from weather damage. Apply as needed to protect the pavement surface from weather.

2. **Opening Pavement to All Traffic.** Pavement that is 7 days old may be opened to all traffic. Before opening to traffic, clean pavement, place stable material against the pavement edges, seal joints, and perform all other traffic safety related work.

3. **Opening Pavement to Construction Equipment.** Unless otherwise shown on the plans, concrete pavement may be opened early to concrete paving equipment and related delivery equipment after the concrete is at least 48 hours old and opening strength has been demonstrated in accordance with Section 209.4.K.4, “Early Opening to All Traffic,” before curing is complete. Keep delivery equipment at least 2-feet from the edge of the concrete pavement. Keep tracks of the paving equipment at least 1 foot from the pavement edge. Protect textured surfaces from the paving equipment. Restore damaged membrane curing as soon as possible. Repair pavement damaged by paving or delivery equipment before opening to all traffic.

4. **Early Opening to All Traffic.** Concrete pavement may be opened after curing is complete and the concrete has attained a compressive strength of 2,800 psi, except that pavement using Class HES concrete may be opened after 24 hours if the specified strength is achieved.
   
   a. **Strength Testing.** Test concrete specimens cured under the same conditions as the portion of the pavement involved.

   b. **Maturity Method.** Unless otherwise shown on the plans, the maturity method, TxDOT standard laboratory test procedure Tex-426-A, may be used to estimate concrete strength for early opening pavement to traffic. Install at least 2 maturity thermocouples for each day’s placement in areas where the maturity method will be used for early opening. Thermocouples, when used, will be installed near the day’s final placement for areas being evaluated for early opening. Use test specimens to verify the strength–maturity relationship in accordance with TxDOT standard laboratory test procedure Tex-426-A, starting with the first day’s placement corresponding to the early opening pavement section.

   After the first day, verify the strength–maturity relationship at least every 10 days of production. Establish a new strength–maturity relationship when the strength specimens deviate more than 10% from the maturity-estimated strengths. Suspend use of the maturity method for opening pavements to traffic when the strength–maturity relationship deviates by more than 10% until a new strength–maturity relationship is established.

   When the maturity method is used intermittently or for only specific areas, the frequency of verification will be as determined by the Engineer.

5. **Emergency Opening to Traffic.** Under emergency conditions, when the pavement is at least 72 hours old, open the pavement to traffic when directed in writing. Remove all obstructing materials, place stable material against the pavement edges, and perform other work involved in providing for the safety of traffic as required for emergency opening.
L. **Pavement Thickness.** Unless otherwise shown on the plans, the Engineer will perform 1 thickness test consisting of 1 reading at approximately the center of each lane every 500 feet or fraction thereof. The Engineer will check the thickness in accordance with TxDOT standard laboratory test procedure Tex-423-A unless other methods are shown on the plans. Core where directed in accordance with TxDOT standard laboratory test procedure Tex-424-A to verify deficiencies of more than 0.2 inch from plan thickness and to determine the limits of deficiencies of more than 0.75 inch from plan thickness. Fill core holes using a concrete mixture and method approved by the Engineer.

1. **Thickness Deficiencies Greater than 0.2-inch.** When any depth test measured in accordance with TxDOT standard laboratory test procedure Tex-423-A is deficient by more than 0.2 inch from the plan thickness, take one 4-inch diameter core at that location to verify the measurement.

   If the core is deficient by more than 0.2 inch but not by more than 0.75 inch from the plan thickness, take 2 additional cores from the unit (as defined in Section 209.4.L.3, “Pavement Units for Payment Adjustment”) at intervals of at least 150 feet and at locations selected by the Engineer, and determine the thickness of the unit for payment purposes by averaging the length of the 3 cores. In calculations of the average thickness of this unit of pavement, measurements in excess of the specified thickness by more than 0.2 inch will be considered as the specified thickness plus 0.2 inch.

2. **Thickness Deficiencies Greater than 0.75-inch.** If a core is deficient by more than 0.75 inch, take additional cores at 10 foot intervals in each direction parallel to the centerline to determine the boundary of the deficient area. The Engineer will evaluate any area of pavement found deficient in thickness by more than 0.75 inch but not more than 1 inch. As directed, remove and replace the deficient areas without additional compensation or retain deficient areas without compensation. Remove and replace any area of pavement found deficient in thickness by more than 1 inch without additional compensation.

3. **Pavement Units for Payment Adjustment.** Limits for applying a payment adjustment for deficient pavement thickness from 0.2 inch to not more than 0.75 inch are 500-feet of pavement in each lane. Lane width will be as shown on typical sections and pavement design standards.

   For greater than 0.75 inch deficient thickness, the limits for applying zero payment or requiring removal will be defined by coring or equivalent nondestructive means as determined by the Engineer. The remaining portion of the unit determined to be less than 0.75 inch deficient will be subject to the payment adjustment based on the average core thickness at each end of the 10 foot interval investigation as determined by the Engineer.

   Shoulders will be measured for thickness unless otherwise shown on the plans. Shoulders 6 feet wide or wider will be considered as lanes. Shoulders less than 6 feet wide will be considered part of the adjacent lane.

   Limits for applying payment adjustment for deficient pavement thickness for ramps, widenings, acceleration and deceleration lanes, and other miscellaneous areas are 500 feet in length. Areas less than 500 feet in length will be individually evaluated for payment adjustment based on the plan area.
M. **Ride Quality.** When required by the plans, measure ride quality in accordance with TxDOT Item 585, “Ride Quality for Pavement Surfaces.” Surface Test Type A or B as well as Pay Schedule 1, 2, or 3 shall also be indicated on the plans.

209.5. **MEASUREMENT:** This Item will be measured as follows:

A. **Concrete Pavement.** Concrete pavement will be measured by the square yard of surface area in place. The surface area includes the portion of the pavement slab extending beneath the curb.

B. **Curb.** Curb on concrete pavement will be measured by the foot in place.

209.6. **PAYMENT:** Payment includes full compensation for materials, equipment, labor, tools, and incidentals.

A. **Concrete Pavement.** The work performed and materials furnished in accordance with this Item and measured as provided under “Measurement” will be paid for at the adjusted unit price bid for “Concrete Pavement” of the type and depth specified as adjusted in accordance with Sections 209.6.B, “Deficient Thickness Adjustment” and 209.4.M, “Ride Quality.”

B. **Deficient Thickness Adjustment.** Where the average thickness of pavement is deficient in thickness by more than 0.2 inch but not more than 0.75 inch, payment will be made using the adjustment factor as specified in Table 2 applied to the bid price for the deficient area for each unit as defined under Section 209.4.L.3, “Pavement Units for Payment Adjustment.”

<table>
<thead>
<tr>
<th>Deficiency in Thickness Determined by Cores (in.)</th>
<th>Proportional Part of Contract Price Allowed (adjustment factor)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not deficient</td>
<td>1.00</td>
</tr>
<tr>
<td>Over 0.00 through 0.20</td>
<td>1.00</td>
</tr>
<tr>
<td>Over 0.20 through 0.30</td>
<td>0.80</td>
</tr>
<tr>
<td>Over 0.30 through 0.40</td>
<td>0.72</td>
</tr>
<tr>
<td>Over 0.40 through 0.50</td>
<td>0.68</td>
</tr>
<tr>
<td>Over 0.50 through 0.75</td>
<td>0.57</td>
</tr>
</tbody>
</table>

C. **Curb.** Work performed and furnished in accordance with this Item and measured as provided under “Measurement” will be paid for at the unit price bid for “Curb” of the type specified.

209.7. **BID ITEM:**

Item 209.1 - Concrete Pavement - per square yard at __ inches of depth
ITEM

210 ROLLING

210.1. DESCRIPTION: Compact embankment, subgrade, base, surface treatments, broken concrete pavement, or asphalt pavement using rollers. Break up asphalt mats, pit run material, or base materials.

210.2. EQUIPMENT: The Contractor may use any type of roller to meet the production rates and quality requirements of the Contract unless otherwise shown on the plans or directed. When specific types of equipment are required, use equipment that meets the requirements of this Article. The Engineer may allow the use of rollers that operate in one direction only when turning does not affect the quality of work or encroach on traffic.

Table 1
Roller Requirements

<table>
<thead>
<tr>
<th>Roller Type</th>
<th>Materials to be Compacted</th>
<th>Load (tons)</th>
<th>Contact Pressure</th>
<th>Roller Speed (mph)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel wheel</td>
<td>Embankment, subgrade, base, asphalt concrete</td>
<td>≥ 10</td>
<td>≥ 325 lb. per linear inch of wheel width</td>
<td>2–3</td>
</tr>
<tr>
<td>Tamping</td>
<td>Embankment, subgrade, base</td>
<td>–</td>
<td>125–550 psi per tamping foot</td>
<td>2–3</td>
</tr>
<tr>
<td>Heavy tamping</td>
<td>Embankment, subgrade, base</td>
<td>–</td>
<td>≤ 550 psi per tamping foot</td>
<td>2–3</td>
</tr>
<tr>
<td>Vibratory</td>
<td>Embankment, subgrade, base, asphalt concrete</td>
<td>Type A &lt; 6</td>
<td>Per equipment specification and as approved</td>
<td>As approved</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Type B &gt; 6</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Type C as shown on plans</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light pneumatic</td>
<td>Embankment, subgrade, base, surface treatment</td>
<td>4.5–9.0</td>
<td>≥ 45 psi</td>
<td>2–6</td>
</tr>
<tr>
<td></td>
<td>Asphalt Concrete</td>
<td></td>
<td></td>
<td>4–12</td>
</tr>
<tr>
<td>Medium pneumatic</td>
<td>Same as light pneumatic</td>
<td>12–25</td>
<td>≥ 80 psi, as directed</td>
<td>Same as light pneumatic</td>
</tr>
<tr>
<td>Heavy pneumatic</td>
<td>Embankment, subgrade, base, previously broken concrete pavement, other pavements</td>
<td>≥ 25</td>
<td>≤ 150 psi</td>
<td>2–6</td>
</tr>
<tr>
<td>Grid</td>
<td>Embankment, base, breaking up existing asphalt mats or base</td>
<td>5–13</td>
<td>–</td>
<td>2–3</td>
</tr>
</tbody>
</table>

1. Unless otherwise specified in the Contract.

1 ton = 0.9 megagrams; 1 psi = 6.9 kPa, 1 lb = 0.45 kg, 1 in = 25.4 mm, 1 mph = 1 kph

A. Static Steel Wheel Rollers. Furnish single, double, or triple steel wheel, self-propelled power rollers weighing at least 10 tons capable of operating in a forward and backward
motion. Confirm all wheels are flat. When static steel wheel rollers are required, vibratory rollers in the static mode may be used.

For single steel wheel rollers, pneumatic rear wheels are allowed for embankment, subgrade, and base. For triple steel wheel rollers, provide rear wheels with a minimum diameter of 48 inches, a minimum width of 20 inches, and a minimum compression of 325 pounds per inch of wheel width.

B. **Tamping Rollers.** Furnish self-propelled rollers with at least 1 self-cleaning metal tamping drum capable of operating in a forward or backward motion with a minimum effective rolling width of 5 feet. For rollers with more than 1 drum, mount drums in a frame so that each drum moves independently of the other. Operate rollers in static or vibratory mode.

1. **Tamping Roller (Minimum Requirement).** For all tamping rollers except for heavy tamping rollers, provide tamping feet that exert a static load of 125 to 550 psi and extend outward at least 3 inches from the surface of the drum.

2. **Heavy Tamping Roller.** Provide tamping rollers that have:
   - 2 metal tamping drums, rolls, or shells, each with a 60 inch minimum diameter and a 5 foot minimum width, or
   - 1 rear and 2 forward drums, each with a 60 inch minimum diameter. Arrange drums so that the rear drum compacts the space between the 2 forward drums and the minimum overall rolling width is 10 feet.

   Equip drums with tamping feet that:
   - extend outward at least 7 inches from the drum surface,
   - have an area of 7 to 21 square inches,
   - are self-cleaning,
   - exert a static load of at least 550 psi, and
   - are spaced at 1 tamping foot per 0.65 to 0.70 square feet of drum area.

C. **Vibratory Rollers.** Furnish self-propelled rollers with at least 1 drum equipped to vibrate. Select and maintain amplitude and frequency settings per manufacturer’s specifications to deliver maximum compaction without material displacement or shoving, as approved. Furnish the equipment manufacturer’s specifications concerning settings and controls for amplitude and frequency. Operate rollers at speeds that will produce at least 10 blows per foot unless otherwise shown on the plans or approved. Pneumatic rear wheels are allowed for embankment, subgrade, and base. Equip each vibrating drum with:
   - separate frequency and amplitude controls,
   - controls to manually start and stop vibration, and
   - a mechanism to continuously clean the face of the drum.
For asphalt-stabilized base and asphalt concrete pavement, furnish a roller that also has the ability to:

- automatically reverse the direction of the rotating eccentric weight,
- stop vibration before the motion of the roller stops, and
- thoroughly moisten the drum with water or approved asphalt release agent.

1. **Drum (Type A).** Furnish a roller with a static weight less than 6 tons and a vibratory drum.

2. **Drum (Type B).** Furnish a roller with a minimum static weight of 6 tons and a vibratory drum.

3. **Drum (Type C).** Furnish a roller as shown on plans.

**D. Pneumatic Tire Rollers.** Pneumatic tire rollers consist of rubber tire wheels on axles mounted in a frame with either a loading platform or body suitable for ballast loading. Arrange the rear tires to cover the gaps 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 air pressure within the range of the manufacturer’s charts or tabulations to attain maximum compaction throughout the lift, as approved. Furnish the manufacturer’s chart 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. Maintain individual tire inflation pressures within 5 psi of each other. Provide uniform compression under all tires.

1. **Light Pneumatic Tire.** Furnish a unit:

   - with at least 9 pneumatic tires,
   - with an effective rolling width of approximately 5 feet,
   - capable of providing a total uniform load of 4.5 to 9 tons, and
   - with tires capable of maintaining a minimum ground contact pressure of 45 psi.

2. **Medium Pneumatic Tire.** Furnish a unit:

   - with at least 7 pneumatic tires,
   - with an effective rolling width of approximately 7 feet,
   - capable of providing a total uniform load of 12 to 25 tons, and
   - with tires capable of maintaining a minimum ground contact pressure of 80 psi or 90 psi as directed.
3. **Heavy Pneumatic Tire.** Furnish a unit:

- with at least 4 pneumatic-tired wheels mounted on axles carrying at most 2 wheels,
- with wheels arranged to carry approximately equal loads on uneven surfaces,
- with a width between 8 and 10 feet that can turn 180° in the crown width,
- capable of providing a total uniform load of at least 25 tons,
- with tires capable of maintaining a maximum ground contact pressure of 150 psi,
- with liquid-filled tires inflated to such a level that liquid will flow from the valve stem when the stem is in the uppermost position.

E. **Grid Rollers.** Furnish rollers that have 2 cylindrical cages with a minimum diameter of 66-inches and a minimum width of 32 inches. Mount cages in a rigid frame with weight boxes. Use a cage surface of cast or welded steel fabric grid with bars 1-½ inches wide, spaced on 5 inch centers in each direction, that undulate approximately 1-inch between the high and low points.

Furnish rollers capable of providing a total load of 5 to 13 tons and capable of being operated in a forward or backward motion

F. **Alternate Equipment.** Instead of the specified equipment, the Contractor may, as approved, operate other compaction equipment that produces equivalent results. Discontinue the use of the alternate equipment and furnish the specified equipment if the desired results are not achieved.

210.2. **CONSTRUCTION:** Perform this work in accordance with the applicable Items using equipment and roller speeds specified in Table 1. Use only rubber-tired equipment to push or pull compaction equipment on base courses. Use equipment that does not damage material being rolled.

210.3. **MEASUREMENT:** The work performed, materials furnished, equipment, labor, tools, and incidentals will not be measured directly but will be subsidiary to pertinent Items.

210.4. **PAYMENT:** The work performed, materials furnished, equipment, labor, tools, and incidentals will not be paid for directly but will be subsidiary to pertinent Items.

210.5. **BID ITEM:**

N/A
ITEM

220 BLADING

220.1. DESCRIPTION: Blade portions of the project limits as shown on the plans or as directed by the Engineer.

220.2. EQUIPMENT: All equipment shall be approved by the Engineer prior to use and shall be able to efficiently produce the desired results. When work is measured and paid by the number of hours of blading, use a dual or four-wheel drive power maintainer equipped with pneumatic tires, a blade of at least 12 feet in length, and a wheelbase of not less than 16 feet. If the maintainer is not equipped with a scarifier attachment, provide a scarifier.

220.3. CONSTRUCTION: Blade all areas to the section, line and grade shown on the plans. Use a scarifier when necessary to loosen materials prior to blading. Use hand methods or other means around structures, trees, and other obstructions if doing the work with a blade is impractical. Do not drag, push, or scrape material along or across completed pavement.

220.4. MEASUREMENT: Unless otherwise shown on the plans as subsidiary to other pertinent items, this item will be measured by the 100-foot station, along the base line of each roadbed or by the number of hours of blading, including scarifying, performed. Roadbed is defined as the graded portion of a roadway prepared as foundation for the pavement structure and shoulders. On divided roadways, the depressed median type and the raised median type roadways are considered to have 2 roadbeds. Roadways with a flush median are considered to have 1 roadbed.

220.5. PAYMENT: Unless otherwise shown on the plans as subsidiary to other items, the work performed in accordance with this Item and measured as provided under “Measurement” will be paid for at the unit price bid for “Blading.” This price is full compensation for furnishing and operating equipment and for labor, materials, tools, and incidentals.

Work done by hand labor methods adjacent to structures, trees, and other obstructions is not paid for directly, but will be considered subsidiary to this Item. Work performed under this Item will not include work specified for payment under other Items.

220.6. BID ITEM:

N/A
ITEM

230 BASE AND PAVEMENT REPLACEMENT

230.1. DESCRIPTION: Repair localized sections of flexible pavement and full depth repair of concrete pavement including subgrade, base, and surfacing as shown on the plans due to distress from traffic loading, environment, or other causes. Cutting and replacing existing pavements for utility trench construction (cuts up to 6 feet in width) is specified in Item 511, “Cutting and Replacing Pavements (Trench Repair).”

230.2. MATERIALS: Furnish materials in accordance with the requirements herein unless otherwise shown on the plans. Provide materials of the type and grade as shown on the plans and in accordance with the pertinent Items listed below:

A. Embankment. Item 107, “Embankment.”
C. Cement Treated Subgrade. Item 109, “Cement Treated Subgrade.”
D. Flexible Base. Item 200, “Flexible Base.”
E. Cement Treated Base. Item 201, “Cement Treated Base.”
F. Asphalt Treated Base. Item 206, “Asphalt Treated Base.”
G. Prime Coat. Item 202, “Prime Coat.”
H. Surface Treatments. Item 204, “Surface Treatments.”
I. Hot Mix Asphaltic Concrete Pavement. Item 205, “Hot Mixed Asphaltic Concrete Pavement.”
J. Concrete Pavement. Item 209, “Concrete Pavements.”
K. Concrete. Item 300, “Concrete.”
L. Reinforcing Steel. Item 301, “Reinforcing Steel.”
M. Epoxy. TxDOT DMS 6100, “Epoxies and Adhesives.”

230.3. EQUIPMENT: Furnish equipment in accordance with the pertinent Items. Use of a motor grader will be permitted for asphalt concrete pavement unless otherwise shown on the plans.

230.4. CONSTRUCTION: Repair using one or more of the following operations as shown on the plans. Cut neat vertical faces around the perimeter of the work area when removing pavement structure layers. Removed materials are the property of the Contractor unless otherwise shown on the plans. Dispose of removed material in accordance with federal, state, and local regulations. Provide a smooth line and grade conforming to the adjacent pavement.

A. Removing Pavement Structure. All concrete and asphaltic concrete pavements shall be cut with a concrete saw or other approved equally capable equipment. If necessary, remove
adjacent soil and vegetation to prevent contamination of the repair area, and place it in a windrow. Do not damage adjacent pavement structure during repair operations.

1. **Existing Flexible Pavement.** The depth of the cut shall be such that upon removal of asphaltic concrete, the sides of the cut will be straight and square. Where existing base materials are to remain, pavements shall be removed to their full depth up to the top of the base material. Care shall be taken not to damage the existing base. If subgrade work is required, remove flexible pavement structure layers from work area.

2. **Existing Concrete Pavement.** Remove areas identified by the Engineer. Make repair areas rectangular, at least 6 feet long and at least ½ a full lane in width unless otherwise shown on the plans. Saw-cut and remove existing asphalt concrete overlay over the repair area and at least 6 inches outside each end of the repair area. Saw-cut full depth through the concrete around the perimeter of the repair area before removal. Do not spall or fracture concrete adjacent to the repair area. Schedule work so that concrete placement follows full-depth saw cutting by no more than 7 days unless otherwise shown on the plans or approved.

   Remove or repair loose or damaged base material, and replace or repair it with approved base material to the original top of base grade. Place a polyethylene sheet at least 4 mils thick as a bond breaker at the interface of the base and new pavement. Allow concrete used as base material to attain sufficient strength to prevent displacement when placing pavement concrete.

B. **Preparing Subgrade.** Fill holes, ruts, and depressions with approved material. If required, thoroughly wet, reshape, and compact the subgrade as directed.

   Where subgrade has failed, remove unstable subgrade material to the depth directed and replace with an approved material.

C. **Mixing and Placing Base Material.** Place, spread, and compact material in accordance with the applicable Item to the required or directed depth. For flexible pavement repair, when bituminous material is to remain in the pavement structure, pulverize to a maximum dimension of 2-½ inches and uniformly mix with existing base to the depth shown on the plans.

   1. **Flexible Base.** Use existing base and add new flexible base as required in accordance with Item 200, “Flexible Base,” and details shown on the plans to achieve required section.

   2. **Cement-Treated Base.** Use existing base, add flexible base, and stabilize with a minimum cement content of 4% by weight of the total mixture. Construct in accordance with details shown on the plans and Item 201, “Cement Treated Base,” to achieve required section.

   3. **Asphalt-Treated Base.** Place asphalt-treated base in accordance with details shown on the plans and Item 206, “Asphalt Treated Base,” or Item 205, “Hot Mix Asphaltic Concrete Pavement,” to achieve required section.

   4. **Concrete Base.** Unless otherwise shown on the plans or permitted, furnish pavement concrete for replacement base material when required. The Engineer may waive quality control tests for base material.
D. **Curing Base.** Cure in accordance with the appropriate Item unless otherwise directed or approved by the Engineer. Maintain completed base sections until surfacing.

E. **Surfacing.** Apply surfacing with materials as shown on the plans to the completed base section.

1. **Prime Coat.** Protect the compacted, finished, and cured flexible or cement-treated base mixtures with a prime coat of the type and grade shown on the plans. Apply the prime coat at the rate shown on the plans.

2. **Surface Treatments.** Apply surface treatment with the type and grade of asphalt and aggregate as shown on the plans in accordance with Item 204, “Surface Treatments.”

3. **Asphalt Concrete Pavement.** Apply tack coat of the type and grade and at the rate shown on the plans unless otherwise directed. Construct in accordance with Item 205, “Hot Mix Asphaltic Concrete Pavement,” to achieve required section.

4. **Portland Cement Concrete Pavement.** Use only drilling operations that do not damage the surrounding operations when drilling holes for replacement steel. Place new deformed reinforcing steel bars of the same size and spacing as the bars removed or as shown on the plans. Lap all reinforcing steel splices in accordance with Item 301, “Reinforcing Steel.” Place dowel bars and tiebars as shown on the plans. Epoxy-grout all tiebars for at least a 12 inch embedment into existing concrete. Completely fill the tiebar hole with Type III, Class A or Class C epoxy before inserting the tiebar into the hole.

   Provide grout retention disks for all tiebar holes. Provide and place approved supports to firmly hold the new reinforcing steel, tiebars, and dowel bars in place. Demonstrate, through simulated job conditions, that the bond strength of the epoxy-grouted tiebars meets a pullout strength of at least $\frac{3}{4}$ of the yield strength of the tiebar when tested in accordance with ASTM E 488 within 18 hr. after grouting. Increase embedment depth and retest when necessary to meet testing requirements. Perform tiebar testing before starting repair work.

   If the time frame designated for opening to traffic is less than 72 hours after concrete placement, provide Class HES concrete designed to attain a minimum average flexural strength of 255 psi or a minimum average compressive strength of 1,800 psi within the designated time frame. Otherwise provide Class P concrete conforming to Item 209, “Concrete Pavement.” Type III cement is permitted for Class HES concrete. Mix, place, cure, and test concrete to the requirements of Item 209, “Concrete Pavement,” and Item 300, “Concrete,” unless otherwise shown on the plans. Broom-finish the concrete surface unless otherwise shown on the plans.

   Match the grade and alignment of existing concrete pavement. After concrete strength requirements have been met, replace any asphalt overlay and shoulder material removed with new asphalt concrete material in accordance with Item 205, “Hot Mixed Asphaltic Concrete Pavement.”

   For repair areas to be opened to traffic before 72 hours, use curing mats to maintain a minimum concrete surface temperature of 70°F when air temperature is less than 70°F. Cure repaired area for at least 72 hours or until overlaid with asphalt concrete, if required, or until the area is opened to traffic. Saw and seal contraction joints in the repair area in
accordance with Item 209, “Concrete Pavement.” Remove repair area debris from the right of way each day.

F. **Finishing.** Regrade and compact disturbed topsoil. Clean roadway surface after repair operations.

**230.5. MEASUREMENT:**

A. **Flexible Pavement.** This Item will be measured by the square yard. In areas where material is excavated, as directed, to depths greater than those specified on the plans, measurement will be made by dividing the actual depth of such area by the plan depth and then multiplying this figure by the area in square yards of work performed. Calculations for each repaired area will be rounded up to the nearest 1/10 square yard. At each repair location, the minimum area for payment purposes will be 1 square yard.

B. **Concrete Pavement.** This Item will be measured by the square yard of concrete surface area repaired. No measurement will be made for areas damaged because of Contractor negligence.

**230.6. PAYMENT:**

A. **Flexible Pavement.** The work performed and materials furnished in accordance with this Item and measured as provided under “Measurement” will be paid for at the unit price bid for “Flexible Pavement Structure Repair” of the specified depth. This price is full compensation for scarifying, removing, hauling, spreading, disposing of, and stockpiling existing pavement structure; removing objectionable or unstable material; furnishing and placing materials; maintaining completed section before surfacing; applying tack or prime coat; hauling, sprinkling, spreading, and compacting; and equipment, labor, tools, and incidentals.

B. **Concrete Pavement.** The work performed and the materials furnished in accordance with this Item and measured as specified under “Measurement” will be paid for at the unit price bid for “Concrete Full-Depth Repair” of the type and depth specified. This price is full compensation for removal, stockpiling, and disposal of waste material and for equipment, materials, labor, tools, and incidentals. Asphalt concrete, base material, and curbing will not be paid for directly but will be considered subsidiary to this Item.

**230.7. BID ITEM:**

Item 230.1 - Flexible Pavement Structure Repair - __inches compacted depth - per square yard  
Item 230.2 - Concrete Pavement Full-Depth Repair - __inches compacted depth - per square yard
DIVISION III - CONCRETE & CONCRETE STRUCTURES

ITEM

300 CONCRETE

300.1. DESCRIPTION: Furnish hydraulic cement concrete for concrete pavements, concrete structures, and other concrete construction.

300.2. MATERIALS:

A. Cement. Furnish cement conforming to TxDOT’s DMS-4600, “Hydraulic Cement.”

B. Supplementary Cementing Materials (SCM).

1. Fly Ash. Furnish fly ash conforming to TxDOT’s DMS-4610, “Fly Ash.”


3. Ground Granulated Blast-Furnace Slag (GGBFS). Furnish GGBFS conforming to TxDOT’s DMS-4620, “Ground Granulated Blast-Furnace Slag,” Grade 100 or 120.


5. Metakaolin. Furnish metakaolin conforming to TxDOT’s DMS-4635, “Metakaolin.”

C. Chemical Admixtures. Furnish admixtures conforming to TxDOT’s DMS-4640, “Chemical Admixtures for Concrete.” Do not use calcium chloride.

D. Water. Furnish mixing and curing water that is free from oils, acids, organic matter, or other deleterious substances. Water from municipal supplies approved by the Texas Department of Health will not require testing. When using water from other sources, provide test reports showing compliance with Table 1 before use.

Water that is a blend of concrete wash water and other acceptable water sources, certified by the concrete producer as complying with the requirements of both Table 1 and Table 2, may be used as mix water. Test the blended water weekly for 4 weeks for compliance with Table 1 and Table 2 or provide previous test results. Then test every month for compliance. Provide water test results upon request.

Table 1
Chemical Limits for Mix Water

<table>
<thead>
<tr>
<th>Contaminant</th>
<th>Test Method</th>
<th>Maximum Concentration (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chloride (Cl)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prestressed concrete</td>
<td>ASTM C 114</td>
<td>500</td>
</tr>
<tr>
<td>Bridge decks and superstructure</td>
<td></td>
<td>500</td>
</tr>
<tr>
<td>All other concrete</td>
<td></td>
<td>1,000</td>
</tr>
<tr>
<td>Sulfate (SO₄)</td>
<td>ASTM C 114</td>
<td>2,000</td>
</tr>
<tr>
<td>Alkalies (Na₂O + 0.658K₂O)</td>
<td>ASTM C 114</td>
<td>600</td>
</tr>
<tr>
<td>Total Solids</td>
<td>ASTM C 1603</td>
<td>50,000</td>
</tr>
</tbody>
</table>
Table 2
Acceptance Criteria for Questionable Water Supplies

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compressive strength, min. % control at 7 days</td>
<td>ASTM C 31, ASTM C 39(^{1,2})</td>
<td>90</td>
</tr>
<tr>
<td>Time of set, deviation from control, h:min.</td>
<td>ASTM C 403(^1)</td>
<td>From 1:00 early to 1:30 later</td>
</tr>
</tbody>
</table>

\(^1\) Base comparisons on fixed proportions and the same volume of test water compared to the control mix using 100% potable water or distilled water.

\(^2\) Base comparisons on sets consisting of at least two standard specimens made from a composite sample.

Do not use mix water that has an adverse effect on the air-entraining agent, on any other chemical admixture, or on strength or time of set of the concrete. When using white hydraulic cement, use mixing and curing water free of iron and other impurities that may cause staining or discoloration.

E. Aggregate. Supply aggregates that meet the definitions in TxDOT standard laboratory test procedure Tex-100-E. Provide coarse and fine aggregates from sources listed in TxDOT’s Concrete Rated Source Quality Catalog (CRSQC). Provide aggregate from non-listed sources only when tested and approved by the Engineer before use. Allow 30 calendar days for the Engineer to sample, test, and report results for non-listed sources. Do not combine approved material with unapproved material.

1. Coarse Aggregate. Provide coarse aggregate consisting of durable particles of gravel, crushed blast furnace slag, recycled crushed hydraulic cement concrete, crushed stone, or combinations thereof that are free from frozen material and from injurious amounts of salt, alkali, vegetable matter, or other objectionable material, either free or as an adherent coating. Provide coarse aggregate of uniform quality throughout.

Provide coarse aggregate that, when tested in accordance with TxDOT standard laboratory test procedure Tex-413-A, has:

- at most 0.25% by weight of clay lumps,
- at most 1.0% by weight of shale, and
- at most 5.0% by weight of laminated and friable particles.

Wear must not be more than 40% when tested in accordance with TxDOT standard laboratory test procedure Tex-410-A.

Unless otherwise shown on the plans, provide coarse aggregate with a 5 cycle magnesium sulfate soundness of not more than 18% when tested in accordance with TxDOT standard laboratory test procedure Tex-411-A. Crushed recycled hydraulic cement concrete is not subject to the 5 cycle soundness test.

The loss by decantation as tested in accordance with TxDOT standard laboratory test procedure Tex-406-A, plus the allowable weight of clay lumps, must not exceed 1.0% or the value shown on the plans, whichever is smaller. In the case of aggregates made primarily from crushing stone, if the material finer than the No. 200 sieve is established to be the dust of fracture and essentially free from clay or shale as established by TxDOT
standard laboratory test procedure Tex-406-A, Part III, the limit may be increased to 1.5%. When crushed limestone coarse aggregate is used in concrete pavements, the decant may exceed 1.0% but not more than 3.0% if the material finer than the No. 200 sieve is determined to be at least 67% calcium carbonate in accordance with TxDOT standard laboratory test procedure Tex-406-A, Part III.

Unless otherwise specified, provide aggregate conforming to the gradation requirements shown in Table 3 when tested in accordance with TxDOT standard laboratory test procedure Tex-401-A.

<table>
<thead>
<tr>
<th>Aggregate Grade No.</th>
<th>Nominal Size</th>
<th>Percent Passing on Each Sieve</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2&quot;</td>
<td>100 80–100 50–85 20–40 0–5</td>
</tr>
<tr>
<td>2 (467)</td>
<td>1–1/2&quot;</td>
<td>100 95–100 35–70 10–30 0–5</td>
</tr>
<tr>
<td>3</td>
<td>1–1/2&quot;</td>
<td>100 95–100 60–90 25–60 0–5</td>
</tr>
<tr>
<td>4 (57)</td>
<td>1&quot;</td>
<td>100 95–100 25–60 0–10 0–5</td>
</tr>
<tr>
<td>5 (67)</td>
<td>3/4&quot;</td>
<td>100 90–100 20–55 0–10 0–5</td>
</tr>
<tr>
<td>6 (57)</td>
<td>1/2&quot;</td>
<td>100 90–100 40–70 0–15 0–5</td>
</tr>
<tr>
<td>7</td>
<td>3/8&quot;</td>
<td>100 70–95 0–25</td>
</tr>
<tr>
<td>8</td>
<td>3/8&quot;</td>
<td>100 95–100 20–65 0–10</td>
</tr>
</tbody>
</table>

1. Corresponding ASTM C 33 gradation shown in parentheses.

2. **Fine Aggregate.** Provide fine aggregate consisting of clean, hard, durable particles of natural or manufactured sand or a combination thereof with or without mineral filler. Provide fine aggregate free from frozen material and from injurious amounts of salt, alkali, vegetable matter, or other objectionable material, and containing no more than 0.5% clay lumps by weight in accordance with TxDOT standard laboratory test procedure Tex-413-A.

Provide fine aggregate that does not show a color darker than standard when subjected to the color test for organic impurities in accordance with TxDOT standard laboratory test procedure Tex-408-A.

Unless otherwise shown on the plans, use fine aggregate with an acid insoluble residue of at least 60% by weight when tested in accordance with TxDOT standard laboratory test procedure Tex-612-J in all concrete subject to direct traffic.

Unless otherwise shown on the plans, when necessary, blend the fine aggregate to meet the acid insoluble residue requirement. When blending, use the following equation:

\[
\text{Acid insoluble (%)} = \{(A1)(P1)+(A2)(P2)\}/100
\]

where:

\[
\begin{align*}
A1 &= \text{acid insoluble (%) of aggregate 1} \\
A2 &= \text{acid insoluble (%) of aggregate 2} \\
P1 &= \text{percent by weight of aggregate 1 of the fine aggregate blend} \\
P2 &= \text{percent by weight of aggregate 2 of the fine aggregate blend}
\end{align*}
\]
Provide fine aggregate or combinations of aggregates, including mineral filler, conforming to the gradation requirements shown in Table 4 when tested in accordance with TxDOT standard laboratory test procedure Tex-401-A unless otherwise specified.

### Table 4

**Fine Aggregate Gradation Chart (Grade 1)**

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8 in.</td>
<td>100</td>
</tr>
<tr>
<td>No. 4</td>
<td>95–100</td>
</tr>
<tr>
<td>No. 8</td>
<td>80–100</td>
</tr>
<tr>
<td>No. 16</td>
<td>50–85</td>
</tr>
<tr>
<td>No. 30</td>
<td>25–65</td>
</tr>
<tr>
<td>No. 50</td>
<td>10–35</td>
</tr>
<tr>
<td>No. 100</td>
<td>0–10</td>
</tr>
<tr>
<td>No. 200</td>
<td>0–3</td>
</tr>
</tbody>
</table>

1. 6–35 when sand equivalent value is greater than 85.
2. 0–6 for manufactured sand.

Unless otherwise shown on the plans, provide fine aggregate with a sand equivalent of at least 80 in accordance with TxDOT standard laboratory test procedure Tex-203-F.

For all classes of concrete, provide fine aggregate with a fineness modulus between 2.30 and 3.10 as determined by TxDOT standard laboratory test procedure Tex-402-A.

3. **Mineral Filler.** Provide mineral filler consisting of stone dust, clean crushed sand, or other approved inert material with 100% passing the No. 30 sieve and 65 to 100% passing the No. 200 sieve when tested in accordance with TxDOT standard laboratory test procedure Tex-401-A.

**F. Mortar and Grout.** When required or shown on the plans, provide mortar and grout consisting of 1 part hydraulic cement, 2 parts sand, and sufficient water to provide the desired consistency. Provide mortar with a consistency such that the mortar can be easily handled and spread by trowel. Provide grout of a consistency that will flow into and completely fill all voids. Section 300.4.A.6, “Mix Design Options,” does not apply for mortar and grout.

### 300.3. EQUIPMENT:

**A. Concrete Plants and Mixing Equipment.** Except for volumetric mixers (auger/mixer), each plant and truck mixer must be currently certified by the National Ready Mixed Concrete Association (NRMCA) or have an inspection report signed and sealed by a licensed professional engineer showing that concrete measuring, mixing, and delivery equipment meets all requirements of ASTM C-94. A new certification or signed and sealed report is required every time a plant is moved. Plants with a licensed engineer’s inspection require reinspection every 2-years. Provide a copy of the certification or the signed and sealed inspection report to the Engineer. When equipment or facilities fail to meet specification requirements, remove them from service until corrected. When allowed by the plans or the Engineer, for concrete classes not identified as structural concrete in Table 5 or for Class “C” concrete not used for bridge-class structures, the Engineer may inspect and approve all plants and trucks in lieu of the NRMCA or non-City engineer sealed certifications. The criteria and frequency of Engineer approval of plants and trucks is the same used for NRMCA certification.
1. **Scales.** Check all scales prior to beginning of operations, after each move, or whenever their accuracy or adequacy is questioned, and at least once every 6 months. Immediately correct deficiencies, and recalibrate. Provide a record of calibration showing scales in compliance with ASTM C-94 requirements. Check batching accuracy of volumetric water batching devices and admixture dispensing devices at least every 90 days. Perform daily checks as necessary to confirm measuring accuracy.

2. **Volumetric Mixers.** Provide volumetric mixers with rating plates defining the capacity and the performance of the mixer in accordance with the Volumetric Mixer Manufacturers Bureau or equivalent. Provide volumetric mixers that comply with ASTM C-685. Provide test data showing mixers meet the uniformity test requirements of TxDOT standard laboratory test procedure Tex-472-A. Unless allowed by the plans or the Engineer, volumetric mixers may not supply classes of concrete identified as structural concrete in Table 5.

3. **Agitators and Truck and Stationary Mixers.** Inspect and furnish inspection reports on truck mixers and agitators annually. If an inspection within 12 months is not practical, a 2 month grace period (for a maximum of 14 months between inspections) is permitted. Include in the report the condition of blades and fins and their percent wear from the original manufacturer’s design. Repair mixing equipment exhibiting 10% or more wear before use. Provide truck mixers and agitators equipped with means to readily verify the number of revolutions of the drum, blades, or paddles.

Provide stationary and truck mixers capable of combining the ingredients of the concrete within the specified time or the number of revolutions specified into a thoroughly mixed and uniform mass and capable of discharging the concrete so that at least 5 of the 6 requirements of TxDOT standard laboratory test procedure Tex-472-A are met.

As directed, to resolve issues of mix uniformity and mixer performance, perform concrete uniformity tests on mixers or agitators in accordance with TxDOT standard laboratory test procedure Tex-472-A.

Perform the mixer or agitator uniformity test at the full rated capacity of the equipment and within the maximum mixing time or maximum number of revolutions. Remove from service all equipment that fails the uniformity test.

Inspect and maintain mixers and agitators. Keep them reasonably free of concrete buildup, and repair or replace worn or damaged blades or fins.

Confirm all mixers have a plate affixed showing manufacturer’s recommended operating speed and rated capacity for mixing and agitating.

Previous inspections performed for TxDOT are acceptable for submittal provided the inspection meets the 12-month inspection period referenced above.

**B. Hauling Equipment.** Provide hauling equipment capable of maintaining the mixed concrete in a thoroughly mixed and uniform mass and of discharging the concrete with a satisfactory degree of uniformity.

When using non-agitating equipment for transporting concrete, provide equipment with smooth, mortar-tight metal containers equipped with gates that prevent accidental discharge of the concrete.
C. **Testing Equipment.** Unless otherwise shown on the plans or specified, in accordance with the pertinent test procedure, furnish and maintain:

- test molds,
- curing facilities,
- maturity meters if used, and
- wheelbarrow or other container acceptable for the sampling of the concrete.

Provide strength-testing equipment in accordance with the Contract controlling test unless shown otherwise.

### 300.4. CONSTRUCTION:

**A. Classification and Mix Design.** Furnish mix designs using ACI 211, “Standard Practice for Selecting Proportions for Normal, Heavy Weight, and Mass Concrete,” or other approved procedures for the classes of concrete required in accordance with Table 5. Do not exceed the maximum water-to-cementitious-material ratio. Perform mix design and cement replacement using the design by weight method unless otherwise approved.

A higher-strength class of concrete with equal or lower water-to-cementitious-material ratio may be substituted for the specified class of concrete.

To account for production variability and confirm minimum compressive strength requirements are met, over-design the mix in accordance with Table 6.

1. **Cementitious Materials.** Use cementitious materials from TxDOT prequalified sources; otherwise, request sampling and testing for approval before use. Unless otherwise specified or approved, limit cementitious material content to no more than 700 pounds per cubic yard. When supplementary cementing materials are used, “cement” is defined as “cement plus supplementary cementing material.”

   Use Type III cement only in precast concrete or when specified or permitted.

For monolithic placements, use cement of the same type and from the same source.

When sulfate-resistant concrete is required, use mix design options 1, 2, 3, or 4 given in Section 300.4.A.6, “Mix Design Options,” using Type I/II, II, V, IP, or IS cement. Do not use Class C fly ash in sulfate-resistant concrete.

Do not use supplementary cementing materials when white hydraulic cement is specified.

The upper limit of 35% replacement of cement with Class F fly ash specified by mix design options 1 and 3 may be increased to a maximum of 45% for mass placements, high performance concrete, and precast members when approved.
### Table 5
Concrete Classes

<table>
<thead>
<tr>
<th>Class of Concrete</th>
<th>Design Strength, Min. 28-day $f'_c$ (psi)</th>
<th>Maximum W/C Ratio¹</th>
<th>Coarse Aggregate Grades²,³</th>
<th>General Usage⁴</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>3,000</td>
<td>0.60</td>
<td>1–4, 8</td>
<td>Inlets, manholes, curb, gutter, curb &amp; gutter, conc. retards, sidewalks, driveways, backup walls, anchors</td>
</tr>
<tr>
<td>B</td>
<td>2,000</td>
<td>0.60</td>
<td>2–7</td>
<td>Riprap, small roadside signs, and anchors</td>
</tr>
<tr>
<td>C⁵</td>
<td>3,600</td>
<td>0.45</td>
<td>1–6</td>
<td>Drilled shafts, bridge substructure, bridge railing, culverts except top slab of direct traffic culverts, headwalls, wing walls, approach slabs, concrete traffic barrier (cast-in-place)</td>
</tr>
<tr>
<td>C(HPC)⁵</td>
<td>3,600</td>
<td>0.45</td>
<td>1–6</td>
<td>As shown on the plans</td>
</tr>
<tr>
<td>D</td>
<td>1,500</td>
<td>0.60</td>
<td>2–7</td>
<td>Riprap</td>
</tr>
<tr>
<td>E</td>
<td>3,000</td>
<td>0.50</td>
<td>2–5</td>
<td>Seal concrete</td>
</tr>
<tr>
<td>F⁵</td>
<td>Note 6</td>
<td>0.45</td>
<td>2–5</td>
<td>Railroad structures; occasionally for bridge piers, columns, or bents</td>
</tr>
<tr>
<td>F(HPC)⁵</td>
<td>Note 6</td>
<td>0.45</td>
<td>2–5</td>
<td>As shown on the plans</td>
</tr>
<tr>
<td>H⁵</td>
<td>Note 6</td>
<td>0.45</td>
<td>3–6</td>
<td>Prestressed concrete beams, boxes, piling, and concrete traffic barrier (precast)</td>
</tr>
<tr>
<td>H(HPC)⁵</td>
<td>Note 6</td>
<td>0.45</td>
<td>3–6</td>
<td>As shown on the plans</td>
</tr>
<tr>
<td>S⁵</td>
<td>4,000</td>
<td>0.45</td>
<td>2–5</td>
<td>Bridge slabs, top slabs of direct traffic culverts</td>
</tr>
<tr>
<td>S(HPC)⁵</td>
<td>4,000</td>
<td>0.45</td>
<td>2–5</td>
<td>As shown on the plans</td>
</tr>
<tr>
<td>P</td>
<td>See Item 209</td>
<td>0.45</td>
<td>2–3</td>
<td>Concrete pavement, bus pads</td>
</tr>
<tr>
<td>DC⁵</td>
<td>5,500</td>
<td>0.40</td>
<td>6</td>
<td>Dense conc. overlay</td>
</tr>
<tr>
<td>CO⁵</td>
<td>4,600</td>
<td>0.40</td>
<td>6</td>
<td>Conc. overlay</td>
</tr>
<tr>
<td>LMC⁵</td>
<td>4,000</td>
<td>0.40</td>
<td>6–8</td>
<td>Latex-modified concrete overlay</td>
</tr>
<tr>
<td>SS⁵</td>
<td>3,600⁷</td>
<td>0.45</td>
<td>4–6</td>
<td>Slurry displacement shafts, underwater drilled shafts</td>
</tr>
<tr>
<td>K⁵</td>
<td>Note 6</td>
<td>0.45</td>
<td>Note 6</td>
<td>Note 6</td>
</tr>
<tr>
<td>HES</td>
<td>Note 6</td>
<td>0.45</td>
<td>Note 6</td>
<td>Note 6</td>
</tr>
</tbody>
</table>

¹. Maximum water-cement or water-cementitious ratio by weight.
². Unless otherwise permitted, do not use Grade 1 coarse aggregate except in massive foundations with 4-in. minimum clear spacing between reinforcing steel bars. Do not use Grade 1 aggregate in drilled shafts.
³. Unless otherwise approved, use Grade 8 aggregate in extruded curbs.
⁴. For information only.
⁵. Structural concrete classes.
⁶. As shown on the plans or specified.
⁷. Use a minimum cementitious material content of 650 lb/cy of concrete. Do not apply Table 6 over design requirements to Class SS concrete.
### Table 6

<table>
<thead>
<tr>
<th>No. of Tests²,³</th>
<th>Standard Deviation, psi</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>300</td>
</tr>
<tr>
<td>15</td>
<td>470</td>
</tr>
<tr>
<td>20</td>
<td>430</td>
</tr>
<tr>
<td>30 or more</td>
<td>400</td>
</tr>
</tbody>
</table>

1. When designing the mix, add the tabulated amounts to the minimum design strength in Table 5.
2. Number of tests of a concrete mixture used to estimate the standard deviation of a concrete production facility. Test of another mix within 1,000 psi of the specified strength may be used.
3. If less than 15 prior tests are available, the overdesign should be 1,000 psi for specified strength less than 3,000 psi, 1,200 psi for specified strengths from 3,000 to 5,000 psi and 1,400 psi for specified strengths greater than 5,000 psi. For Class K and concrete classes not identified as structural concrete in Table 5 or for Class “C” concrete not used for bridge-class structures, the Engineer may designate on the plans an alternative over-design requirement up to and including 1,000 psi for specified strengths less than 3,000 psi and up to and including 1,200 psi for specified strengths from 3,000 to 5,000 psi.

2. **Aggregates.** Limit the use of recycled crushed hydraulic cement concrete as a coarse or fine aggregate to Class A, B, D, E, and P concrete. Limit recycled crushed concrete fine aggregate to a maximum of 20% of the fine aggregate.

When white hydraulic cement is specified, use light-colored aggregates.

3. **Chemical Admixtures.** Use only preapproved concrete chemical admixtures from the list of prequalified concrete admixtures maintained by the TxDOT Construction Division. Submit non-preapproved admixtures for testing to the Engineer for approval. Do not use high-range water-reducing admixtures (Type F or G) or accelerating admixtures (Type C or E) in bridge deck concrete.

When a corrosion-inhibiting admixture is required, use a 30% calcium nitrite solution. The corrosion inhibiting admixture must be set neutral unless otherwise approved. Dose the admixture at the rate of gallons of admixture per cubic yard of concrete shown on the plans.

4. **Slump.** Unless otherwise specified, provide concrete slump in accordance with Table 7 using the lowest slump possible that can be placed and finished efficiently without segregation or honeycombing.

Concrete that exceeds the maximum acceptable placement slump at time of delivery will be rejected.

When approved, the slump of a given concrete mix may be increased above the values shown in Table 8 using chemical admixtures, provided that the admixture-treated concrete has the same or lower water–cement or water–cementitious-material ratio and does not exhibit segregation or excessive bleeding. Request approval for the mix design sufficiently in advance for proper evaluation by the Engineer.
Table 7
Slump Requirements

<table>
<thead>
<tr>
<th>Concrete Designation</th>
<th>Recommended Design and Placement Slump, in.</th>
<th>Maximum Acceptable Placement Slump, in.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drilled shafts</td>
<td>See TxDOT Item 416</td>
<td>See TxDOT Item 416</td>
</tr>
<tr>
<td>Thin walled section</td>
<td>4</td>
<td>6-1/2</td>
</tr>
<tr>
<td>(9 in. or less)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Approach slabs, concrete overlays, caps, columns, piers, wall sections (over 9 in.)</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Bridge slabs</td>
<td>4</td>
<td>5-1/2</td>
</tr>
<tr>
<td>Prestressed concrete members</td>
<td>4</td>
<td>6-1/2</td>
</tr>
<tr>
<td>Concrete traffic barrier, concrete bridge railing</td>
<td>4</td>
<td>6-1/2</td>
</tr>
<tr>
<td>Dense concrete overlay</td>
<td>3/4</td>
<td>2</td>
</tr>
<tr>
<td>Latex-modified conc. for bridge deck overlays</td>
<td>3</td>
<td>7-1/2</td>
</tr>
<tr>
<td>Concrete placed underwater</td>
<td>6</td>
<td>8-1/2</td>
</tr>
<tr>
<td>Concrete pavement (slip-formed)</td>
<td>1-1/2</td>
<td>3</td>
</tr>
<tr>
<td>Concrete pavement (formed)</td>
<td>4</td>
<td>6-1/2</td>
</tr>
<tr>
<td>Riprap, curb, gutter, slip-formed, and extruded concrete</td>
<td>As approved</td>
<td>As approved</td>
</tr>
</tbody>
</table>

1. If a high-range water reducer (HRWR) is used, maximum acceptable placement slump will be 9 in.

5. Mix Design Options. For structural concrete identified in Table 5 and any other class of concrete designed using more than 520 pounds of cementitious material per cubic yard, use one of the mix design Options 1–8 shown below.

For concrete classes not identified as structural concrete in Table 5 and designed using less than 520 pounds of cementitious material per cubic yard, use one of the mix design Options 1–8 shown below, except that Class C fly ash may be used instead of Class F fly ash for Options 1, 3, and 4 unless sulfate-resistant concrete is shown on the plans.

Do not use mix design options 6 or 7 when High Performance Concrete (HPC) is required. Option 8 may be used when HPC is required provided: a minimum of 20% of the cement is replaced with a Class C fly ash; TxDOT standard laboratory test procedure Tex-440-A, “Initial Time of Set of Fresh Concrete” is performed during mix design verification; the additional requirements for permeability are met; and the concrete is not required to be sulfate-resistant.

a. **Option 1.** Replace 20 to 35% of the cement with Class F fly ash.

b. **Option 2.** Replace 35 to 50% of the cement with GGBFS.

c. **Option 3.** Replace 35 to 50% of the cement with a combination of Class F fly ash, GGBFS, UFFA, metakaolin, or silica fume. However, no more than 35% may be fly ash, and no more than 10% may be silica fume.

d. **Option 4.** Use Type IP or Type IS cement. (Up to 10% of a Type IP or Type IS cement may be replaced with Class F fly ash, GGBFS, or silica fume.)
e. **Option 5.** Replace 35 to 50% of the cement with a combination of Class C fly ash and at least 6% of silica fume, UFFA, or metakaolin. However, no more than 35% may be Class C fly ash, and no more than 10% may be silica fume.

f. **Option 6.** Use a lithium nitrate admixture at a minimum dosage of 0.55 gallon of 30% lithium nitrate solution per pound of alkalis present in the hydraulic cement.

g. **Option 7.** When using hydraulic cement only, confirm that the total alkali contribution from the cement in the concrete does not exceed 4.00 pounds per cubic yard of concrete when calculated as follows:

\[
\text{lb. alkali per cu. yd.} = \frac{(\text{lb. cement per cu. yd.}) \times (\% \text{ Na}_2\text{O equivalent in cement})}{100}
\]

In the above calculation, use the maximum cement alkali content reported on the cement mill certificate.

h. **Option 8.** For any deviations from Options 1–7, perform testing on both coarse and fine aggregate separately in accordance with ASTM C 1567. Before use of the mix, provide a certified test report signed and sealed by a licensed professional engineer, from a laboratory on TxDOT’s List of Approved ASTM C 1260 Laboratories, demonstrating that the ASTM C-1567 test result for each aggregate does not exceed 0.10% expansion.

When HPC is required, provide a certified test report signed and sealed by a licensed professional engineer demonstrating that AASHTO T 277 test results indicate the permeability of the concrete is less than 1,500 coulombs tested immediately after either of the following curing schedules:

- Moist cure specimens 56 days at 73ºF.
- Moist cure specimens 7 days at 73ºF followed by 21 days at 100ºF.

B. **Trial Batches.** Perform all preliminary trial batches and testing necessary to substantiate the proposed mix designs, and provide documentation including mix design, material proportions, and test results substantiating that the mix design conforms to specification requirements. Once a trial batch substantiates the mix design, the proportions and mixing methods used in the trial batch become the mix design of record.

Make all final trial batches using the proposed ingredients in a mixer that is representative of the mixers to be used on the job. Make the batch size at least 50% of the mixer’s rated capacity. Perform fresh concrete tests for air and slump, and make, cure, and test strength specimens for compliance with specification requirements. Test at least 1 set of design strength specimens, consisting of 2 specimens per set, at 7-day, 28-day, and at least one additional age. Before placing, provide the Engineer the option of witnessing final trial batches, including the testing of the concrete. If not provided this option, the Engineer may require additional trial batches, including testing, before the concrete is placed.

Establish 7-day compressive strength target values using the following formula for each concrete mix to be used:
When there are changes in aggregates or in type, brand, or source of cement, SCM, or chemical admixtures, reevaluate the mix as a new mix design. A change in vendor does not necessarily constitute a change in materials or source. When only the brand or source of cement is changed and there is a prior record of satisfactory performance of the cement with the ingredients, new trial batches may be waived by the Engineer.

When the maturity method is specified or permitted, establish the strength–maturity relationship in accordance with TxDOT standard laboratory test procedure Tex-426-A. When using the maturity method any changes in any of the ingredients, including changes in proportions, will require the development of a new strength–maturity relationship for the mix.

C. Storage of Materials.

1. Cement, Supplementary Cementing Materials, and Mineral Filler. Store all cement, supplementary cementing materials, and mineral filler in weatherproof enclosures that will protect them from dampness or absorption of moisture.

   When permitted, small quantities of sacked cement may be stored in the open, on a raised platform, and under waterproof covering for up to 48 hours.

2. Aggregates. Handle and store concrete aggregates in a manner that prevents contamination with foreign materials. If the aggregates are stored on the ground, clear the sites for the stockpiles of all vegetation, level the sites, and do not use the bottom 6 inch layer of aggregate without cleaning the aggregate before use.

   When conditions require the use of 2 or more grades of coarse aggregates, maintain separate stockpiles and prevent intermixing. Where space is limited, separate the stockpiles using physical barriers. Store aggregates from different sources in different stockpiles unless the Engineer authorizes pre-blending of the aggregates. Minimize segregation in stockpiles. Remix and test stockpiles when segregation is apparent.

   Sprinkle stockpiles to control moisture and temperature as necessary. Maintain reasonably uniform moisture content in aggregate stockpiles.

3. Admixtures. Store admixtures in accordance with manufacturer’s recommendations and prevent admixtures from freezing.

D. Measurement of Materials. Except for volumetric mixers, measure concrete materials by weight. Measure mixing water, consisting of water added to the batch, ice added to the batch, water occurring as surface moisture on the aggregates, and water introduced in the form of admixtures, by volume or weight. Measure ice by weight. Measure cement and supplementary cementing materials in a weigh hopper and on a separate scale from those used for other materials. Measure the cement first when measuring the cumulative weight. Measure concrete chemical admixtures in powdered form by weight. Measure concrete chemical admixtures in liquid form by weight or volume. Measure batch materials within the tolerances of Table 8.

\[
\text{Target value} = \text{Minimum design strength} \times \frac{7\text{-day avg. trial batch strength}}{28\text{-day avg. trial batch strength}}
\]
### Table 8

**Measurement Tolerances – Non-Volumetric Mixers**

<table>
<thead>
<tr>
<th>Material</th>
<th>Tolerance (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement, wt.</td>
<td>±1</td>
</tr>
<tr>
<td>Mineral admixture, wt.</td>
<td>±1</td>
</tr>
<tr>
<td>Cement + SCM (cumulative weighing), wt.</td>
<td>±1</td>
</tr>
<tr>
<td>Water, wt. or volume</td>
<td>±3</td>
</tr>
<tr>
<td>Fine aggregate, wt.</td>
<td>±2</td>
</tr>
<tr>
<td>Coarse aggregate, wt.</td>
<td>±2</td>
</tr>
<tr>
<td>Fine + coarse aggregate (cumulative weighing), wt.</td>
<td>±1</td>
</tr>
<tr>
<td>Chemical admixtures, wt. or volume</td>
<td>±3</td>
</tr>
</tbody>
</table>

When measuring cementitious materials at less than 30% of scale capacity, confirm that the quantity measured is accurate to not less than the required amount and not more than 4% in excess. When measuring aggregates in a cumulative weigh batcher at less than 30% of the scale capacity, confirm that the cumulative quantity is measured accurate to ±0.3% of scale capacity or ±3% of the required cumulative weight, whichever is less.

For volumetric mixers, base tolerances on volume-weight relationship established by calibration, and measure the various ingredients within the tolerances of Table 9.

Correct batch weight measurements for moisture.

When approved, under special circumstances, measure cement in bags of standard weight. Weighing of sacked cement is not required. Do not use fractional bags except for small hand-mixed batches of approximately 5 cubic feet or less and when an approved method of volumetric or weight measurement is used.

### Table 9

**Measurement Tolerances – Volumetric Mixers**

<table>
<thead>
<tr>
<th>Material</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement, wt. %</td>
<td>0 to +4</td>
</tr>
<tr>
<td>SCM, wt. %</td>
<td>0 to +4</td>
</tr>
<tr>
<td>Fine aggregate, wt. %</td>
<td>±2</td>
</tr>
<tr>
<td>Coarse aggregate, wt. %</td>
<td>±2</td>
</tr>
<tr>
<td>Admixtures, wt. or volume %</td>
<td>±3</td>
</tr>
<tr>
<td>Water, wt. or volume %</td>
<td>±1</td>
</tr>
</tbody>
</table>

### E. Mixing and Delivering Concrete

Mix and deliver concrete by means of one of the following operations:

- central-mixed,
- shrink-mixed,
- truck-mixed,
- volumetric mixer-mixed, or
- hand-mixed.

Operate mixers and agitators within the limits of the rated capacity and speed of rotation for mixing and agitation as designated by the manufacturer of the equipment.
For shrink-mixed and truck-mixed concrete, when there is a reason to suspect the uniformity of concrete delivered using a truck mixer or truck agitator, conduct slump tests of 2 individual samples taken after discharging approximately 15% and 85% of the load as a quick check of the probable degree of uniformity. Take the 2 samples within an elapsed time of at most 15 minutes. If the slumps of the 2 samples differ by more than the values shown in Table 10, investigate the causes and take corrective actions including adjusting the batching sequence at the plant and the mixing time and number of revolutions. Delivery vehicles that fail to meet the mixing uniformity requirements must not be used until the condition is corrected.

<table>
<thead>
<tr>
<th>Average Slump</th>
<th>Slump Tolerance (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 in. or less</td>
<td>1.0 in. (2)</td>
</tr>
<tr>
<td>4 to 6 in.</td>
<td>1.5 in.</td>
</tr>
</tbody>
</table>

1. Do not apply these tolerances to the required slumps in Table 8.
2. Maximum permissible difference in results of test of samples from 2 locations in the concrete batch.

Re-tempering or adding concrete chemical admixtures is only permitted at the job site when concrete is delivered in a truck mixer. Do not add water after the introduction of mixing water at the batch plant except on arrival at the job site, with approval, to adjust the slump of the concrete. When this water is added, do not exceed the mix design water-cementitious-material ratio. Turn the drum or blades at least 30 additional revolutions at mixing speed to confirm thorough and uniform mixing of the concrete. Do not add water or chemical admixtures to the batch after any concrete has been discharged.

Maintain concrete delivery and placement rates sufficient to prevent cold joints.

Before unloading, furnish the computer generated delivery ticket for the batch of concrete containing the information required on TxDOT Form 596, “Concrete Batch Ticket.” When the concrete contains silica fume, adjust mixing times and batching operations as necessary to confirm the material is completely and uniformly dispersed in the mix. The dispersion of the silica fume within the mix will be verified by the City, using cylinders made from trial batches. If uniform dispersion is not achieved, make necessary changes to the batching operations until uniform and complete dispersion of the silica fume is achieved.

1. **Central-Mixed Concrete.** Provide concrete that is mixed completely in a stationary mixer. Mix concrete for a period of 1 minute for 1 cubic yard and 15 seconds for each additional cubic yard of rated capacity of the mixer unless mixer performance test data demonstrate that shorter mixing times can be used to obtain a uniform mix in accordance with TxDOT standard laboratory test procedure Tex-472-A. Count the mixing time from the time all the solid materials are in the drum. Charge the mixer so that some water will enter before the cement and aggregate. Confirm that all water is in the drum by the end of the first ¼ of the specified mixing time. Adjust the mixing time if necessary to achieve a uniform mix. Concrete mixed completely in a stationary mixer must be delivered to the project in a truck mixer, truck agitator, or non-agitating delivery vehicle. When a truck mixer or truck agitator is used for transporting concrete, use the manufacturer’s designated agitating speed for any turning during transportation. Non-agitating delivery vehicles must be clean and free of built-up concrete with adequate means to control concrete discharge. Deliver the concrete to the project in a thoroughly mixed and uniform
mass, and discharge the concrete with a satisfactory degree of uniformity. Resolve
questions regarding the uniformity of the concrete by testing when directed by the
Engineer in accordance with TxDOT standard laboratory test procedure Tex-472-A.

2. Shrink-Mixed Concrete. Provide concrete that is first partially mixed in a stationary
mixer and then mixed completely in a truck mixer. Partially mix for the minimum time
required to intermingle the ingredients in the stationary mixer, and then transfer to a truck
mixer and mix the concrete at the manufacturer’s designated mixing speed for an
adequate amount of time to produce thoroughly mixed concrete. Deliver the concrete to
the project in a thoroughly mixed and uniform mass, and discharge the concrete with a
satisfactory degree of uniformity.

3. Truck-Mixed Concrete. Mix the concrete in a truck mixer from 70 to 100 revolutions at
the mixing speed designated by the manufacturer to produce a uniform concrete mix.
Deliver the concrete to the project in a thoroughly mixed and uniform mass and discharge
the concrete with a satisfactory degree of uniformity. Additional mixing at the job site at
the mixing speed designated by the manufacturer is allowed as long as concrete is
discharged before the drum has revolved a total of 300 revolutions after the introduction
of the mixing water to the cement and the aggregates.

4. Volumetric Mixer-Mixed Concrete. Unless otherwise specified or permitted, perform
all mixing operations in accordance with manufacturer’s recommended procedures.
Provide an accurate method of measuring all ingredients by volume, and calibrate
equipment to assure correct measurement of materials within the specified tolerances.

5. Hand-Mixed Concrete. When permitted, for small placements of less than 2 cubic
yards, mix up to a 2 sack batch of concrete by hand methods or in a small motor-driven
mixer. For such placements, proportion the mix by volume or weight.

F. Placing, Finishing, and Curing Concrete. Place, finish, and cure concrete in accordance
with the pertinent Items.

G. Sampling and Testing of Concrete. Unless otherwise specified, all fresh and hardened
concrete is subject to testing as follows:

1. Sampling Fresh Concrete. Provide all material to be tested. Fresh concrete will be
sampled for testing at the discharge end if using belt conveyors or pumps. When it is
impractical to sample at the discharge end, a sample will be taken at the time of discharge
from the delivery equipment and correlation testing will be performed and documented to
confirm specification requirements are met at the discharge end.

2. Testing of Fresh Concrete.
   a. Air Content. TxDOT standard laboratory test procedure Tex-414-A or Tex-416-A.
   b. Slump. TxDOT standard laboratory test procedure Tex-415-A.
   c. Temperature. TxDOT standard laboratory test procedure Tex-422-A.
   d. Making and Curing Strength Specimens. TxDOT standard laboratory test
      procedure Tex-447-A.
3. **Testing of Hardened Concrete.** Only compressive strength testing will be used unless otherwise specified or shown on the plans.

   a. **Compressive Strength.** TxDOT standard laboratory test procedure Tex-418-A.

   b. **Flexural Strength.** TxDOT standard laboratory test procedure Tex-448-A.

   c. **Maturity.** TxDOT standard laboratory test procedure Tex-426-A.

4. **Certification of Testing Personnel.** Contractor personnel performing testing must be ACI-certified for the tests being performed. Personnel performing these tests are subject to City approval. Use of a commercial laboratory is permitted. All personnel performing testing using the maturity method must be qualified by a training program recognized by TxDOT before using this method on the job.

5. **Adequacy and Acceptance of Concrete.** The Engineer will sample and test the fresh and hardened concrete for acceptance. The test results will be reported to the Contractor and the concrete supplier. For any concrete that fails to meet the required strengths as outlined below, investigate the quality of the materials, the concrete production operations, and other possible problem areas to determine the cause. Take necessary actions to correct the problem including redesign of the concrete mix. The Engineer may suspend all concrete operations under the pertinent Items if the Contractor is unable to identify, document, and correct the cause of the low strengths in a timely manner. Resume concrete operations only after obtaining approval for any proposed corrective actions.

   a. **Structural Concrete.** For concrete classes identified as structural concrete in Table 5, the Engineer will make and test 7 day and 28 day specimens. Acceptance will be based on the design strength given in Table 5.

      The Engineer will evaluate the adequacy of the concrete by comparing 7 day test results to the target value established in accordance with Section 300.4.B, “Trial Batches.”

   b. **All Other Concrete.** For concrete classes not identified as structural concrete in Table 5, the Engineer will make and test 7-day specimens. The Engineer will base acceptance on the 7 day target value established in accordance with Section 300.4.B, “Trial Batches.”

6. **Test Sample Handling.** Unless otherwise shown on the plans or directed, remove forms and deliver department test specimens to curing facilities, in accordance with pertinent test procedures. Clean and prepare forms for reuse.

300.5. **MEASUREMENT AND PAYMENT:** The work performed, materials furnished, equipment, labor, tools, and incidentals will not be measured or paid for directly but will be subsidiary to pertinent Items.

300.6. **BID ITEM:**

   N/A
ITEM

311 CONCRETE SURFACE FINISH

311.1. DESCRIPTION: Finish concrete surface as specified.

311.2. MATERIALS: Furnish materials in accordance with this Article for the type of surface finish specified.

A. Coatings.

1. Adhesive Grout and Concrete Paint. Provide coatings in accordance with TxDOT’s DMS 8110, “Coatings for Concrete.” Match color of coating with Federal Standard 595B color 35630, concrete gray, unless otherwise shown on the plans.

2. Opaque Sealer. Provide penetrating-type sealer in accordance with TxDOT’s DMS 8110, “Coatings for Concrete.” Match color of coating with Federal Standard 595B color 35630, concrete gray, unless otherwise shown on the plans.

3. 742 Appearance Coating. Provide #742 gray appearance coating (Federal Standard 595B color 35630) in accordance with TxDOT’s DMS 8100, “Structural Steel Paints-Formula.”

4. Epoxy Paint. Provide Type X epoxy coating in accordance with TxDOT’s DMS 6100, “Epoxies and Adhesives.”

B. Exposed Aggregate Finish. Provide approved aggregates meeting the grading requirements shown on the plans. Unless otherwise shown on the plans, provide gravel consisting of predominantly rounded particles. When a bush-hammered finish is desired, use crushed stone. Provide a concrete surface retardant. Provide clear acrylic resin sealer in accordance with TxDOT’s DMS 8110, “Coatings for Concrete,” or clear Type II permanent anti-graffiti coating in accordance with TxDOT’s DMS 8111, “Anti-Graffiti Coatings.”

311.3. EQUIPMENT: The Engineer may require demonstration of the equipment’s capabilities.

A. Low-Pressure Water Blasting. Use equipment capable of supplying a minimum pressure at the nozzle end of 3,000 psi at a minimum flow rate of 3 gpm. Use a 0° rotary, vibratory, or wobble-type nozzle. Use equipment capable of including abrasives in the water stream when specified on the plans.

B. Abrasive Blasting. Use equipment equipped with filters to produce oil-free air and also water-free air when dry air is required.

C. Slurry Blasting. Use equipment capable of combining air and abrasives with water to form a wet blast media capable of cleaning and preparing surface without creating dust.

D. Spraying. For spray applications, use equipment with fluid and air pressure regulators and gauges to allow for adjustment to produce a uniform spray pattern.

E. Off-the-Form Finish Forms. Use non-staining, nonporous, high-quality forming materials (e.g., steel or medium-density and high-density overlaid plywood forms). Use steel or high-density overlaid plywood forms when the same form will be used more than twice.
F. **Form Liners.** Provide form liners capable of producing a patterned finish as shown on the plans. Use form liners that provide a clean release from the concrete surface without pulling or breaking the textured concrete.

311.4. **CONSTRUCTION:** Provide the finish specified on the plans for the specific surface areas.

A. **Surface Areas of Finish.** “Surface area of finish” designates the areas where the specified surface is to be applied.

1. **Surface Area I.** Surface Area I includes:
   - surfaces of railing;
   - exterior vertical faces of fascia beams, slabs, slab spans, arches, and box girders;
   - the outside bottom surface of fascia beams and girders;
   - the underside of overhanging slabs to the point of juncture of the supporting beam;
   - the entire underside of slab spans when shown on the plans;
   - vertical and underside surfaces of bents and piers;
   - all surfaces of tie beams, abutments, bridge wingwalls, culvert headwalls and wingwalls and retaining walls exposed to view after all backfill and embankment is placed; and
   - all other exposed surfaces shown in the plans to require surface treatment.

2. **Surface Area II.** Surface Area II includes surfaces of railing, all wingwalls, and the exterior vertical faces of slabs.

3. **Surface Area III.** Surface Area III includes only the top and roadway faces of all concrete railing and bridge wingwalls.

4. **Surface Area IV.** Surface Area IV includes areas designated on the plans.

B. **Surface Finishes.** Apply the coating or special finish from Table 1 as specified on the plans.

<table>
<thead>
<tr>
<th>Coatings</th>
<th>Special Surface Finishes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adhesive grout</td>
<td>Blast</td>
</tr>
<tr>
<td>Concrete paint</td>
<td>Rub</td>
</tr>
<tr>
<td>Opaque sealer</td>
<td>Off-the-form</td>
</tr>
<tr>
<td>742 appearance coating</td>
<td>Form liner</td>
</tr>
<tr>
<td>Epoxy paint</td>
<td>Exposed aggregate</td>
</tr>
</tbody>
</table>

1. **Application of Coatings.**

   a. **Preparation.** Before applying a coating, thoroughly clean the surface by chemical cleaning, if required, and by blast cleaning.
(1) **Chemical Cleaning.** Clean surfaces contaminated with oil, grease, or other contaminants by scrubbing the area with an approved detergent or other concrete cleaning material before blast cleaning. Do not use a solvent that will stain the surface or inhibit coating adhesion. Perform the following test to check for surface contamination of oil type materials:

- Spray the surface with a fine mist of potable water.
- Examine the area to see if water beads up.
- If beading is found, clean the surface.

(2) **Blast Cleaning.** Before applying a specified coating, blast-clean the designated surface to remove weak surface material, curing compound, and other contaminants, leaving a lightly etched uniformly textured surface. Use an approved abrasive propelled by oil-free air with or without the addition of potable water, or blast with potable water with or without the addition of an approved abrasive at sufficient pressure to effectively clean and prepare the surface. When water-blasting, maintain the stand-off-distance of the nozzle to a maximum of 12-inches from the surface being cleaned.

Do not damage concrete surface by gouging, spalling, or exposing coarse aggregate by the blasting operation.

Immediately before application of any coating, blow clean oil- and moisture-free air on all surfaces with sufficient pressure to remove loose particles. Perform the following test to check for surface cleanliness as directed:

- Press a 10-inch long strip of 2-inches wide clear packing tape on the surface by rubbing with moderate pressure times.
- Grasp the free end of the tape, and remove the tape from the surface with a sharp jerk.
- Examine the surface of the tape for clinging particles.

Continue cleaning the concrete surface until there are no particles clinging to the tape surface for subsequent tests. An additional test that can be used to check the surface for dust is to wipe the surface with a dark cloth and then examine the cloth for discoloration.

b. **Application.** Mix coating materials thoroughly with a mechanical mixer at a speed that causes the mixture to rotate entirely in the container. Ensure complete mixing by probing the container with a stirring device searching for non-dispersed or settled material.

Do not apply coatings before the new concrete aging a minimum of 28-days unless approved otherwise. Do not apply coatings when weather conditions will be detrimental to the final surface finish as determined by the Engineer. Do not apply coatings when surface temperature of the concrete exceeds 110°F.

Apply coatings to obtain a consistent color and texture.
(1) **Adhesive Grout.** Apply coating on a moistened surface to a uniform minimum thickness of 1/16-inch. Do not apply when ambient temperature is less than 50°F.

(2) **Concrete Paint.** Apply the coating on a dry surface in 2 coats for a total maximum application rate of 150 square feet per gallon. Match the color of the applied coating with the color standard shown on the plans. Do not thin material unless approved. Apply when ambient temperature is between 50°F and 100°F.

(3) **Opaque Sealer.** Apply the coating to a dry surface in 2 coats for a total maximum application rate of 200 square feet per gallon. Match the color of the applied coating with the approved color standard shown on the plans. Do not thin the material unless approved. Apply when ambient temperature is between 40°F and 95°F.

(4) **742 Appearance Coating.** Apply the coating on a dry surface at a rate of at most 400 square feet per gallon. Apply when ambient temperature is above 40°F.

(5) **Epoxy Paint.** Apply the coating on a dry surface at a maximum application rate of 100 square feet per gallon. Apply when ambient temperature is above 50°F.

Repair surface finish where coating has been applied that exhibits peeling, flaking, or discoloration or that has been damaged during construction. Remove defective or damaged coating. Clean and recoat repair area in accordance with the requirements of this Item.

2. **Special Surface Finishes.** Submit a work plan to the Engineer for any special finish shown on the plans. Include in the work plan the type of aggregates, materials, variation of panel or pattern arrangement, dimensions, construction methods, and other features affecting the work as is necessary for the “Special Surface Finish” specified.

   a. **Blast Finish.** Provide surface profile as shown in the plans, or meet the minimum requirements of Section 311.4.B.1.a, “Preparation.” Construct a 4 feet by 4 feet sample panel using the same concrete used in construction of the member to receive the blast finish. Prepare the surface of the sample panel to meet the specified finish, and obtain approval of the sample finish. Use the approved sample panel finish as the standard for surfaces requiring a blast finish.

   b. **Rub Finish.** Provide a finish to the surface by rubbing the surface with a carborundum stone or other approved material. Begin rubbing the surface immediately after forms have been removed. If rubbing surface is delayed to the point where the surface is dry and unable to be rubbed to produce an acceptable finish, provide blast finish or other finish as directed at no additional cost to the City. Perform the requirements to obtain the ordinary surface finish specified in Section 307.4.M, “Ordinary Surface Finish,” concurrently with rubbing the surface. Where concrete patching is performed, rub these areas after the patch material has thoroughly set and blend the patch in with the surrounding area to produce a surface with uniform color and texture.

After form removal, keep the surface continuously wet until the rubbing is complete. Rub the surface sufficiently to bring the wetted concrete surface to a paste producing a smooth dense surface without pits, form marks, or other irregularities. Do not use
c. **Off-the-Form Finish.** Provide a finish with minimal surface defects and uniform color and texture by using non-staining, non-porous, high-quality forming materials. Use the same type of forming materials for like elements for the entire structure.

Use mortar-tight forms to prevent leakage and discoloration. If necessary, seal joints with compressible gasket material, caulk, tape or by other suitable means that are not detrimental to the concrete finish. Use one brand and type of form release agents for all surfaces unless another product produces a similar concrete surface appearance. Do not use barrier-type (wax, fuel oil, carrier oil, etc.) release agents. Use form release agents containing a rust inhibitor on steel forms. Clean rust off steel forms before use. Do not use plywood that will cause discoloration of the concrete surface.

Direct special attention to consolidation and vibration of the concrete around the form surfaces to minimize bug holes. Modify concrete placement and vibration techniques if surface contains an excessive amount of bug holes. Remove all forms without interruption once form removal begins to prevent discoloration due to differing form curing times.

Do not use membrane curing on surfaces with off-the-form finish.

Repair honeycombed and spall areas with least dimension larger than 2-inches in accordance with the concrete surface repair procedures outlined in Item 307, “Concrete Structures,” to obtain an ordinary surface finish as defined in Section 307.4.M, “Ordinary Surface Finish.” For honeycombed and spall areas with least dimension greater than ¼-inch but smaller than 2-inches, patch by filling defect with repair material omitting the chipping operation. Do not patch honeycombed and spall areas with least dimension smaller than ¼-inch. Perform required repairs as soon as forms are removed. Match repair material color and texture with surrounding concrete surfaces. Minimize the area of repair by not smearing the repair material over acceptable concrete surfaces in an attempt to blend the repair with the surrounding concrete. Cut out form ties at least ½-inch below the surface, and patch accordingly. Perform repair work as soon as possible after removing forms so that concrete and repair material have similar ages. Replace or refurbish the forms when the Engineer determines that defective formwork is causing an excessive amount of repair work.

d. **Form Liner Finish.** Provide patterned finish as shown on the plans. Do not splice form liner panels in a way that causes a noticeable transition or line between pieces. Wash and clean form liners after each use when the forms can be re-used. Replace form liners that have become damaged or worn.

Construct a sample panel for each form liner finish. Approval is required to verify that the sample panel meets the requirements of the plans and specifications before beginning work. Upon approval, the sample panel becomes the model panel that all other work will be compared against. Deviation in color, grade, or depth from the model panel is grounds for rejection of the form liner finish. Removal of defective
work may be necessary as determined by the Engineer and in accordance with the surface finish requirements outlined in Item 307, “Concrete Structures,” to obtain an ordinary surface finish as defined in Section 307.4.M, “Ordinary Surface Finish.”

Seal all form liner joints in a manner acceptable to the Engineer to prevent leakage at the surface.

e. Exposed Aggregate Finish. Provide exposed aggregate finish as indicated on the plans. Provide a depth of finish between 3/8-inch and ½-inch unless directed otherwise.

Apply a concrete surface retarder that penetrates approximately ¼-inch into the forms or concrete surface to help achieve the desired finish. Apply 2 or 3 coats to wood forms to account for absorption if necessary. Tape or caulk form joints to prevent escape of the retarder during the placing operations. Protect the form surfaces from sun and rain while exposed to the atmosphere. Re-treat form surfaces with retarder if disturbed. Protect adjacent areas of concrete not requiring exposed aggregate finish from the retarder.

Remove forms 12 to 15 hours after concrete placement but not before concrete has gained sufficient strength to support the self-weight of the member unless directed otherwise. Expose the aggregate for the finish immediately after form removal. Remove the grout paste covering the aggregate to be exposed by an approved method. Do not loosen the aggregate by the grout removal operation. Maintain required curing on all surfaces except for the time while the aggregate is being exposed. Cure using wet mats or membrane after the aggregate is exposed.

Repair defective areas as determined by the Engineer.

Re-clean exposed aggregate surfaces by an approved method. Apply a coat of acrylic resin sealer or clear Type II permanent anti-graffiti coating to cleaned exposed aggregate surface. Apply a single coat or multiple coats for a total maximum application rate of 250 square feet per gallon.

311.5. MEASUREMENT: When surface finishes for concrete is shown on the plans to be a pay item, measurement will be by the square foot of the type of surface finish specified.

This is a plans quantity measurement Item. The quantity to be paid is the quantity shown in the proposal, unless modified by TxDOT’s Article 9.2, “Plans Quantity Measurement.” Additional measurement or calculations will be made if adjustments of quantities are required.

311.6. PAYMENT: Unless otherwise specified on the plans, the work performed, materials furnished, equipment, labor, tools, and incidentals will not be paid for directly, but will be considered subsidiary to pertinent Items.

When a surface finish for concrete is specified as a pay item, the work performed and materials furnished in accordance with this Item and measured as provided under “Measurement” will be paid for at the unit price bid for “Adhesive Grout Finish,” “Concrete Paint Finish,” “Opaque Sealer Finish,” “742 Appearance Coating Finish,” “Epoxy Paint Finish,” “Blast Finish,” or “Rub Finish.” This price is full compensation for materials; cleaning and preparing surfaces; application of materials; and equipment, labor, tools, and incidentals.
Off-the-form, form liner, or exposed aggregate finishes (including anti-graffiti coating) will not be paid for under this Item but are subsidiary to other pertinent Items.

311.7. **BID ITEM:**

- Item 311.1 - Concrete Surface Finish - Adhesive Grout Finish - per square yard
- Item 311.2 - Concrete Surface Finish - Concrete Paint Finish - per square yard
- Item 311.3 - Concrete Surface Finish - Opaque Sealer Finish - per square yard
- Item 311.4 - Concrete Surface Finish - 742 Appearance Coating Finish - per square yard
- Item 311.5 - Concrete Surface Finish - Epoxy Paint Finish - per square yard
- Item 311.6 - Concrete Surface Finish - Blast Finish - per square yard
- Item 311.7 - Concrete Surface Finish - Rub Finish - per square yard
DIVISION IV - STORM SEWERS

ITEM

400 EXCAVATION, TRENCHING AND BACKFILLING

400.1. DESCRIPTION: Excavate, trench, and backfill storm drainage pipe, and pipe culverts, unless otherwise noted on the plans, details and the specifications. The work shall include all necessary pumping or bailing, sheeting, drainage and the construction and removal of any required cofferdams. All existing utilities shall be protected from damage during the excavation and backfilling of trenches, and if damaged, shall be replaced or repaired by the Contractor at his expense. Unless otherwise shown on the plans and bid proposal all excavation shall be unclassified, and shall include all materials encountered regardless of their nature or the manner in which they are removed.

400.2. MATERIALS: Use materials that meet the requirements of the following Items:

A. Aggregate. Item 200, “Flexible Base.”

B. Gravel. Item 410, “Subgrade Filler.”


D. Glass Cullet. Item 411, “Glass Cullet use for Utility Bedding and Backfill.”

E. Flowable Fill. Item 413, “Flowable Fill.”


400.3. CONSTRUCTION:

A. Excavation.

1. General. The Contractor shall perform all excavation of every description and of whatever substances encountered, to the lines and grades shown on the plans or determined by the Engineer. Unless otherwise indicated, excavation shall be by open cut except that short sections may be tunneled, if in the opinion of the Engineer, the pipe or structure can be safely and properly installed or constructed, and backfill can be properly tamped in such tunnel sections.


3. Excavated Materials. During excavation, material suitable for backfilling shall be stockpiled in an orderly manner a sufficient distance from the banks of the trench to avoid overloading and to prevent slides or cave-ins. All excavated materials not required or not suitable for backfill shall be removed and properly disposed of by the Contractor or as directed by the Engineer. Proper disposal shall be in conformance with, but not limited to, the following provisions:

a. Do not deposit excavated material within jurisdictional wetlands, and
DIVISION V - INCIDENTAL CONSTRUCTION

ITEM

500 CONCRETE CURB, GUTTER, AND CONCRETE CURB AND GUTTER

500.1. DESCRIPTION: Construct hydraulic cement concrete curb, gutter, and combined curb and gutter.

500.2. MATERIALS: Furnish materials conforming to:

A. Concrete. Item 300, “Concrete.” Use Class A concrete or material specified in the plans. Use Grade 8 coarse aggregate for extruded Class A concrete. Use other grades if approved by the Engineer.

B. Reinforcing Steel. Item 301, “Reinforcing Steel.”


D. Membrane Curing Compound. Item 305, “Membrane Curing.”

500.3. EQUIPMENT:

A. General. Provide machinery, tools, and equipment necessary for proper execution of the work.

B. Concrete Forms. Forms shall be of metal and shall extend for the full depth of the concrete. Wooden forms may be used, when authorized by the Engineer, on short radius curves such as at street intersections and at such other locations for which curved metal forms may not be available. Wooden forms may be used in other situations when authorized by the Engineer.

All forms shall be free from warp and of sufficient strength to resist the pressure of the concrete without displacement. Bracing and staking of forms shall be such that the forms remain in both horizontal and vertical alignment until their removal. All forms shall be cleaned and coated with an approved form release agent or form oil before concrete is placed. Divider plates shall be of metal. Forms shall conform to the specified radius when placed on curves.

C. Concrete Curbing Machine. The curb, gutter, or curb and gutter may be constructed by the use of an automatic curb forming machine meeting the following requirements:

1. The weight of the machine shall be such that required compaction is obtained without the machine riding above the bed on which curbing is constructed.

2. The machine shall form curbing that is uniform in texture, shape and density.

3. The forming tube of the extrusion machine or the form of the slipform machine must be easily adjustable vertically during the forward motion of the machine to provide variable heights necessary to conform to the established gradeline.
4. A pointer or gauge shall be attached to the machine so that a continual comparison can be made between the extruded or slipform work and the grade guideline. Other methods may be used when approved by the Engineer.

500.4. **CONSTRUCTION:** Curbs, gutters, or curb and gutter combinations may be placed using conventionally formed concrete placement or using a City approved self-propelled concrete curbing machine.

Provide finished work with a well-compacted mass and a surface free from voids and honeycomb, in the required shape, line, and grade. Round exposed edges with an edging tool of the radius shown on the plans. Mix, place, and cure concrete in accordance with Item 307, “Concrete Structures.” Construct joints at locations shown on the plans. Cure for at least 72 hours unless approved by the Engineer.

Furnish and place reinforcing steel in accordance with Item 301, “Reinforcing Steel.”

Set and maintain a guideline that conforms to alignment data shown on the plans, with an outline that conforms to the details shown on the plans.

A. **Formed Concrete.**

1. **Excavation and Foundation.** Excavate, shape and compact subgrade, foundation, or pavement surface to the line, grade, and cross section shown on the plans. Lightly sprinkle subgrade or foundation material immediately before concrete placement.

If the subgrade is undercut, or the natural ground is below “top of subgrade,” the necessary backfill shall be made with an approved material and compacted with a mechanical tamper. Hand tamping will not be permitted.

2. **Placement.** Place concrete into forms, and strike off with a template \(\frac{1}{4}\) to \(\frac{3}{8}\) inch less than the dimensions of the finished curb unless otherwise approved. After initial set, plaster surface with mortar consisting of 1 part hydraulic cement and 2 parts fine aggregate. Brush exposed surfaces to a uniform texture.

Place curbs, gutters, and combined curb and gutters in 50 foot maximum sections unless otherwise approved.

The reinforcing steel, if required, shall be placed in position as shown on the typical section. Care shall be exercised to keep all steel in its proper location.

Expansion joint material shall be provided at intervals not to exceed 50 feet, and shall extend the full width and depth of the concrete. Templates for joints shall be of steel, not less than 3/16 of an inch in thickness and patterned to the shape of the curb. Templates shall be cleaned and oiled and spaced to cut the curb in sections 10 feet in length. The templates shall extend a distance of 8 inches into the curb from the top down.

Two round smooth dowel bars \(\frac{3}{8}\) of an inch in diameter and 18 inches in length shall be installed at each expansion joint. One 9 inch end of each dowel shall be thoroughly coated with hot oil asphalt so that it will not bond to the concrete; approved types of slip joints may be used in lieu of coating ends of dowels. The dowels shall be placed on the vertical centerline 3 inches from the top and bottom.
Immediately after finishing the curb, it shall be protected by a membrane-compound curing agent.

The curb shall be backfilled to the full height of the concrete, tamped and sloped as directed by the Inspector. The top 4 inches of fill shall be of clean top soil, free of stones and debris.

**B. Machine Laid Concrete.**

1. **Foundation.** Hand-tamp and sprinkle subgrade or foundation material before concrete placement. Provide clean surfaces for concrete placement. If required, coat cleaned surfaces with approved adhesive or coating at the rate of application shown on the plans or as directed.

2. **Placement.** The concrete shall be fed into the machine in such a manner and at such consistency that the finished curb will present a well compacted mass with a surface free from voids and honeycomb and true to established shape, line and grade.

Immediately following extrusion any voids between the trench walls and curb shall be filled with well compacted concrete and finished off flush with the surface of the base. Any additional surface finishing specified and/or required shall be performed immediately after the above void-filling operation. Joints shall be cut to a depth of ½ inch at 10 foot intervals or as directed by the Inspector.

Whenever the curb end abuts a concrete structure a ½ inch, pre-molded, expansion joint, conforming to the curb section, shall be placed between the two concrete surfaces.

Whenever extrusion is suspended long enough to produce a cold joint, ⅙ inch smooth dowel bars, 18 inches long, shall be embedded 9 inches into the completed curb, one-quarter (¼) curb height from top and bottom. The end of the curb at the point of suspension of extrusion shall be cut back until all remaining concrete is of a dense well compacted nature.

Any addition of concrete to the extruded curb is to be applied and finished before the extruded curb has achieved its initial set.

When finishing operations are completed the curb is to be coated with membrane curing compound.

When the curb has cured, it shall be backfilled to the full height of the concrete, tamped and sloped as directed by the Inspector. The top 4-inches of fill shall be clean top soil, free of stones and debris.

**500.5. MEASUREMENT:** Accepted work as prescribed by this item will be measured by the linear foot of concrete curb, complete in place.

**500.6. PAYMENT:** The work performed and materials furnished in accordance with this Item and measured as provided under “Measurement” will be paid for at the unit price bid for “Concrete Curb,” “Concrete Curb (Mono),” “Concrete Gutter,” or “Concrete Curb and Gutter” of the type specified. This price is full compensation for surface preparation of base, equipment, labor, materials, tools, and incidentals. Topsoil to be paid under Item 515, “Topsoil.”
500.7. **BID ITEM:**

- Item 500.1 - Concrete Curb - per linear foot
- Item 500.2 - Concrete Curb (Mono) - per linear foot
- Item 500.3 - Concrete Gutter - per linear foot
- Item 500.4 - Concrete Curb and Gutter - per linear foot
ITEM

502 CONCRETE SIDEWALKS

502.1. DESCRIPTION: Construct or repair hydraulic cement concrete sidewalks.

502.2. MATERIALS: Furnish materials conforming to the following:
   
   A. **Hydraulic Cement Concrete.** Item 300, “Concrete.” Use Class A concrete or other concrete as specified. Use Grade 8 course aggregate for extruded Class A concrete. Use other grades if approved by the Engineer.
   
   B. **Reinforcing Steel.** Item 301, “Reinforcing Steel.”
   
   C. **Wire Mesh.** Item 303, Welded Wire Flat Sheets.”
   
   D. **Expansion Joint Material:** Item 304, “Expansion Joint Materials.”
   
   E. **Membrane Curing Compound:** Item 305, “Membrane Curing.”
   
   F. **Concrete Structures.** Item 307, “Concrete Structures.”

502.3. EQUIPMENT: Furnish equipment as required and/or in accordance with the pertinent Items.

502.4. CONSTRUCTION: Routing and location of sidewalks shall be indicated by plans or as directed by the Engineer. Grading of sidewalks shall be a minimum of two feet wider than sidewalk width on straight sections and three feet wider than sidewalk at turns. Grading for sidewalks shall be in accordance with direction by the Engineer. Generally, where sidewalks occur on slopes, grading shall be performed so as to result in curved contours rather than abrupt banks. Fine grading shall prevent pocketing of water. Contractor shall complete final excavation and preparation of subgrade achieving slope, drainage and compaction.

Where a sidewalk crosses a concrete driveway, confirm that the sidewalk depth and reinforcement are not less than the driveway cross-sectional details shown on the plans.

A. **Trees and Roots.**

   1. **Tree Protection.** Trees that are near sidewalk construction shall be protected from construction equipment through the use of fencing or boarding in accordance with *City of San Antonio Tree Protection Details – Tree Preservation Standard Details 1.1.3, “Level II A Fence Protection,” 1.1.4, “Level II B Fence Protection,”* as shown on the plans. Whenever possible, the entire drip line of the tree should be protected from construction activities in accordance with *Tree Preservation Standard Details 1.1.2, “Level I & Fence Protection.”*

   2. **Root Barriers.** When shown on the plans, install root barriers near the edge of the sidewalk to reduce potential future damage to the sidewalk in accordance with the locations and depths shown on the plans. Unless otherwise shown on the plans, the root barrier shall be thermoplastic panels or sheets.

   3. **Root Damage to Existing Sidewalks.** When roots have damaged the sidewalk and repairs are undertaken, the tree roots causing the damage shall be removed. Unless
otherwise shown on the plans, retain the City Arborist to review the trees affected before sidewalk reconstruction begins. The City Arborist will identify roots to be removed and branches to be pruned, if required. Utilize equipment that will provide a sharp clean cut to minimize damage to the tree roots and branches. Prune the tree in accordance with the City Arborist’s requirements.

B. Removal of Existing Sidewalk. If an existing sidewalk is to be reconstructed or repaired, remove existing sidewalk to the depths and limits shown on the plans or identified by the Engineer. All concrete sidewalks to be repaired shall be cut with a concrete saw or other equipment approved by the Engineer from existing sidewalks, driveways or other concrete structures. If necessary, remove adjacent soil and vegetation to prevent contamination of the sidewalk area, and place it in a windrow or stockpile. Do not damage adjacent sidewalk or other structures during removal and reconstruction operations. Remove and dispose of existing concrete and other materials from the work area.

C. Subgrade Preparation. Shape and compact subgrade to the line, grade, and cross-section shown on the plans. Mechanically tamp and sprinkle foundation when placement is directly on subgrade.

D. Subbase Placement. A cushion, 2 inch minimum thickness, of crusher screenings, gravel, crushed rock or flexible base material shall be spread, wetted thoroughly, tamped and leveled. The cushion shall be moist at the time the concrete is placed. Where the subgrade is rock or gravel, 70% of which is rock, the 2 inch cushion need not be used. The Engineer will determine if the subgrade meets the above requirement.

If the subgrade is undercut, or the natural ground is below “top of subgrade,” the necessary backfill shall be made with an approved material and compacted with a mechanical tamper. Hand tamping will not be permitted.

The foundation shall be level and uniformly compacted to prevent future settlement.

E. Reinforcement. Concrete sidewalks shall be reinforced as shown in the plans. Concrete reinforcement for sidewalks may consist of longitudinal reinforcing steel without traverse reinforcement or as specified by the manufacturer or the Engineer. Steel reinforcement may be omitted if approved by the Engineer.

An alternate method of reinforcing using nylon or polypropylene fibers may be used if approved by Engineer or slip-form paver equipment manufacturer. Nylon fibers shall be used at a rate of one pound (1 lb) per cubic yard or polypropylene fibers at one and a half pounds (1.5 lbs) per cubic yard, unless otherwise specified by the Engineer or slip-form paver manufacturer.

F. Joints. Unless otherwise specified on plans or as agreed to by Engineer, tooled joints with rounded edges will be placed every ten feet (10’) and will be opened with one-half inch (½”) radius by one and one-half inch (1 ½”) depth and closed by one-half inch (½”) radius by one-inch (1”) depth.

1. Expansion Joints. Provide sidewalk sections separated by pre-molded or board joint ½ inch thick, or as shown on the plans, in lengths greater than 8 feet but less than 50 feet, unless otherwise directed. Terminate workday production at an expansion joint. Expansion joint material shall also be placed where the new construction abuts the existing curbs or driveways if the Engineer deems it necessary. The expansion joint
material shall be placed vertically and shall extend the full depth and width of the concrete.

2. **Expansion Joint Dowels.** Unless otherwise shown on the plans, a minimum of two (2) round smooth dowel bars \( \frac{3}{8} \) inch in diameter and 18 inches in length shall be spaced 18 inches apart at each expansion joint. Nine inches (9") of each dowel shall be thoroughly coated with hot oil asphalt or greased, so that it will not bond to the concrete. Approved types of slip joints may be used in lieu of coating ends of dowels.

3. **Transverse Joints.** Sidewalks shall be marked with transverse “dummy” joints as shown on detail sheets, by the use of City approved jointing tools.

G. **Curb Ramps.** Curb ramps must include a detectable warning surface and conform to details shown on the plans. Confirm that abrupt changes in sidewalk elevation do not exceed ¼ inch, sidewalk cross slope does not exceed 2%, curb ramp grade does not exceed 8.3%, and flares adjacent to the ramp do not exceed 10% slope.

H. **Concrete Placement.** Provide a smooth, uniform surface free of debris and loose foundation material for concrete placement. Lightly sprinkle subgrade or foundation material immediately before concrete placement. Mix and place concrete in accordance with the pertinent Items. Hand-finishing is allowed for any method of construction. Finish exposed surfaces to a uniform transverse broom finish surface.

1. **Conventionally Formed Concrete.** Forms shall be of metal or wood and shall extend for the full depth of the concrete. All forms shall be free from warp and of sufficient strength to resist the pressure of the concrete without displacement. Bracing and staking of forms shall be such that the forms remain in both horizontal and vertical alignment until their removal. All forms shall be cleaned and coated with an approved form release agent or form oil before concrete is placed. Divider plates shall be of metal. Forms shall conform to the specified radius when placed on curves.

2. **Extruded or Slip-Formed Concrete.** A slip form paver approved by the Engineer shall lay the sidewalk. Contractor shall set guidelines or guide-rails from survey marks established by the Engineer. Guidelines shall be set to avoid obstacles in the path that may interfere with operation of equipment and overall quality of sidewalk. Sidewalk outline shall strictly conform to the details shown on the plans or as set by Engineer. Slip form equipment shall be operated according to machine specifications and manual for paving accuracy. Slip form equipment shall spread, consolidate and finish the concrete to produce a dense homogeneous concrete true to grade and cross section. Concrete shall be consolidated by the use of internal vibrators. The concrete shall be of such consistency that it will maintain the shape of the sidewalk section without support.

Where forms are required for transitional zones the forms shall conform to 502.4.G.2. “Conventionally Formed Concrete.”

I. **Finish and Curing.** Provide finished work with a well-compacted mass, a surface free from voids and honeycomb, and the required true-to-line shape and grade. After finishing each portion of the sidewalk, the surface shall be textured with heavy broom finish. Within twenty minutes of broom finish, a curing compound shall be used to protect the sidewalk. The curing compound shall be of a high solid content, greater than thirty percent (+30%). All edges shall be tooled to have slight radius. Surface water retention is not acceptable. Finished surface of
sidewalks shall generally be one-half inch (½ inch) to one inch (1 inch) above existing grade. Concrete must be cured and protected from freezing temperatures for at least three (3) days.

J. Exposed Aggregate Surface. For exposed Aggregate finished sidewalks, wash concrete surface after initial set with staff bristle brush and water to remove matrix and clean each piece of exposed coarse aggregate. Unless otherwise acceptable to the Engineer, perform washing and brushing 3 - 4 hours after casting. Care shall be taken to uniformly expose about a third of each piece of coarse aggregate, removing no more of the matrix than necessary across the panel surface and as required to achieve appearance similar to adjacent existing work. After seven days, follow with a final cleaning with a mild acid solution and final rinsing with clear water.

K. Backfilling. Once sidewalk has cured, sidewalk will need to be backfilled to the full height of the sidewalk with material approve by the Engineer. The top 4 inches of fill shall be tamped and sloped using clean topsoil. Heavy equipment must remain off sidewalks at all times.

All necessary excavation for the sidewalk section, will be considered incidental work pertaining to this item, and will not be paid for directly. The adjacent excavation and grading of the slopes shall be done in a manner acceptable to the Engineer.

502.5. MEASUREMENT: Sidewalks will be measured by the square yard of surface area at the depth specified. Curb ramps will be measured by the square yard of surface area or by each unit. The unit will consist of the curb ramp, landing, adjacent flares or side curb, and detectable warning surface as shown on the plans.

502.6. PAYMENT: The work performed and materials furnished in accordance with this Item and measured as provided under “Measurement” will be paid for at the unit price bid per square yard for “Concrete Sidewalks - Conventionally Formed” or “Concrete Sidewalks - Machine Laid” an includes curb ramps where applicable. This price is full compensation for surface preparation of base; materials; removal and disposal of existing concrete; excavation, hauling and disposal of excavated material; drilling and doweling into existing concrete curb, sidewalk, and pavement; repair of adjacent street or pavement structure damaged by these operations; and equipment, labor, materials, tools, and incidentals.

Sidewalks that cross and connect to concrete driveways will be measured and paid for in accordance with Item 503, “Asphaltic Concrete, Portland Cement Concrete, and Gravel Driveways.”

502.7. BID ITEM:

Item 502.1 - Concrete Sidewalks - Conventionally Formed - per square yard

Item 502.2 - Concrete Sidewalks - Machine Laid - per square yard
ITEM

503 ASPHALTIC CONCRETE, PORTLAND CEMENT CONCRETE, AND GRAVEL DRIVEWAYS

503.1. DESCRIPTION: Construct and pave driveways. Reconstruct existing driveways.

503.2. MATERIALS: Furnish materials in accordance with the requirements herein unless otherwise shown on the plans. Provide materials of the type and grade as shown on the plans or directed by the Engineer and in accordance with the pertinent Items listed below:

A. Embankment. Item 107, “Embarkment.”
C. Cement Treated Subgrade. Item 109, “Cement Treated Subgrade.”
D. Flexible Base. Item 200, “Flexible Base.”
E. Cement Treated Base. Item 201, “Cement Treated Base.”
F. Prime Coat. Item 202, “Prime Coat.”
G. Tack Coat. Item 203, “Tack Coat.”
H. Surface Treatments. Item 204, “Surface Treatments.”
I. Hot Mix Asphaltic Concrete Pavement. Item 205, “Hot Mixed Asphaltic Concrete Pavement.”
J. Asphalt Treated Base. Item 206, “Asphalt Treated Base.”
K. Concrete Pavement. Item 209, “Concrete Pavements.”
L. Concrete. Item 300, “Concrete.”
M. Reinforcing Steel. Item 301, “Reinforcing Steel.”
O. Epoxy. TxDOT DMS 6100, “Epoxies and Adhesives.”

503.3. EQUIPMENT: Furnish equipment as required and/or in accordance with the pertinent Items. Use of a motor grader will be permitted for asphalt concrete pavement unless otherwise shown on the plans.

503.4. CONSTRUCTION:

A. Removal of Existing Driveway or Curbs. If an existing driveway is to be reconstructed, remove existing driveway pavement to the depths and limits shown on the plans or identified by the Engineer using the methods described herein. All concrete and asphaltic concrete driveway pavements shall be cut with a concrete saw or other equipment approved by the
Engineer from existing pavement lanes and/or parking areas. Existing gravel driveways shall be removed with appropriate excavation equipment as shown on the plans or approved by the Engineer. If necessary, remove adjacent soil and vegetation to prevent contamination of the driveway area, and place it in a windrow or stockpile. Do not damage adjacent pavement structure during removal and reconstruction operations.

1. **Existing Asphaltic Concrete Driveway.** Unless otherwise shown on the plans or directed by the Engineer, saw-cut the existing driveway from existing pavement lanes and/or parking areas. The depth of the cut shall be such that upon removal of asphaltic concrete, the sides of the cut will be straight and square. Where existing base materials are to remain, driveway pavements shall be removed to their full depth up to the top of the base material. Care shall be taken not to damage the existing base. Remove or repair loose or damaged base material if present, and replace or repair it with approved base material to the original top of base grade. If subgrade work is required, remove flexible pavement structure layers to the top of subgrade and remove material from work area.

2. **Existing Portland Cement Concrete Driveway.** If required, saw-cut full depth through the concrete around the perimeter of the existing driveway before removal. Do not spall or fracture concrete adjacent to the repair area. Remove or repair loose or damaged base material if present, and replace or repair it with approved base material to the original top of base grade. Allow treated materials used as base material to attain sufficient strength to prevent displacement when placing concrete pavement. If subgrade work is required, remove the entire pavement structure to the top of subgrade and remove material from work area.

3. **Curb Cuts.** If required, saw-cut full depth through the concrete curb before removal. Do not spall or fracture concrete adjacent to the repair area. Remove or repair loose or damaged base material if present, and replace or repair it with approved base material to the original top of base grade. Allow treated materials used as base material to attain sufficient strength to prevent displacement when placing concrete pavement.

B. **Preparing Subgrade.** For construction of new driveways or vertical and/or horizontal realignment of existing driveways, the subgrade shall be excavated to the depth below the finished grade of the driveway as shown on the plans or directed by the Engineer. For new construction, or reconstruction where the subgrade has been exposed, scarify the top 6 inches of the subgrade, recompact, and shape to the proper line and cross-section as shown on the plans or as directed by the Engineer. Compaction shall be controlled by “Ordinary Compaction” unless “Density Control” is shown in the plans or required by the Engineer.

1. **Ordinary Compaction.** Use approved equipment to compact the subgrade layer. The plans or the Engineer may require specific equipment. Before and during compaction, bring the scarified layer to the moisture content directed. Compact until there is no evidence of further consolidation. Maintain a level layer to ensure uniform compaction. If the required stability or finish is lost for any reason, recompact and refinish the subgrade at no additional expense to the City.

2. **Density Control.** Wet the subgrade to optimum moisture content but not exceeding 3% above the optimum moisture content ($W_{opt}$) and compact to at least 95% of the maximum dry density ($D_{max}$) determined using TxDOT standard laboratory test procedure Tex-114-E. Density of the completed subgrade will be measured in the field in accordance with TxDOT standard test procedure Tex-115-E.
If the subgrade is undercut, or the natural ground is below “top of subgrade,” the necessary backfill shall be made with flexible base, or approved material as directed by the Engineer and the applicable item.

C. Placing Base Material. When shown on the plans, place, spread, and compact material in accordance with the applicable Item to the required or directed depth.

1. Flexible Base. Place or repair flexible base as required in accordance with Item 200, “Flexible Base,” and details shown on the plans to achieve required section.

2. Cement-Treated Base. Use existing base, add flexible base if required, and stabilize with a minimum cement content of 3% by weight of the total mixture. Construct in accordance with details shown on the plans and Item 201, “Cement Treated Base,” to achieve required section.

3. Asphalt-Treated Base or Asphalitic Concrete Base. Place asphalt-treated base in accordance with details shown on the plans and Item 206, “Asphalt Treated Base,” or Item 205, “Hot Mix Asphalitic Concrete Pavement,” to achieve required section.

D. Curing Base. Cure in accordance with the appropriate Item unless otherwise directed or approved by the Engineer. Maintain completed base sections until surfacing.

E. Surfacing. Apply surfacing with materials as shown on the plans to the completed base section.

1. Gravel Driveway. A gravel driveway is defined as a driveway consisting entirely of flexible base material without an asphaltic concrete, Portland cement concrete, or surface treatment layer. The surface of the compacted base shall be smooth and in conformity with typical sections and to the established lines and grades. Prime coat the surface if shown on the plans or directed.

2. Prime Coat. Protect the compacted, finished, and cured flexible or cement-treated base mixtures with a prime coat. Unless otherwise shown on the plans, apply prime coat with an approved sprayer at a rate not to exceed 0.20 gallons per square yard of surface. The type and grade shall be shown on the plans or directed by the Engineer.

3. Surface Treatments. If shown on the plans, apply surface treatment with the type and grade of asphalt and aggregate as shown on the plans in accordance with Item 204, “Surface Treatments.”

4. Asphalt Concrete Pavement. Unless otherwise shown on the plans, apply tack coat at a rate not to exceed 0.10 gallons per square yard. The type and grade shall be shown on the plans or directed by the Engineer. Place asphaltic concrete in accordance with Item 205, “Hot Mixed Asphalitic Concrete Pavement,” to achieve required section. Testing requirements may be altered or waived by the Engineer.

5. Portland Cement Concrete Pavement. If shown on the plans, tie the concrete driveway to concrete pavement or concrete parking lot pavement. Use only drilling operations that do not damage the surrounding operations when drilling holes for replacement steel. Unless otherwise shown on the plans, reinforcement shall consist of either one layer of 6” x 6” - W5 x W5 welded wire flat sheet or No. 3 (¾”) reinforcing steel placed not more than 12 inches on centers both directions. All reinforcement shall be placed equidistant
from the top and bottom of the concrete. Care shall be exercised to keep all steel in its proper position during the depositing of concrete. Splices in wire fabric shall conform to the requirements set forth in Item 303, “Welded Wire Flat Sheets.” Splices in the No. 3 bars shall have a minimum lap of 12 inches. For existing driveways with existing steel, place new deformed reinforcing steel bars of the same size and spacing as the bars removed or as shown on the plans. Lap all reinforcing steel splices in accordance with Item 301, “Reinforcing Steel.” Epoxy-grout all tiebars for at least a 12 inch embedment into existing concrete. Completely fill the tiebar hole with Type III, Class A or Class C epoxy before inserting the tiebar into the hole. Provide grout retention disks for all tiebar holes. Provide and place approved supports to firmly hold the new reinforcing steel, tiebars, and dowel bars in place.

Place a polyethylene sheet at least 4 mils thick as a bond breaker at the interface of the base or subgrade and new driveway pavement. Provide Class P concrete conforming to Item 209, “Concrete Pavement.” Mix, place, and cure concrete to the requirements of Item 209, “Concrete Pavement,” and Item 300, “Concrete,” unless otherwise shown on the plans. Hand placement of concrete is allowed. The Engineer may waive testing requirements.

If the time frame designated for opening to traffic is less than 72 hours after concrete placement, provide Class HES concrete designed to attain a minimum average flexural strength of 255 psi or a minimum average compressive strength of 1,800 psi within the designated time frame. Type III cement is permitted for Class HES concrete. For driveways that are to be opened to traffic before 72 hours, use curing mats to maintain a minimum concrete surface temperature of 70°F when air temperature is less than 70°F.

Match the grade and alignment of existing concrete pavement. Broom-finish the concrete surface unless otherwise shown on the plans. Saw and seal contraction joints, if shown on the plans or directed by the Engineer, in accordance with Item 209, “Concrete Pavement.”

a. Commercial Driveways. Reinforcing for commercial driveways shall consist of either one (1) layer of 6” x 6” - W10 x W10 welded wire flat sheets or No. 4 (½”) reinforcing steel placed not more than 12 inches on center both directions. The concrete slab shall be a minimum of 6 inches thick or as shown on the plans.

b. Exposed Aggregate Surface. For exposed Aggregate finished driveways, wash concrete surface after initial set with staff bristle brush and water to remove matrix and clean each piece of exposed coarse aggregate. Unless otherwise acceptable to the Engineer, perform washing and brushing 3 - 4 hours after casting. Care shall be taken to uniformly expose about a third of each piece of coarse aggregate, removing no more of the matrix than necessary across the panel surface and as required to achieve appearance similar to adjacent existing work. After seven days, follow with a final cleaning with a mild acid solution and final rinsing with clear water.

503.5. MEASUREMENT: No separate measurement of excavation, base material, prime coat, tack coat, Portland cement concrete, or asphalt surfacing will be made. Accepted work as prescribed by this item will be measured by the square yard of Portland cement concrete driveway, asphaltic concrete driveway or gravel driveway.

503.6. PAYMENT: The work performed as prescribed by this item will be paid for at the contract unit price bid per square yard for “Portland Cement Concrete Driveway,” “Portland Cement Concrete Driveway,” or “Asphaltic Concrete Driveway.”
Driveway - Commercial,” “Asphaltic Concrete Driveway,” or “Gravel Driveway,” which price shall be full compensation for removal of existing driveway (if required), preparing the subgrade, for furnishing and placing all materials, manipulations, labor, tools, equipment and incidentals necessary to complete the work.

503.7. **BID ITEM:**

- Item 503.1 - Portland Cement Concrete Driveway - per square yard
- Item 503.2 - Portland Cement Concrete Driveway - Commercial - per square yard
- Item 503.3 - Exposed Aggregate Driveway - per square yard
- Item 503.4 - Asphaltic Concrete Driveway - per square yard
- Item 503.5 - Gravel Driveway - per square yard
ITEM

512 ADJUSTING EXISTING MANHOLES AND VALVE BOXES

512.1. DESCRIPTION: Adjustment of all existing manholes and valve boxes by either lowering or raising the top elevation to match the final profile grade line and includes the reconstruction of existing manholes or valve boxes in conformity with the provisions of these specifications.

512.2. MATERIALS: Provide materials as provided herein or as shown on the plans.

A. Concrete. Item No. 300, “Concrete (Class B).”

512.3. EQUIPMENT: Provide equipment necessary to conduct the work specified herein or as directed by the Engineer.

512.4. CONSTRUCTION:

A. Manholes. Perform all work in conformance with Sections 1. “Lowering Manholes”, 2. “Raising Manholes” and 3. “Reconstructing Existing Manholes” unless otherwise shown on the plans. Existing manhole rings, risers, and covers which are determined by the Inspector to be in an unacceptable condition, will be removed and replaced with new rings, risers, and cover. Contractor shall take all necessary measures to prevent damage to existing or new rings, risers, covers, or cones from equipment and materials used in or taken through the work area. If an existing or new manhole cover, ring, riser, or cone is damaged by the Contractor, it shall be replaced, as directed by the Engineer, by the Contractor at his expense.

1. Lowering Manholes. Manholes shall be lowered below subgrade before placing base materials and openings shall be protected by hatch covers. Manholes shall be adjusted after the base material has been laid and before placing of the surface course. Material excavation from around the manholes shall be replaced with concrete in accordance with Standard Drawings, and select materials from the excavation as shown on the plans or specified by the Engineer. All excess materials shall be disposed of by the Contractor at his own expense and in an approved location.

All manholes shall be lowered a sufficient depth so as to be level with the finished surface course and shall not exceed ±½ inch deviation at any point between the top of manhole elevation and surface of pavement. Adjustment in height will be made by removal of “throat rings” above the manhole “cone” where feasible. A minimum of two and a maximum of six throat rings shall be used at each manhole. If the height of the manhole cannot be adjusted to meet the required number of throat rings, the manhole shall be reconstructed in accordance with Section 3, “Reconstructing Existing Manholes.”

2. Raising Manholes. Manholes to be raised between ¾ inches to 5-¾ inches on an existing surface course not being replaced will be completed utilizing a pivoted turnbuckle manhole riser meeting the requirements shown in Figure 1. Installation of the riser begins by removal of the manhole lid and cleaning the manhole frame from roadway materials, dirt, and any other debris not part of the manhole frame. Insert appropriately sized riser (see Section a. “Measurement Dimensions Required for Obtaining Properly Sized Riser”) and seat with a hammer. Expand turnbuckle mechanism to full circumferential engagement. Replace lid and ensure that lid seats fully on riser without rocking. If necessary, seating surfaces shall be machined. Apply solvent to the top of the lid just
prior to application of pavement overlay. Manufacturer’s instructions shall be consulted to ensure proper installation of riser.

All manholes shall be raised a sufficient height so as to be level with the finished surface course and shall not exceed ±½ inch deviation at any point between the top of manhole elevation and surface of pavement.

a. **Measurement Dimensions Required for Obtaining Properly Sized Manhole Riser.** Measurement dimensions typically required to obtain a properly sized riser include the interior or bottom of hole dimension, the top of hole opening, the lid thickness, lid diameter, and riser height. Manufacturer’s requirements shall be consulted to ensure that the proper dimensions for the riser are obtained.

3. **Reconstructing Existing Manholes.** Major adjustments will be made by reconstruction of the manhole below the “cone” where necessary. Material excavation from around the manholes shall be replaced with concrete meeting the requirements of Item No. 300, “Concrete (Class B),” and select materials from the excavation as shown on the plans or specified by the Engineer. All excess materials shall be disposed of by the Contractor.

B. **Valve Boxes.** Perform all work in conformance with this section unless otherwise shown on the plans. Adjust existing valve boxes in situations where the finished profile of the street or sidewalk will be changed from its existing elevation. Existing valve boxes and covers which are determined by the Inspector to be in an unacceptable condition, will be removed and replaced with new boxes and/or covers. Material excavation from around the valve boxes shall be replaced with concrete meeting the requirements of Item No. 300, “Concrete (Class B),” and select materials from the excavation as shown on the plans or specified by the Engineer. Contractor shall take all necessary measures to prevent damage to existing or new boxes and covers from equipment and materials used in or taken through the work area. If an existing or new box and/or cover is/are damaged by the Contractor, it shall be replaced, as directed by the Engineer, by the Contractor at his expense.

The valve box shall be repositioned in such a manner as to prevent shock or stress from being transmitted to the valve. It shall be centered and plumb over the operating nut of the valve. Valve boxes shall be located so that the valve operating nut is readily accessible for operation through the opening in the valve box.

All valve box covers shall be raised or lowered a sufficient distance so as to be level with the finished surface course and shall not exceed ±½ inch deviation at any point between the top of valve box elevation and surface of pavement or sidewalk.

512.5. **MEASUREMENT:** Manholes adjusted, as prescribed above, will be measured by the unit of each manhole adjusted. The excavation and the amount of concrete or reinforced concrete as necessary to fill the area excavated, if required, will not be measured for payment.

512.6. **PAYMENT:** The work performed as prescribed by this item will be paid for at the contract unit price bid per manhole for “Adjusting Existing Manholes” which price shall be full compensation for all excavation, including saw cutting of surfaces as required, reinforced concrete and disposal of material excavated; for furnishing and placing all materials and for all labor, tools, equipment and incidentals necessary to complete the work.
512.7. **BID ITEM:**

- Item 512.1 - Adjusting Existing Manholes - per each
- Item 512.2 - Reconstructing Existing Manholes - per each
- Item 512.3 - Valve Box Adjustments - per each
Figure 1
Manhole Riser Detail

<table>
<thead>
<tr>
<th>Item Number</th>
<th>Item Description</th>
<th>Material Description</th>
<th>Tensile Yield</th>
<th>Tensile Ultimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3/8&quot; Roll Pins</td>
<td>302 Stainless Steel (14,000 LB Double Sheer Strength)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Steel Skirt</td>
<td>12 or 10 gage AISI 1020 Steel (A-36) G-90 Galvanized</td>
<td>33,000 P.S.I.</td>
<td>60,000 P.S.I.</td>
</tr>
<tr>
<td>3</td>
<td>Weld</td>
<td>65%-70% circumference welded</td>
<td>75,000 P.S.I.</td>
<td>85,000 P.S.I.</td>
</tr>
<tr>
<td>4</td>
<td>3/4&quot; wide Riser Bar</td>
<td>Hot Rolled Steel AISI 1020 (A-36)</td>
<td>33,000 P.S.I.</td>
<td>80,000 P.S.I.</td>
</tr>
<tr>
<td>5</td>
<td>Rod Ends</td>
<td>Forging AISI C-1030 Steel Heat Treated BH1 240 Zinc Plated with Dicromate Finish</td>
<td>70,000 P.S.I.</td>
<td>92,000 P.S.I.</td>
</tr>
<tr>
<td>6</td>
<td>Turnbuckle</td>
<td>AISI 1020 BH1 49 Zinc Plated dipped in Leadbacker rust inhibitor</td>
<td>70,000 P.S.I.</td>
<td>80,000 P.S.I.</td>
</tr>
</tbody>
</table>

City of San Antonio Standard Specifications for Construction
ITEM

513 REMOVING AND RELOCATING MAILBOXES

513.1. DESCRIPTION: This item shall govern for the removal, temporarily relocating, or replacing of mailbox assemblies of the type specified on the plans or as directed by the Engineer.

513.2. MATERIALS: Provide materials to meet the requirements of section 513.4, “Construction.”

513.3. EQUIPMENT: Provide the machinery, tools and equipment necessary for proper prosecution of the work. All machinery, tools and equipment used shall be maintained in a satisfactory and workmanlike manner.

513.4. CONSTRUCTION: Mail boxes and any supporting posts shall be removed from their present location, installed in a temporary, serviceable location or locations during construction and replaced in a permanent location as shown on the plans. Any supporting posts found to be set in concrete at the time of their removal shall be reset in the permanent location in concrete. As a minimum, each individual mailbox shall be set on a 4 inch x 4 inch wood post, equal or better than the original, at the location and to the height shown on the plans. Relocate mailbox assemblies to permanent locations upon completion of construction work.

Temporary community boxes may be required in lieu of temporarily relocating existing mail boxes. Community boxes will be installed by the U.S. Postal Service on concrete slabs installed as a part of this contract. Contractor shall install temporary concrete pads at locations and dimensions as shown on the plans, or as directed by the Inspector. Contractor shall remove concrete slabs upon completion of the project.

Mail boxes found to be set on ornamental iron, masonry or other special posts shall be relocated on such posts undamaged by the Contractor.

Maintain mailbox assemblies in a serviceable condition while in their temporary locations. The Contractor is not responsible for damage to the mailbox not of their causing while in the temporary locations. Any damage to the mail boxes, posts, supporting members, braces etc., caused by negligence of the Contractor shall be remedied by the Contractor at his expense. All such repairs shall be made in such a manner so as to insure the unit to be in as good as, or better condition than it was originally. Any such repairs shall be subject to approval by the Engineer.

513.5. MEASUREMENT:

A. Removing and Relocating Mail Boxes. “Removing and Relocating Mail Boxes” will be measured by the number of mail boxes so removed and relocated.

B. Community Mailbox Slabs. Concrete slabs for community mail boxes will be measured by the square yard, complete and in place, to include removal at job completion.

513.6. PAYMENT:

A. Removing and Relocating Mail Boxes. The work performed as prescribed by this item will be paid for at the contract unit price bid, per mail box, for “Removing and Relocating Mail Boxes” which price shall be full compensation for removing mail boxes from their present position, temporary relocation in a serviceable position, and relocation to permanent
designated location, for resetting in concrete if required, for furnishing all materials, labor, tools, equipment and incidentals necessary to complete the work.

B. **Community Mailbox Slabs.** Work performed as prescribed by this item will be paid for at the contract unit price bid per square yard, which price shall be full compensation for the construction and removal of concrete slab(s), materials including reinforcing, labor, tools, equipment and incidentals necessary to complete the work.

513.7. **BID ITEM:**

- Item 513.1 - Removing and Relocating Mail Boxes - per each
- Item 513.2 - Community Mail Box Slab - per square yard
ITEM

515 TOPSOIL

515.1. DESCRIPTION: This item shall govern for the furnishing, placing and spreading of approved selected topsoil, to the lines and grades, at locations shown on the plans or as directed by the Inspector and in conformity with these specifications.

515.2. MATERIALS: Use easily cultivated, fertile topsoil that is free from objectionable material, has a high resistance to erosion, and is able to support plant growth. Obtain topsoil from the right of way at sites of proposed excavation or embankment when specified on the plans, or as directed. Secure additional topsoil, if necessary, from approved sources outside the right of way in accordance with the requirements of TxDOT Standard Specification Item 7, Article 7.19, “Preservation of Cultural and Natural Resources and the Environment.” Ensure that the topsoil obtained from sites outside the right of way has a pH of 5.5 to 8.5. Topsoil is subject to testing by the Engineer. Use water that is clean and free of industrial wastes and other substances harmful to the growth of vegetation.

515.3. EQUIPMENT: Provide the machinery, tools and equipment necessary for proper prosecution of the work. All machinery, tools and equipment used shall be maintained in a satisfactory and workmanlike manner.

515.4. CONSTRUCTION: Remove and dispose of objectionable material from the topsoil source before beginning the work. Stockpile topsoil, when necessary, in a windrow at designated locations along the right of way line or as directed by the Engineer. Keep source and stockpile areas drained during the period of topsoil removal and leave them in a neat condition when removal is complete. Before placing topsoil, cultivate the area to a depth of 4 in. Spread the topsoil on excavated areas to a uniform loose cover at a minimum thickness of 4 in. or at the thickness specified in the plans. Water and roll the topsoil with a light roller or other suitable equipment. If the topsoil settles below the established grade after the application of water and light rolling, additional topsoil shall be added and sprinkled with water and rolled as directed by the Engineer.

515.5. MEASUREMENT: Measurement of “Topsoil” shall be made by the cubic yard in place and only for those areas designated on the plans, or to areas as directed by the Engineer.

515.6. PAYMENT: Topsoil measured as specified above will be paid for at the contract unit price bid per cubic yard, which price shall be full compensation for all hauling, placing material, sprinkling the material with water, and for all labor, equipment, tools and incidentals necessary to complete the work.

515.7. BID ITEM:

Item 515.1 - Topsoil - per cubic yard
ITEM

516 SODDING

516.1. DESCRIPTION: This item shall govern for the furnishing and planting of Bermuda, St. Augustine, Buffalo 609 or other acceptable grass sod on the areas designated on the plans or as directed by the Engineer. All planting shall be completed as soon as practical to avoid erosion of topsoil and graded areas in advance of acceptance of the work.

516.2. MATERIALS: The sod shall consist of live, growing grass secured from sources where the soil is fertile. All grass sod shall have a healthy, virile root system of dense, thickly matted roots throughout the soil of the sod for a minimum thickness of 1 inch. The Contractor shall not use sod from areas where the grass is thinned out, or where the grass roots have been dried out by exposure to air and sun to such an extent as to damage its ability to grow when transplanted. The sod shall be free from noxious weeds or other grasses and shall not contain any matter deleterious to its growth or which might affect its subsistence or hardiness when transplanted. Sources from which sod is to be obtained shall be subject to approval by the Engineer.

A. Block Sod. Use block sod free from noxious weeds, Johnson grass, other grasses, or any matter deleterious to the growth and subsistence of the sod.

B. Fertilizer. A pelleted or granulated fertilizer shall be used with an analysis of 16-8-8. (The figures in the analysis represent the percent of nitrogen, phosphoric acid, and potash nutrients respectively.) At least 50% of the nitrogen component must be of a slow-release formulation such as urea-based and plastic resin-coated fertilizers. Ensure that fertilizer is in an acceptable condition for distribution in containers labeled with the analysis. Fertilizer is subject to testing by the Texas A&M Feed and Fertilizer Control Service in accordance with the Texas Fertilizer Law.

C. Water. Use water that is clean and free of industrial wastes and other substances harmful to the growth of vegetation.

D. Mulch. When mulch is specified below the sod, use straw mulch consisting of oat, wheat or rice straw or hay mulch of either Bermudagrass or prairie grasses. Use straw or hay mulch free of Johnson grass and other noxious and foreign materials. Keep the mulch dry and do not use molded or rotted material.

E. Tacking Methods. Use a tacking agent applied in accordance with the manufacturer’s recommendations or a crimping method on all straw or hay mulch operations. Tacking agents must be approved before use, or may be specified on the plans.

516.3. EQUIPMENT: Provide the machinery, tools and equipment necessary for proper prosecution of the work. All machinery, tools and equipment used shall be maintained in a satisfactory and workmanlike manner.

516.4. CONSTRUCTION:

A. General. Cultivate the area to a depth of 4 in. before placing the sod. Plant the sod specified and mulch, if required, after the area has been completed to lines and grades as shown on the plans. Where rolling is specified by the following sub-articles, the roller shall be a light corrugated drum roller.
B. **Planting Season.** All planting shall be done between the average date of the last freeze in the spring and six weeks prior to the average date for the first freeze in the fall according to the U.S. Weather Bureau for the area.

C. **Block Sodding.** At locations shown on plans or where directed by the Engineer, sod blocks shall be carefully placed on the prepared areas. The fertilizer shall then be applied and thoroughly watered. When sufficiently dry, the sodded area shall be rolled or tamped to form a thoroughly compacted, solid mat. Any voids left in the block sodding shall be filled with additional sod and tamped.

D. **Watering.** Sod shall be thoroughly watered immediately after planting and subsequently at such intervals to promote growth or as directed by the Engineer. Furnish and operate equipment to distribute water at a uniform and controllable rate. Ensure that watering does not erode soil or plantings. Apply water in the required quantity where shown on the plans or as directed by the Engineer.

E. **Fertilizing.** The fertilizer shall be applied uniformly over the sodded areas and in the manner directed. The fertilizer shall be dry and in good physical condition. Fertilizer that is powdered or caked will be rejected. Distribution of fertilizer shall meet the approval of the Engineer. Unless otherwise indicated on the plans, fertilizer shall be applied uniformly at the average rate of 300 pounds per acre for all types of sod.

F. **Finishing.** Where applicable, the shoulders, slopes, and ditches shall be smoothed after planting has been completed and shaped to conform to the cross-section previously provided and existing at the time sodding operations were begun. Any excess dirt from the planting operations shall be spread uniformly over adjacent areas or disposed of as directed by the Engineer so that the completed surfaces will present a sightly appearance. Keep sod along edges of curbs, driveways, walkways, etc., trimmed until acceptance.

G. **Sequence of Sodding.** It is the intent of this specification that all sodding be placed and watered twice a week, unless intervening rains make watering unnecessary. Watering shall be required for at least thirty (30) days after planting to establish growth or until acceptance of the work by the City. If the season is inappropriate, the Engineer may require that the sodding operations be advanced or retarded as may seem advisable. All areas shall be covered with live sod before final acceptance. Any blocks which show no signs of life shall be replaced with live sod before the work shall be measured for payment.

516.5. **MEASUREMENT:** Measurement of acceptable “Sodding,” complete in place, will be by the square yard. Fertilizer, mulch, and water will not be measured for payment.

516.6. **PAYMENT:** “Sodding,” measured as provided above, will be paid for at the contract unit price bid per square yard, which price shall be full compensation for furnishing, hauling and placing all materials, for all fertilizer and water required and for all labor, tools, equipment and incidentals necessary to complete the work.

516.7. **BID ITEM:**

- Item 516.1 - Bermuda Sodding - per square yard
- Item 516.2 - St. Augustine Sodding - per square yard
- Item 516.3 - Buffalo 609 Sodding - per square yard
ITEM

520 HYDROMULCHING

520.1. DESCRIPTION: This item shall govern for preparing ground, providing for sowing of seeds, mulching with 70/30 wood/cellulosic blend fiber mulch, and other management practices along and across such areas as are designated on the plans and in accordance with these specifications. All areas shall be covered with live grass before acceptance.

520.2. MATERIALS:

A. Seeds. All seed must meet the requirements of the Texas Seed Law including the labeling requirements for showing purity, germination, name and type of seed. Seed furnished shall be of the previous season’s crop for the date of the project. Each variety of seed shall be furnished and delivered in separate bags or containers. A sample of each variety shall be furnished for analysis and testing when directed by the Engineer. The amount of seed planted per acre shall be of the type specified below and shall equal or exceed the following percentages for purity and germination or an equivalent amount of pure live seed.

- **Common Name:** Bermuda and Giant Bermuda grass (hulled)
- **Scientific Name:** Cynodon Dactylon
- **Purity:** 95%
- **Germination:** 90%

Annual Rye grass will be free of Johnson grass, field bind weed, dodder seed, and free of other seed to the limits allowable under the Federal Seed Act and applicable State Seed Laws.

Annual Rye grass will be added into slurry between October 1 and March 15. No additional cost will be charged to the City.

B. 70/30 Wood/Cellulose Blend Fiber Mulch. Wood/Cellulose blend fiber mulch shall consist of 70% long wood grain fibers produced from grinding clean, whole wood chips and 30% cellulose fiber produced from ground newsprint. Mulch fibers shall be free of abrasive or hard contaminants which would inhibit hydraulic pumping. The mulch fibers must maintain uniform suspension in water under agitation and shall blend with grass seed, fertilizer, and other additives to form homogeneous slurry. Upon application, the mulch material shall form a blotter-like mat covering the ground. This mat shall have the characteristics of water absorption and percolation and shall cover and bond grass seed in contact with the soil. The wood fiber mulch shall be dyed green to aid visual metering during application. The dye shall be biodegradable and not inhibit plant growth. The wood fiber mulch shall also conform to the following specifications:

1. **Percent moisture content (maximum)** 12.5% ±3.0%
2. **Percent organic matter**
   a. **Wood fiber (minimum)** 70% ±0.8% O.D. Basis

---

1 Oven Dry Basis
The wood fiber mulch shall be packaged in units not exceeding 100 lbs. and shall be suitable for outdoors storage for up to six months. The package shall contain, on current labels, the manufacturer’s name and address, net weight, and customer service telephone number.

C. **Fertilizers.** Fertilizer shall have a chemical analysis of 15-15-15 with micronutrients and shall be water soluble (The figures in the analysis represent the percent of nitrogen, phosphoric acid and potash nutrients, respectively). Fifty percent or greater of the Nitrogen required shall be in the form of Nitrate Nitrogen (N\(_{2}\)). The remaining Nitrogen required may be in the form urea Nitrogen (C0(NH\(_{2}\))\(_{2}\)).

In the event it is necessary to substitute a fertilizer of a different analysis, it shall be a pelleted or granulated fertilizer with a lower concentration, but the total amount of nutrients furnished and applied per acre shall equal or exceed that specified for each nutrient.

The fertilizer shall be dry and in good physical condition. Fertilizer that is powdered or caked will be rejected.

D. **Tactifier and Binder.** Natural vegetable gum containing gelling and hardening agents that when mixed with water and properly cured, shall form an insoluble network.

E. **Water.** Shall be furnished by the contractor and shall be clean and free of substances harmful to the growth of vegetation.

F. **Herbicide.** Herbicide used shall be an easy to apply, effective in a short term, chemical agent to inhibit or destroy weed growth, while being harmless to seed and grass being implanted.

G. **Topsoil.** Topsoil shall conform to the provisions of Item 515, “Topsoil.”

520.3. **EQUIPMENT:** Provide the machinery, tools and equipment necessary for proper prosecution of the work. All machinery, tools and equipment used shall be maintained in a satisfactory and workmanlike manner.

520.4. **CONSTRUCTION:**

A. **General.** Security of stored hydromulch materials will be the sole responsibility of the Contractor at no additional expense to the City.

It is the contractor's responsibility to verify the location of all utility lines, electric cables, sprinkling systems and conduits so that the proper precautions must be taken not to disturb or damage any subsurface improvements. Should obstructions be found, the Contractor will promptly notify the City Inspector. Any damage caused by the contractor shall be repaired by himself at no cost to the City. Any such repairs shall be subject to approval by the Inspector.

B. **Preparation of Subsoil.** Inspect subsoil for the presence of objectionable materials, such as rocks (2 inches in diameter and larger), concrete waste, building debris, weeds, grass or other
material that would be detrimental to the growth of grasses. Protect existing underground improvements from damage.

Cultivate to a depth of 3 inches in areas to receive hydromulch. If compaction is due to equipment, traffic or storage, cultivate to a depth of 6 inches, and apply herbicide as directed by manufacturer.

Remove any foreign or objectionable materials collected during cultivation.

Grade placement area to eliminate rough spots and low areas where ponding may occur. Assure positive drainage away from all buildings. Maintain smooth, uniform grades.

Hydromulch area and weed control shall consist of killing all weeds and maintaining a weed-free condition until completion of the project by applying herbicide as directed by the manufacturer.

C. **Seeded Lawns.** The following construction sequences and procedures shall be observed:

1. The contractor shall notify the Inspector not less than 48 hours in advance of any seeding operation and shall not begin the work until areas prepared or designated for seeding have been approved.
2. Before placement of hydromulch, all areas shall be cultivated to a depth of 3 inches unless otherwise specified or ordered by the Engineer. Cultivation of the soil may be done by disc, spring tooth harrow, roto-tiler, or similar equipment. This operation shall be done at right angles to the natural flow of water on the slopes.
3. The area shall then be rolled in two directions; the second shall be done at right angles to the first rolling.
4. Rake the area to make it smooth and level. Add soil where necessary or as directed by the Inspector.
5. The finished grade shall be 1 inch below all curbs, sidewalks, and/or other appurtenances.
6. Apply the fertilizer at the rate and mixture specified. The fertilizer shall be applied by an approved hand or mechanical method.
7. Roll the area in one direction.
8. Slurry to be sprayed evenly in two intersecting directions with a hydraulic seeder.
9. Erect a barrier of stakes and strings, and post warning signs where necessary, or as directed by the Inspector.
10. Apply water as required to keep the mulch damp at all times throughout germination and initial growth period as determined by the Inspector.
11. Upon completion, all excess material shall be removed and disposed of off the project site at contractor's expense.

D. **Slurry.** The slurry will be mixed and spread uniformly over the area at the following rate for both residential and commercial areas:
E. Guarantee and Lawn Established Period. The guarantee and lawn established period shall begin immediately after the completion of the planting and shall start with the Provisional Acceptance and end with the Final Acceptance.

1. Provisional Acceptance. Upon completion of hydromulching and written request of Contractor, the Inspector will inspect all the work for Provisional Acceptance.

2. Guarantee Period. The guarantee period shall begin upon completion of the provisional acceptance. All plant materials shall be guaranteed by the Contractor for a period of thirty days (30) from the date of provisional acceptance, to be in good, healthy, and nourished condition. The exceptions are damages resulting from neglect by the property owner, abuse or damage by others, or unusual phenomena or incidents which are beyond the Contractor's control.

During the lawn establishment period, it shall be the contractor's responsibility to ensure the continuing healthy growth. This care shall include labor, water and material necessary to keep the project in a presentable condition, including but not limit to removal of litter, mowing, trimming, removal of grass clippings, edging, fertilization, insecticide and fungicide applications, weed control, and repair and reseeding any and all damaged areas.

Water application shall be accomplished each week from March through October. An even application of one inch minimum of water shall be required over all lawn areas weekly. The rate and frequency of water application may be changed, as directed by the Inspector, depending on weather, and soil conditions.

3. Replacement. The Contractor shall replace, without cost to the City, and as soon as weather conditions permit, all dead grassed areas not in a vigorous, thriving condition, as determined by the Inspector during and at the end of the guarantee period. Replacements shall be subject to all requirements stated in this specification. The Contractor shall make all necessary repairs to grades, grassed areas, and terrace paving required because of grass replacement at no cost to the City.

4. Final Inspection and Acceptance. At the end of the guarantee period and upon written request of the contractor, the Inspector will inspect all guaranteed work for final acceptance. The written request shall be submitted to the City ten (10) days prior to the anticipated date of inspection.

Acceptance of hydromulching lawn as herein specified shall be based on a uniform stand of grass and a uniform grade at the time of final inspection. Area of two square feet or more that are bare or have a poor stand of grass and area not having a uniform grade for any cause before final inspection shall be regraded, rehydromulched and reseeded as specified at the Contractor's expense.
Upon completion by the Contractor of all repairs or renewals which may appear at that time to be necessary in the judgment of the City or its authorized representative, the final acceptance of the hydromulching will be issued.

520.5. **MEASUREMENT:** Measurement of acceptable “Hydromulching,” complete in place, shall be made by the square yard and only for those areas designated on the plans, or for other areas directed by the Inspector. Fertilizers, wood cellulose fibers, seeds, herbicide and water will not be measured for payment.

520.6. **PAYMENT:** “Hydromulching,” measured as provided above, will be paid for at the contract unit price bid per square yard, which price shall be full compensation for furnishing, hauling and placing all materials, for all fertilizer and water required and for all labor, tools, equipment and incidentals necessary to complete the work.

520.7. **BID ITEM:**

Item 520.1 - Hydromulching (Residential or Commercial) - per square yard
ITEM

530 BARRICADES, SIGNS, AND TRAFFIC HANDLING

530.1. DESCRIPTION: This item shall govern for providing, installing, moving, repairing, maintaining, cleaning and removing upon completion of work, all barricades, signs, cones, lights and other such type devices and of handling traffic as indicated on the plans or as directed by the Engineer.

530.2. GUIDELINES FOR BARRICADING ON CITY RIGHT-OF-WAY: The barricade contractor must locally maintain sufficient materials in stock to accommodate three or more construction phases per project. These will include all applicable traffic control sign types, trucks, trailers, arrow boards, and all other traffic control devices assigned to the Contractor’s barricading operation.

The Texas Manual on Uniform Traffic Control Devices (TMUTCD), Section 6A-6, requires the appropriate training for all personnel who are involved in the selection, placement, and maintenance of traffic control devices on construction projects. The City of San Antonio requires that all personnel associated with barricading operations and traffic handling possess certificates from either of the two groups listed in Table 1 below. Each certificate will be valid for four years.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Barricading Training</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Texas Engineering Extension Service</td>
</tr>
<tr>
<td></td>
<td>Work Zone Traffic Control</td>
</tr>
</tbody>
</table>

The Contractor shall have a minimum of one barricade supervisor and three persons who are responsible for construction work zone traffic control. These persons shall be based in the San Antonio metropolitan area and their sole tasks shall be implementing and maintaining construction work zone traffic control devices.

The Contractor shall have a commercial telephone answering service during non-working hours. The Contractor shall provide the City during working hours with an office telephone number, pager number, and cellular telephone number to contact the barricading supervisor. The contractor must be able to respond to any call within two hours. The barricading contractor or General Contractor must possess liability insurance in the minimum amount of one million dollars. A copy of the liability policy must be sent to the City Traffic Engineer for approval 48 hours prior to starting barricading operations.

The contractor shall comply with all standards set forth in the plan barricade detail sheets. One noncompliance letter issued by the City to the Contractor in regard to construction work zone traffic control, and not corrected within 48 hours, will be cause for delay of payment for this item.

If the general contractor elects to do his own barricading, he must comply with all the foregoing requirements. Additionally, a general contractor will be required to submit a traffic control plan (TCP) at least 72 hours in advance (excluding weekends and holidays) of starting work in each construction phase. Upon satisfactory evidence of competent barricading expertise, this requirement for a traffic control plan may be waived by the City Traffic Engineer.
530.3. **EQUIPMENT:** Provide the machinery, tools and equipment necessary for proper prosecution of the work. All machinery, tools and equipment used shall be maintained in a satisfactory and workmanlike manner.

530.4. **CONSTRUCTION:** All barricades, signs, and other types of devices listed above shall conform to the requirements of the TMUTCD. It is the contractor’s responsibility to see that all traffic control devices are properly installed and maintained at the job site. If it is determined by the Traffic Engineering Representative that the traffic control devices do not conform to the established standards, or are incorrectly placed to protect the general public, the Traffic Engineer shall have the option to stop the work, at no expense to the City, until the situation is corrected by the Contractor. If it is determined that additional temporary traffic control devices, special directional devices, and/or business name signs are required, they will be provided by the contractor at no additional cost. As work progresses, the location of temporary traffic control devices will be adjusted and modified as necessary by the Contractor.

All retro reflective traffic control devices such as barricades, vertical panels, signs, etc., shall be maintained by cleaning, replacing or a combination thereof such that during darkness and rain, the retro reflective characteristics shall equal or exceed the retro reflective characteristics of the standard reflective panels in the Inspector’s possession.

The contractor shall contact the City of San Antonio Traffic Operations Section prior to removing any traffic signs or traffic signals. Prior to completion of the contract and removal of barricades, all applicable permanent traffic signs and signals must be in place and functioning properly. All permanent signs or traffic control devices missing or damaged during construction shall be replaced at the contractor’s expense. Permanent pavement marking shall be applied prior to the opening of any street to traffic. Temporary short-term expendable pavement markings may be provided prior to application of permanent markings.

The contractor must maintain all streets open to through traffic by repairing trenches, potholes, etc., at no direct payment. The contractor shall provide reasonable access to residences and all businesses within all phases of the work, as well as providing suitable access accommodations for school children, pedestrians, garbage pick-up and mail delivery by the US Postal Service. Temporary pedestrian crossing will be determined in the field by the Police Department School Services Unit. Temporary pedestrian crossings shall be 4 feet wide by 4 inches thick asphalt treated base or asphaltic concrete and will be paid for under Item 206, “Asphalt Treated Base” or Item 205, “Hot Mix Asphaltic Concrete Pavement,” respectively.

When flagging is required by the plans or Traffic Control Plan, provide a Contractor representative who has been certified as a flagging instructor through courses offered by the Texas Engineering Extension Service, the American Traffic Safety Services Association, the National Safety Council, or other approved organizations. Provide the certificate indicating course completion when requested. This representative is responsible for training and assuring that all flaggers are qualified to perform flagging duties. A qualified flagger must be independently certified by one of the organizations listed above or trained by the Contractor’s certified flagging instructor. Provide the Engineer with a current list of qualified flaggers before beginning flagging activities. Use only flaggers on the qualified list.

Flaggers must be courteous and able to effectively communicate with the public. When directing traffic, flaggers must use standard attire, flags, signs, and signals and follow the flagging procedures set forth in the TMUTCD.

530.5. **MEASUREMENT:** This item will be measured by “Lump Sum” as indicated on the plans.
530.6. **PAYMENT:** This item will be paid for at the contract lump sum price bid for “barricades, signs, and traffic handling”. This price shall be full compensation for furnishing all labor, materials, supplies, equipment and incidentals necessary. To complete the work as specified. The lump sum price will be pro-rated based on the number of workdays in the project contract. Failure to complete the work within time allowed in the project contract due to approving designs, testing, material shortages, closed construction season, curing periods, and testing periods will not qualify for additional compensation. When additional work is added by an approved field alteration or when work is suspended for the convenience of the City, through no fault of the contractor, additional compensation may be paid to the Contractors.

530.7. **BID ITEM:**

Item 530.1 - Barricades, Signs and Traffic Handling - lump sum
ITEM

535 HOT APPLIED THERMOPLASTIC PAVEMENT MARKINGS

535.1. DESCRIPTION: Apply thermoplastic pavement markings, in conformance with the minimum optical and physical properties required for a thermoplastic road marking compound described herein, in a molten state, onto a pavement surface.

535.2. MATERIALS: All materials shall conform to the requirements of TxDOT DMS-8220 “Hot Applied Thermoplastic.” Thermoplastic materials shall be stored in a dry environment to minimize the amount of moisture retained during storage.

535.3. EQUIPMENT: Provide the necessary equipment to conduct the work specified herein. All equipment shall be maintained in good working order such that neat and clean thermoplastic markings are applied at the proper thicknesses and glass beads are placed at the correct rate. Equipment that is deemed deficient by the Engineer shall be replaced immediately.

535.4. CONSTRUCTION: The appearance of the finished markings shall have a uniform surface, crisp edges with a minimum over-spray, clean cut-off, meet straightness requirements and conform to the design drawings and/or engineer instructions.

The contractor shall provide the Engineer with certification from the marking manufacturer that contractor has been adequately trained and certified to apply the manufacturer's material. This certification shall be considered current if the certification date provided by the manufacturer is within two years of the date of marking application.

All striping and pavement markings shall be placed in accordance with the requirements of this specification, the detailed plans, and the current edition of the *Texas Manual on Uniform Traffic Control Devices* (TMUTCD). The Contractor shall provide all other engineering services necessary for pre-marking of all proposed stripe within the limits of the designated work.

Unless authorized otherwise in writing by the Engineer, striping shall be accomplished during daylight hours. Approved lighting arrangements will be required for night time operations when allowed.

The Contractor may be required to place markings over existing markings, as determined by the Engineer. The contractor shall adjust the operation of the thermoplastic screed shoe to match the previous lengths of stripes and skips, when necessary.

Failure of the striping material to adhere to the pavement surface during the life of the contract shall be prima facie evidence that the materials, even though complying with these specifications, or the application thereof, was inconsistent with the intent of the requirements for the work under the latest City specifications and shall be cause for ordering corrective action or replacement of the marking without additional cost to the City.

Unless otherwise approved by the Engineer, permanent pavement markings on newly constructed pavements surfaced with asphaltic concrete or bituminous seals shall not be applied for a minimum of 14 days or a maximum 35 days. Temporary pavement marking shall be provided during the 14 to 35 day period.
A. Surface Preparation.

1. Moisture. All surfaces shall be inspected for moisture content prior to application of thermoplastic. Approximately two square feet of a clear plastic or tar paper shall be laid on the road surface and held in place for 15 to 20 minutes. The underside of the plastic or tar paper shall then be inspected for a buildup of condensed moisture from the road surface. Pavement is considered dry if there is no condensation on the underside of the plastic or tarpaper. In the event of moisture, this test shall be repeated until there is no moisture on the underside of the plastic or tar paper.

2. Cleaning. All surfaces shall be clean and dry, as defined in Section 535.4.A.1, before thermoplastic can be applied. Loose dirt and debris shall be removed by thoroughly blowing compressed air over the area to be striped. If the thermoplastic is to be applied over existing paint lines, the paint line shall be swept with a mechanical sweeper or wire brush to remove poorly adhered paint and dirt that would interfere with the proper bonding or the thermoplastic. Additional cleaning through the use of compressed air may be required to remove embedded dirt and debris after sweeping. Latence and curing compound shall be removed from all new portland cement concrete surfaces in accordance with Item 533, “Removal of Pavement Markings and Markers.”

3. Layout. The pavement markings shall be placed in proper alignment with guidelines established on the roadway. Deviation from the alignment established shall not exceed 2 inches and, in addition, the deviation in alignment of the marking being placed shall not exceed 1 inch per 200 feet of roadway nor shall any deviation be abrupt. No striping material shall be applied over a guide cord; only longitudinal joints, existing stripes, primer, or other approved type guides will be permitted. In the absence of a longitudinal joint or existing stripe, the Contractor shall mark the points necessary for the placing of the proposed stripe. Edge striping shall be adjusted as necessary so that the edge stripe will be parallel to the centerline and shall not be placed off the edge of the pavement.

Longitudinal markings shall be offset at least 2-inches from construction joints of portland cement concrete surfaces and joints and shoulder breaks of asphalt surfaces.

4. Primer Sealer. Primer sealer shall be used on all portland cement concrete surfaces. A primer sealer shall be used on asphalt surfaces that are over two years old and/or on asphalt surfaces that are worn or oxidized to a condition where 50 percent or more of the wearing surface is exposed aggregate. Existing pavement markings may act as the primer sealer if, after cleaning, more than 70 percent of the existing pavement marking is still properly bonded to the asphalt surface (see coverage check procedure in Appendix A to estimate percent of marking remaining).

5. Primer Sealer Application. When required as described, the primer-sealer shall be applied to the road surface in a continuous film at a minimum thickness of 3 to 5 mils. Before the Thermoplastic is applied, the primer-sealer shall be allowed to dry to a tacky state. The thermoplastic shall be applied within 4 hours after the primer application.

B. Temperature Requirements.

1. Ambient Conditions. The ambient air and road surface shall be 55°F and rising before application of thermoplastic can begin.
2. **Material Requirements.** Unless otherwise specified by the material manufacturer, the thermoplastic compound shall be heated from 400°F to 450°F and shall be a minimum of 400°F as it makes contact with road surface during application. An infrared temperature gun shall be used to determine the temperature of the thermoplastic as it is being applied to the road surface.

C. **Drop-on Glass Sphere Application.**

1. **Application Rate.** Retro-reflective glass spheres shall be applied at the rate of 10 pounds per 100 square feet of applied markings. This application rate shall be determined by confirming the following consumption rates:

   a. 200 pounds of drop on glass spheres per ton of applied thermoplastic when the thermoplastic is being applied at 0.090 inch film thickness.

   b. 150 pounds of drop on glass spheres per ton of applied thermoplastic when the thermoplastic is being applied at 0.125 inch thickness.

2. **Application Method.** Retro-reflective glass spheres shall be applied by a mechanical dispenser property calibrated and adjusted to provide proper application rates and uniform distribution of the spheres across the cross section of the entire width of the line. To enable the spheres to embed themselves into the hot thermoplastic, the sphere dispenser shall be positioned immediately behind the thermoplastic application device. This insures that the spheres are applied to the thermoplastic material while it is still in the molten state.

D. **Application Thickness.**

1. **Longitudinal and Transverse Markings.** On previously unmarked pavements or pavements where markings have been effectively removed, all lane lines, center lines, transverse markings and pavement markings in traffic areas with ≤1,000 vehicles per day per lane shall have a minimum film thickness of 0.090 inch at the edges and a maximum of 0.145 inch at the center. A minimum average film thickness of 0.090 inch shall be maintained. On pavements with existing markings, meeting the traffic requirements stated above, all lane lines, center lines, transverse markings and pavement markings shall have a minimum film thickness of 0.060 inch for re-application over existing strip line.

2. **High Wear Longitudinal and Transverse Marking.** On previously unmarked pavements or pavements where markings have been effectively removed, all lane lines, center lines, transverse markings and pavement markings in high traffic areas (>1,000 vehicles per day per lane) shall have a minimum film thickness of 0.125 inch at the edges and a maximum of 0.188 inch at the center. A minimum average film thickness of 0.125 inch shall be maintained. On pavements with existing markings, meeting the traffic requirements stated above, all lane lines, center lines, transverse markings and pavement markings shall have a minimum film thickness of 0.090 inch for re-application over existing strip line.

E. **Packaging.**
1. **Containers.** The thermoplastic material shall be delivered in 50 pound containers or bags of sufficient strength to permit normal handling during shipment and handling on the job without loss of material.

2. **Labeling.** Each container shall be clearly marked to indicate the color of the material, the process batch number and/or manufacturer’s formulation number, the manufacturer's name and address and the date of manufacture.

F. **Acceptance.**

1. **Sampling Procedure.** Random samples may be taken at the job site at the discretion of the City Engineer for quality assurance. The City reserves the right to conduct the tests deemed necessary to identify component materials and verify results of specific tests indicated in conjunction with the specification requirements.

   The sample(s) shall be labeled as to the shipment number, lot number, date, quantity, and any other pertinent information. At least three randomly selected bags shall be obtained from each lot. A 10 pound) sample from the three bags shall be submitted for testing and acceptance. The lot size shall be approximately 44,000 pounds unless the total order is less than this amount.

2. **Manufacturer’s Responsibility.**
   
a. **Sampling and Testing.** The manufacturer shall submit test results from an approved independent laboratory. All material samples shall be obtained 20 days in advance of the pavement marking operations. The cost of testing shall be included in the price of thermoplastic material. The approved independent laboratory's test results shall be submitted to the City Traffic Engineer in the form of a certified test report.

   b. **Bill of Lading.** The manufacturer shall furnish the Material and Tests Laboratory with copies of Bills of Lading for all materials inspected. Bill of lading shall indicate the consignee and the destination, date of shipment, lot numbers, quantity, type of material, and location of source.

   c. **Material Acceptance.** Final acceptance of a particular lot of thermoplastic will be based on the following.

      (1) Compliance with the specification for material composition requirements verified by approved independent laboratory with tests results.

      (2) Compliance with the specification for the physical properties required and verified by an approved independent laboratory with test results.

      (3) Manufacturer's test results for each lot thermoplastic have been received.

      (4) Identification requirements are satisfactory.

3. **Contractor’s Responsibility.**
   
a. **Notification.** The contractor shall notify the Construction Inspector 72 hours prior to the placement of the thermoplastic markings to enable the inspector to be present during the application operation. At the time of notification, the Contractor shall indicate the manufacturer and the lot numbers of the thermoplastic that will be used.
A check should be made by the contractor to insure that the approved lot numbers
appear on the material package. Failure to do so is cause for rejection.

b. Warranty or Guarantee. If the normal trade practice for manufacturers is to furnish
warranties or guarantees for the materials and equipment specified herein, the
Contractor shall turn the guarantees and warranties over to the Engineer for potential
dealing with the manufactures. The extent of such warranties or guarantees will not
be a factor in selecting the successful bidder.

535.5. MEASUREMENT: Measurement shall be based on the length of satisfactorily installed line, in
feet, or as appropriate, the number of symbols or words which are satisfactorily installed on the
roadway surface by the contractor.

535.6. PAYMENT: Payment shall be according to the quantities measured for each bid item.

535.7. BID ITEM:

Item 535.1 - 4 inch wide yellow line
Item 535.2 - 4 inch wide white line
Item 535.3 - 8 inch wide yellow line
Item 535.4 - 8 inch wide white line
Item 535.5 - 12 inch wide white line
Item 535.6 - 16 inch wide white line
Item 535.7 - 24 inch wide white line
Item 535.8 - Right White Arrow (per each)
Item 535.9 - Left White Arrow (per each)
Item 535.10 - Combination Thru/Right White Arrow (per each)
Item 535.11 - Combination Thru/Left White Arrow (per each)
Item 535.12 - Word “ONLY” (per word)
Item 535.13 - Straight White Arrow (per each)
Item 535.14 - Railroad Crossing Symbol, including two R's, crossbuck and 3 transverse bars (per
each)
Item 535.15 - White Diamond (per each)
Item 535.16 - Straight White Arrow Bicycle Facility (per each)
Item 535.17 - Bicycle Rider Symbol (per each)
Item 535.18 - Solid White Yield Lines (6” x 9”) (per each)
Item 535.19 - Word “STOP” (per word)

Item 535.20 - Word “YIELD” (per word)

Item 535.21 - Word “BUS) (per word)
**APPENDIX A: Method for Estimating Amount of Marking Bonded to Pavement**

This inspection will ensure uniformity of coverage of the entire line, such as paint cracking, peeling, and whether or not the marking has adequate coverage. One-square-inch sections of transparent material inscribed within a grid of 100 equal squares shall be used as a tool for quantitative measure of specified percentage of coverage. The grid concept was taken from the Air Force who used it for measuring rubber coverage on pavement. For a 4-inch line, it is suggested that a grid of 4 x 25 inches be used, and for a 12-inch (or larger) line, a grid of 10 x 10 inches. Count the squares that have no paint, e.g., 3 out of 100 squares equal 3% of the paint gone or 97% coverage.

Follow the steps below to take the readings of the pavement markings:

1. Using either the 10- x 10-inch grid or the 4- x 25-inch grid, place the grid on the line to be evaluated.

2. Count the squares that have no paint.

3. The number of squares without paint will be the percentage of paint gone. In other words, if there are 30 out of 100 squares that have no paint, then 30% of the paint is gone.

ITEM

540 TEMPORARY EROSION, SEDIMENTATION AND WATER POLLUTION PREVENTION AND CONTROL

540.1. DESCRIPTION: This item shall govern the control measures necessary to prevent and control soil erosion, sedimentation and water pollution which may degrade receiving waters including rivers, streams, lakes, reservoirs, tidal water, groundwater and wetlands.

Note: The control measures contained herein shall be installed and maintained throughout the construction contract and coordinated with the permanent or existing temporary pollution control features specified elsewhere on the plans and in the specifications to assure effective and continuous water pollution control throughout the construction and post construction period. These control measures shall not be used as a substitute for the permanent pollution control measures unless otherwise directed by the Engineer in writing. The controls may include sediment control fences, inlet protection, baled hay, rock filter dams, dikes, swales, sediment traps and basins, pipe slope drains, paved flumes, construction exits, temporary seeding, sodding, mulching, soil retention blankets or other structural or non-structural water pollution controls. This item does not apply to commercial operations.

540.2. MATERIALS: The items, estimated quantities and locations of the control measures are shown on the plans; however, the Engineer may increase or decrease the quantity of these items as the need arises. The materials will be shown on the plans and in this specification. The Engineer may allow other materials and work as the need arises and as approved in writing. Pollution control measures may be applicable to contractor operations outside the right of way where such work is necessary as a result of roadway related construction such as construction and haul roads, field offices, equipment and supply areas, and materials sources.

Unless otherwise shown on the plans, provide materials that meet the following requirements:

A. Rock Filter Dams.

1. Aggregate. Furnish aggregate with hardness, durability, cleanliness, and resistance to crumbling, flaking, and eroding acceptable to the Engineer. Provide the following:
   - Types 1, 2, and 4 Rock Filter Dams. Use 3 to 6 in. aggregate.
   - Type 3 Rock Filter Dams. Use 4 to 8 in. aggregate.

2. Wire. Provide minimum 20 gauge galvanized wire for the steel wire mesh and tie wires for Types 2 and 3 rock filter dams. Type 4 dams require:
   - a double-twisted, hexagonal weave with a nominal mesh opening of 2½ in. x 3¼ in.;
   - minimum 0.0866 in. steel wire for netting;
   - minimum 0.1063 in. steel wire for selvages and corners; and
   - minimum 0.0866 in. for binding or tie wire.

3. Sandbag Material. Furnish sandbags meeting Section 540.2.1, “Sandbags,” except that any gradation of aggregate may be used to fill the sandbags.
B. **Temporary Pipe Slope Drains.** Provide corrugated metal pipe, polyvinyl chloride (PVC) pipe, flexible tubing, watertight connection bands, grommet materials, prefabricated fittings, and flared entrance sections that conform to the plans. Recycled and other materials meeting these requirements are allowed if approved. Furnish concrete in accordance with Item 505, “Concrete Riprap.”

C. **Baled Hay.** Provide hay bales weighing at least 50 lb., composed entirely of vegetable matter, measuring 30 in. or longer, and bound with wire, nylon, or polypropylene string.

D. **Temporary Paved Flumes.** Furnish asphalt concrete, hydraulic cement concrete, or other comparable non-erodible material that conforms to the plans. Provide rock or rubble with a minimum diameter of 6 in. and a maximum volume of ½ cu. ft. for the construction of energy dissipaters.

E. **Construction Exits.** Provide materials that meet the details shown on the plans and this Section.

1. **Rock Construction Exit.** Provide crushed aggregate for long and short-term construction exits. Furnish aggregates that are clean, hard, durable, and free from adherent coatings such as salt, alkali, dirt, clay, loam, shale, soft, or flaky materials and organic and injurious matter. Use 4- to 8- in. rock for Type 1 and 2- to 4- in. rock for Type 3. Unless otherwise shown on the plans, provide a light weight (4 oz.) non-woven filter fabric below the ballast to prevent mud and sediment migration.

2. **Timber Construction Exit.** Furnish No. 2 quality or better railroad ties and timbers for long-term construction exits, free of large and loose knots and treated to control rot. Fasten timbers with nuts and bolts or lag bolts, of at least ½ in. diameter, unless otherwise shown on the plans or allowed. For short-term exits, provide plywood or pressed wafer board at least ½ in. thick.

3. **Foundation Course.** Provide a foundation course consisting of flexible base, bituminous concrete, hydraulic cement concrete, or other materials as shown on the plans or directed.

F. **Embankment for Erosion Control.** Provide rock, loam, clay, topsoil, or other earth materials that will form a stable embankment to meet the intended use.

G. **Pipe.** Provide pipe outlet material in accordance with TxDOT Standard Specification Item 556, “Pipe Underdrains,” and details shown on the plans.

H. **Construction Perimeter Fence.**

1. **Posts.** Provide essentially straight wood or steel posts that are at least 60 in. long. Furnish soft wood posts with a minimum diameter of 3 in. or use 2 x 4 boards. Furnish hardwood posts with a minimum cross-section of 1½ x 1-1/5 in. Furnish T- or L-shaped steel posts with a minimum weight of 0.95 lb. per foot.

2. **Fence.** Provide orange construction fencing as approved by the Engineer.

3. **Fence Wire.** Provide 14 gauge or larger galvanized smooth or twisted wire. Provide 16 gauge or larger tie wire.
4. **Flagging.** Provide brightly-colored flagging that is fade-resistant and at least ¾ in. wide to provide maximum visibility both day and night.

5. **Staples.** Provide staples with a crown at least ½ in. wide and legs at least ½ in. long.

6. **Used Materials.** Previously used materials meeting the applicable requirements may be used if accepted by the Engineer.

I. **Sandbags.** Provide sandbag material of polypropylene, polyethylene, or polyamide woven fabric with a minimum unit weight of 4 oz. per square yard, a Mullen burst-strength exceeding 300 psi, and an ultraviolet stability exceeding 70%. Use natural coarse sand or manufactured sand meeting the gradation given in Table 1 to fill sandbags. Filled sandbags must be 24 to 30 in. long, 16 to 18 in. wide, and 6 to 8 in. thick.

<table>
<thead>
<tr>
<th>Sieve #</th>
<th>Maximum Retained ( % by Weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>3%</td>
</tr>
<tr>
<td>100</td>
<td>80%</td>
</tr>
<tr>
<td>200</td>
<td>95%</td>
</tr>
</tbody>
</table>

J. **Temporary Sediment Control Fence.** Provide a net-reinforced fence using woven geo-textile fabric. Logos visible to the traveling public will not be allowed.

1. **Fabric.** Provide fabric materials in accordance with TxDOT DMS-6230, “Temporary Sediment Control Fence Fabric.”

2. **Posts.** Provide essentially straight wood or steel posts with a minimum length of 48 in., unless otherwise shown on the plans. Soft wood posts must be at least 3 in. in diameter or nominal 2 x 4 in. Hardwood posts must have a minimum cross-section of 1½ x 1½ in. T- or L-shaped steel posts must have a minimum weight of 0.95 lb. per foot.

3. **Net Reinforcement.** Provide net reinforcement of at least 14 gauge galvanized welded wire mesh, with a maximum opening size of 2 x 4 in., at least 24 in. wide, unless otherwise shown on the plans.

4. **Staples.** Provide staples with a crown at least ¾ in. wide and legs ½ in. long.

5. **Used Materials.** Use recycled material meeting the applicable requirements if accepted by the Engineer.

K. **Curb Inlet Gravel Filters.**

1. **Gravel Filter Bags.** Furnish gravel filter bags meeting Section 540.2.1, “Sandbags.” Gravel bags shall be filled with ¾ inch gravel.

2. **Concrete Masonry Units.** Hollow, Non-Load-Bearing Concrete blocks of 1500-2000 psi, 28-day compressive strength concrete shall be used with dimensions of 8” x 6” x6” width, height, and length, respectively.

3. **Wood Blocks.** Wolmanized treated 2” x 4” lumber with the length as per inlet size.
540.3. **EQUIPMENT.** Provide a backhoe, front end loader, blade, scraper, bulldozer, or other equipment as required when “Earthwork for Erosion Control” is specified on the plans as a bid item.

540.4. **CONSTRUCTION:** The contractor shall provide control measures to prevent or minimize the impact to receiving waters as required by the plans and/or as directed by the Engineer in writing.

A. **Contractor Responsibilities.**

1. **SW3P.** Implement the City’s Storm Water Pollution Prevention Plan (SW3P) for the project site in accordance with the specific or general storm water permit requirements. Prevent water pollution from storm water associated with construction activity from entering any surface water or private property on or adjacent to the project site. The Contractor shall effectively prevent and control erosion and sedimentation on the site at the earliest practicable time as outlined in the approved schedule. Control measures, where applicable, will be implemented prior to the commencement of each construction operation or immediately after the area has been disturbed.

2. **Preconstruction Submittals.**

   a. **Operations on Right of Way.** Prior to the start of construction, the Contractor shall submit to the Engineer, for approval, schedules for accomplishment of the pollution control measures in accordance with the Storm Water Pollution Prevention Plan (SW3P). A plan for the disposal of waste materials generated on the project site must be submitted for approval, also. The Contractor shall submit to the Engineer, for approval, the proposed SW3P for the industrial activities (such as hot mix plants, concrete batch plants, or material handling areas) on the right of way.

   b. **Operations off Right of Way.** The Contractor shall provide the Engineer, for information purposes only, proposed methods of pollution control for Contractor operations in areas which are outside the right of way (such as construction and haul roads, field offices, equipment and supply areas, and material sources).

   Pollution control measures for the Contractor's facilities off the right of way are not covered by the City's Environmental Protection Agency (EPA) NPDES general permit. The Contractor shall obtain his own Notice of Intent for the off-site operations. These pollution controls will not be measured for payment but shall be performed at the Contractor's expense.

B. **General.**

1. **Phasing.** Implement control measures in the area to be disturbed before beginning construction, or as directed. Limit the disturbance to the area shown on the plans or as directed. If, in the opinion of the Engineer, the Contractor cannot control soil erosion and sedimentation resulting from construction operations, the Engineer will limit the disturbed area to that which the Contractor is able to control. Minimize disturbance to vegetation.

2. **Rainfall Events.** A rain gauge shall be provided by the Contractor and located at the project site. Within 24 hours of a rainfall event of ½ inch or more as measured by the project rain gauge, the Contractor and Inspector will inspect the entire project to
determine the condition of the control measures. Maintain control measures in accordance with Item 540.4.B.3, “Maintenance.”

3. **Maintenance.** Correct ineffective control measures in accordance with this section. Implement additional controls as directed. Remove excavated material within the time requirements specified in the applicable storm water permit.

Following a rain event as described in Item 540.4.B.2, Rainfall Event,” sediment will be removed and devices repaired as soon as practicable but no later than 7 days after the surrounding exposed ground has dried sufficiently to prevent further damage from equipment needed for repair of control measures.

In the event of continuous rainfall over a 24-hour period, or other circumstances that preclude equipment operation in the area, the Contractor will hand carry and install additional backup devices as determined by the Engineer. The Contractor will remove silt accumulations and deposit the spoils in an area approved by the Engineer as soon as practical. Any corrective action needed for the control measures will be accomplished in the sequence directed by the Engineer; however, areas adjacent to waterbodies shall generally have priority followed by devices protecting storm sewer inlets.

4. **Stabilization.** Stabilize disturbed areas where construction activities will be temporarily stopped, or construction becomes inactive, in accordance with the applicable storm water permit. Inactive construction areas are defined as areas in which no construction activity will occur for a period of 30 days or longer. Inactive construction areas which have been disturbed will require stabilization through the use of vegetation, mulch, erosion control matting or structural methods within 7 calendar days from the last construction activity in the area. At all times prior to stabilization, inactive construction areas shall be considered as active, disturbed construction area, contributing to the sediment loading at the site control systems. After stabilization, inactive construction areas will be considered undisturbed areas, eliminating the contribution of sediment to the erosion control devices.

5. **Finished Work.** Upon acceptance of vegetative cover, remove and dispose of all temporary control measures, temporary embankments, bridges, matting, falsework, piling, debris, or other obstructions placed during construction that are not a part of the finished work, or as directed. Soil retention blankets shall be removed only when, in the opinion of the Engineer, final permanent perennial seeding would be adversely affected by the presence of an existing soil retention blanket.

The project will not be accepted until a 70% density of existing adjacent undisturbed areas is obtained, unless otherwise shown on the plans. When shown on the plans, the Engineer may accept the project when adequate controls are in place that will control erosion, sedimentation, and water pollution until sufficient vegetative cover can be established.

6. **Restricted Activities.** Do not locate disposal areas, stockpiles, or haul roads in any wetland, water body, or streambed. Do not install temporary construction crossings in or across any water body without the prior approval of the appropriate resource agency and the Engineer. Restrict construction operations in any water body to the necessary areas as shown on the plans or applicable permit, or as directed. Use temporary bridges, timber mats, or other structurally sound and non-eroding material for stream crossings.
Provide protected storage area for paints, chemicals, solvents, and fertilizers at an approved location. Keep paints, chemicals, solvents, and fertilizers off bare ground and provide shelter for stored chemicals.

C. Installation, Maintenance, and Removal Work. Perform work in accordance with the specific or general storm water permit. Install and maintain the integrity of temporary erosion and sedimentation control devices to accumulate silt and debris until earthwork construction and permanent erosion control features are in place or the disturbed area has been adequately stabilized as determined by the Engineer. If a device ceases to function as intended, repair or replace the device or portions thereof as necessary. Remove sediment, debris, and litter. When approved, sediments may be disposed of within embankments, or in the right of way in areas where the material will not contribute to further siltation. Dispose of removed material in accordance with federal, state, and local regulations. Remove devices upon approval or when directed. Upon removal, finish-grade and dress the area. Stabilize disturbed areas in accordance with the permit, and as shown on the plans or directed. The Contractor retains ownership of stockpiled material and must remove it from the project when new installations or replacements are no longer required.

1. Rock Filter Dams for Erosion Control. Remove trees, brush, stumps, and other objectionable material that may interfere with the construction of rock filter dams. Place sandbags as a foundation when required or at the Contractor’s option. For Types 1, 2, 3, and 5, place the aggregate to the lines, height, and slopes specified, without undue voids. For Types 2 and 3, place the aggregate on the mesh and then fold the mesh at the upstream side over the aggregate and secure it to itself on the downstream side with wire ties, or hog rings, or as directed. Place rock filter dams perpendicular to the flow of the stream or channel unless otherwise directed. Construct filter dams according to the following criteria, unless otherwise shown on the plans:

   a. Type 1 (Non-reinforced).

      (1) **Height.** At least 18 in. measured vertically from existing ground to top of filter dam.

      (2) **Top Width.** At least 2 ft.

      (3) **Slopes.** At most 2:1.

   b. Type 2 (Reinforced).

      (1) **Height.** At least 18 in. measured vertically from existing ground to top of filter dam.

      (2) **Top Width.** At least 2 ft.

      (3) **Slopes.** At most 2:1.

   c. Type 3 (Reinforced).

      (1) **Height.** At least 36 in. measured vertically from existing ground to top of filter dam.

      (2) **Top Width.** At least 2 ft.
(3) Slopes. At most 2:1.

d. Type 4 (Sack Gabions). Unfold sack gabions and smooth out kinks and bends. For vertical filling, connect the sides by lacing in a single loop–double loop pattern on 4- to 5-in. spacing. At one end, pull the end lacing rod until tight, wrap around the end, and twist 4 times. At the filling end, fill with stone, pull the rod tight, cut the wire with approximately 6 in. remaining, and twist wires 4 times. For horizontal filling, place sack flat in a filling trough, fill with stone, and connect sides and secure ends as described above. Lift and place without damaging the gabion. Shape sack gabions to existing contours.

e. Type 5. Provide rock filter dams as shown on the plans.

2. Temporary Pipe Slope Drains. Install pipe with a slope as shown on the plans or as directed. Construct embankment for the drainage system in 8-in. lifts to the required elevations. Hand-tamp the soil around and under the entrance section to the top of the embankment as shown on the plans or as directed. Form the top of the embankment or earth dike over the pipe slope drain at least 1 ft. higher than the top of the inlet pipe at all points. Secure the pipe with hold-downs or hold-down grommets spaced a maximum of 10 ft. on center. Construct the energy dissipaters or sediment traps as shown on the plans or as directed. Construct the sediment trap using concrete in accordance with Item 505, “Concrete Riprap,” when designated on the plans. Rubble riprap in accordance with TxDOT Standard Specification Item 432, “Riprap” may also be used when designated on the plans or as directed by the Engineer.

3. Baled Hay for Erosion and Sedimentation Control. Install hay bales at locations shown on the plans by embedding in the soil at least 4 in. and, where possible, approximately ½ the height of the bale, or as directed. Fill gaps between bales with hay.

4. Temporary Paved Flumes. Construct padded flumes as shown on the plans or as directed. Provide excavation and embankment (including compaction of the subgrade) of material to the dimensions shown on the plans, unless otherwise indicated. Install a rock or rubble riprap energy dissipater, constructed from the materials specified above to a minimum depth of 9 in. at the flume outlet to the limits shown on the plans or as directed.

5. Construction Exits. When tracking conditions exist, prevent traffic from crossing or exiting the construction site or moving directly onto a public roadway, alley, sidewalk, parking area, or other right of way areas other than at the location of construction exits. Construct exits for either long or short-term use.

a. Long-Term. Place the exit over a foundation course, if necessary. Grade the foundation course or compacted subgrade to direct runoff from the construction exits to a sediment trap as shown on the plans or as directed. Construct exits with a width of at least 14 ft. for one-way and 20 ft. for two-way traffic for the full width of the exit, or as directed.

(1) Type 1. Construct to a depth of at least 8 in. using crushed aggregate as shown on the plans or as directed.

(2) Type 2. Construct using railroad ties and timbers as shown on the plans or as directed.
b. **Short-Term.**

(1) **Type 3.** Construct using crushed aggregate, plywood, or wafer board. This type of exit may be used for daily operations where long-term exits are not practical.

(2) **Type 4.** Construct as shown on the plans or as directed.

---

6. **Earthwork for Erosion and Sediment Control.** Perform excavation and embankment operations to minimize erosion and to remove collected sediments from other erosion control devices.

a. **Excavation and Embankment for Erosion Control Features.** Place earth dikes, swales or combinations of both along the low crown of daily lift placement, or as directed, to prevent runoff spillover. Place swales and dikes at other locations as shown on the plans or as directed to prevent runoff spillover or to divert runoff. Construct cuts with the low end blocked with undisturbed earth to prevent erosion of hillsides. Construct sediment traps at drainage structures in conjunction with other erosion control measures as shown on the plans or as directed. Where required, create a sediment basin providing 3,600 cu. ft. of storage per acre drained, or equivalent control measures for drainage locations that serve an area with 10 or more disturbed acres at one time, not including offsite areas.

b. **Excavation of Sediment and Debris.** Remove sediment and debris when accumulation affects the performance of the devices, after a rain, and when directed.

---

7. **Construction Perimeter Fence.** Construct, align, and locate fencing as shown on the plans or as directed.

a. **Installation of Posts.** Embed posts 18 in. deep or adequately anchor in rock, with a spacing of 8 to 10 ft.

b. **Wire Attachment.** Attach the top wire to the posts at least 3 ft. from the ground. Attach the lower wire midway between the ground and the top wire.

c. **Flag Attachment.** Attach flagging to both wire strands midway between each post. Use flagging at least 18 in. long. Tie flagging to the wire using a square knot.

---

8. **Sandbags for Erosion Control.** Construct a berm or dam of sandbags that will intercept sediment-laden storm water runoff from disturbed areas, create a retention pond, detain sediment, and release water in sheet flow. Fill each bag with sand so that at least the top 6 in. of the bag is unfilled to allow for proper tying of the open end. Place the sandbags with their tied ends in the same direction. Offset subsequent rows of sandbags ½ the length of the preceding row. Place a single layer of sandbags downstream as a secondary debris trap. Place additional sandbags as necessary or as directed for supplementary support to berms or dams of sandbags or earth.

---

9. **Temporary Sediment-Control Fence.** Provide temporary sediment-control fence near the downstream perimeter of a disturbed area to intercept sediment from sheet flow. Incorporate the fence into erosion-control measures used to control sediment in areas of higher flow. Install the fence as shown on the plans, as specified in this Section, or as directed.
a. **Installation of Posts.** Embed posts at least 18 in. deep, or adequately anchor, if in rock, with a spacing of 6 to 8 ft. and install on a slight angle toward the run-off source.

b. **Fabric Anchoring.** Dig trenches along the uphill side of the fence to anchor 6 to 8 in. of fabric. Provide a minimum trench cross-section of 6 x 6 in. Place the fabric against the side of the trench and align approximately 2 in of fabric along the bottom in the upstream direction. Backfill the trench, then hand-tamp.

c. **Fabric and Net Reinforcement Attachment.** Unless otherwise shown under the plans, attach the reinforcement to wooden posts with staples, or to steel posts with T-clips, in at least 4 places equally spaced. Sewn vertical pockets may be used to attach reinforcement to end posts. Fasten the fabric to the top strand of reinforcement by hog rings or cord every 15 in. or less.

d. **Fabric and Net Splices.** Locate splices at a fence post with a minimum lap of 6 in. attached in at least 6 places equally spaced, unless otherwise shown under the plans. Do not locate splices in concentrated flow areas. Requirements for installation of used temporary sediment control fence include the following:

- fabric with minimal or no visible signs of biodegradation (weak fibers),
- fabric without excessive patching (more than 1 patch every 15 to 20 ft.),
- posts without bends, and
- backing without holes.

10. **Curb Inlet Gravel Filter.**

a. **Installation.** Install the curb inlet gravel filters in the following manner:

   (1) Place the 2” x 4” treated lumber in front of and parallel with the opening of the inlet.

   (2) Place the Concrete Masonry Units (CMUs) around the inlet, to be protected, in front of the 2” x 4” lumber, with the openings of the CMUs facing the inlet.

   (3) Surround the CMUs with gravel bags, making certain that there are no gaps are evident between the gravel bags.

b. **Sediment Control.** When the accumulated sediment deposit reaches a depth of approximately 6 inches, it shall be removed and disposed of at approved sites in a manner that will not contribute to additional siltation. If the structure ceases to function as intended, the Engineer may direct that the Filter bag be replaced. Such replacement will not be measured for payment. Torn or punctured bags shall be replaced with a new Filter bag.

540.5. **MEASUREMENT:** If the Contractor is required to install temporary erosion, sediment and water pollution control measures due to his negligence, carelessness, lack of maintenance, or failure to install permanent controls as a part of the work as scheduled, and measures are ordered in writing by the Engineer, such work shall not be measured for payment, but shall be performed at the Contractor's expense.
In case of failure on the part of the Contractor to prevent and control soil erosion, sedimentation and water pollution which may degrade receiving water, the Engineer reserves the right to employ outside assistance or to use City forces to provide the necessary corrective measures. All costs including engineering costs will be deducted from any moneys due or to become due to the Contractor.

When the need for control measures cannot be attributed to the contractor’s negligence, carelessness, lack of maintenance or failure to install permanent water pollution control measures and these measures are shown on the plans and/or directed by the Engineer, these measures shall be measured and paid for in accordance with contract bid items shown under this section.

A. Rock Filter Dams. Installation or removal of rock filter dams will be measured by the foot or by the cubic yard. The measured volume will include sandbags, when used.

1. Linear Measurement. When rock filter dams are measured by the foot, measurement will be along the centerline of the top of the dam.

2. Volume Measurement. When rock filter dams are measured by the cubic yard, measurement will be based on the volume of rock computed by the method of average end areas.
   a. Installation. Measurement will be made in final position.
   b. Removal. Measurement will be made at the point of removal.

B. Temporary Pipe Slope Drains. Temporary pipe slope drains will be measured by the foot.

C. Baled Hay. Baled hay will be measured by each bale.

D. Temporary Paved Flumes. Temporary paved flumes will be measured by the square yard of surface area. The measured area will include the energy dissipater at the flume outlet.

E. Construction Exits. Construction exits will be measured by the square yard of surface area.

F. Earthwork for Erosion and Sediment Control. Earthwork for erosion and sediment control will not be measured directly but will be considered subsidiary to this or other pertinent items.

G. Construction Perimeter Fence. Construction perimeter fence will be measured by the foot.

H. Sandbags for Erosion Control. Sandbags will be measured as each sandbag or by the foot along the top of sandbag berms or dams.

I. Temporary Sediment-Control Fence. Temporary sediment-control fence will be measured by the foot.

J. Curb Inlet Gravel Filter. Curb inlet gravel filter will be measured by the linear foot, as measured on the centerline of the gravel bags installed.
540.6. **PAYMENT:** The following will not be paid for directly but are subsidiary to pertinent Items:

- erosion-control measures for Contractor project-specific locations (PSLs) inside and outside the right of way (such as construction and haul roads, field offices, equipment and supply areas, plants, and material sources);
- removal of litter;
- repair to devices and features damaged by Contractor operations;
- added measures and maintenance needed due to negligence, carelessness, lack of maintenance, and failure to install permanent controls;
- removal and reinstallation of devices and features needed for the convenience of the Contractor;
- finish grading and dressing upon removal of the device; and
- minor adjustments including but not limited to plumbing posts, reattaching fabric, minor grading to maintain slopes on an erosion embankment feature, or moving small numbers of sandbags.

The Contractor will be reimbursed for maintenance, repair, or reinstallation of devices and features when the need for additional control measures cannot be attributed to the above, as determined by the Engineer. Stabilization of disturbed areas will be paid for under pertinent Items. Furnishing and installing pipe for outfalls associated with sediment traps and ponds will not be paid for directly but is subsidiary to the excavation and embankment under this Item.

Pollution control measures outside the right of way will not be measured for payment but shall be performed at the Contractor's expense.

Control measures as shown on the plans will be paid for in accordance with applicable bid items as shown below:

**A. Rock Filter Dams.** The work performed and materials furnished in accordance with this Item and measured as provided under “Measurement” will be paid for at the unit price bid as follows:

1. **Installation.** Installation will be paid for as “Rock Filter Dams (Install)” of the type specified. This price is full compensation for furnishing and operating equipment, finish backfill and grading, lacing, proper disposal, labor, materials, tools, and incidentals.

2. **Removal.** Removal will be paid for as “Rock Filter Dams (Remove).” This price is full compensation for furnishing and operating equipment, proper disposal, labor, materials, tools, and incidentals.

When the Engineer directs that the rock filter dam installation or portions thereof be replaced, payment will be made at the unit price bid for “Rock Filter Dams (Remove)” and for “Rock Filter Dams (Install)” of the type specified. This price is full compensation for furnishing and operating equipment, finish backfill and grading, lacing, proper disposal, labor, materials, tools, and incidentals.

**B. Temporary Pipe Slope Drains.** The work performed and materials furnished in accordance with this Item and measured as provided under “Measurement” will be paid for at the unit price bid for “Temporary Pipe Slope Drains” of the size specified. This price is full compensation for furnishing and operating equipment, finish backfill and grading, lacing, proper disposal, labor, materials, tools, and incidentals.
compensation for furnishing materials, removal and disposal, furnishing and operating equipment, labor, tools, and incidentals.

Removal of temporary pipe slope drains will not be paid for directly but is subsidiary to the installation Item. When the Engineer directs that the pipe slope drain installation or portions thereof be replaced, payment will be made at the unit price bid for “Temporary Pipe Slope Drains” of the size specified, which is full compensation for the removal and reinstallation of the pipe drain.

Earthwork required for the pipe slope drain installation, including construction of the sediment trap, will be measured and paid for under Section 540.5.F, “Earthwork for Erosion and Sediment Control.” Riprap concrete or stone, when used as an energy dissipater or as a stabilized sediment trap, will be measured and paid for in accordance with Item 505, “Concrete Riprap” or TxDOT Item 432, “Riprap,” respectively.

C. **Baled Hay.** The work performed and materials furnished in accordance with this Item and measured as provided under “Measurement” will be paid for at the unit price bid for “Baled Hay.” This price is full compensation for furnishing and placing bales, excavating trenches, removal and disposal, equipment, labor, tools, and incidentals.

When the Engineer directs that the baled hay installation (or portions thereof) be replaced, payment will be made at the unit price bid for “Baled Hay,” which is full compensation for removal and reinstallation of the baled hay.

D. **Temporary Paved Flumes.** The work performed and materials furnished in accordance with this Item and measured as provided under “Measurement” will be paid for at the unit price bid for “Temporary Paved Flume (Install)” or “Temporary Paved Flume (Remove).” This price is full compensation for furnishing and placing materials, removal and disposal, equipment, labor, tools, and incidentals.

When the Engineer directs that the paved flume installation or portions thereof be replaced, payment will be made at the unit prices bid for “Temporary Paved Flume (Remove)” and “Temporary Paved Flume (Install).” These prices are full compensation for the removal and replacement of the paved flume and for equipment, labor, tools, and incidentals.

Earthwork required for the paved flume installation, including construction of a sediment trap will be considered subsidiary to this item and will not be measured or paid for directly.

E. **Construction Exits.** Contractor-required construction exits from off right-of-way locations or on-right of way PSLs will not be paid for directly but are subsidiary to pertinent Items.

The work performed and materials furnished in accordance with this Item and measured as provided under “Measurement” for construction exits needed on right-of-way access to work areas required by the Department will be paid for at the unit price bid for “Construction Exits (Install)” of the type specified or “Construction Exits (Remove).” This price is full compensation for furnishing and placing materials, excavating, removal and disposal, cleaning vehicles, labor, tools, and incidentals.

When the Engineer directs that a construction exit or portion thereof be removed and replaced, payment will be made at the unit prices bid for “Construction Exit (Remove)” and “Construction Exit (Install)” of the type specified. These prices are full compensation for the
removal and replacement of the construction exit and for equipment, labor, tools, and incidentals.

Construction of sediment traps used in conjunction with the construction exit will be considered subsidiary to this item and will not be measured or paid for directly.

F. Earthwork for Erosion and Sediment Control. The work performed and materials furnished in accordance with this Item will not be paid for directly but is subsidiary to pertinent Items unless otherwise shown on the plans.

Sprinkling and rolling required by this Item will not be paid for directly, but will be subsidiary to this Item.

G. Construction Perimeter Fence. The work performed and materials furnished in accordance with this Item and measured as provided under “Measurement” will be paid for at the unit price bid for “Construction Perimeter Fence.” This price is full compensation for furnishing and placing the fence; digging, fence posts, wire, and flagging; removal and disposal; and materials, equipment, labor, tools, and incidentals.

Removal of construction perimeter fence will be not be paid for directly but is subsidiary to the installation Item. When the Engineer directs that the perimeter fence installation or portions thereof be removed and replaced, payment will be made at the unit price bid for “Construction Perimeter Fence,” which is full compensation for the removal and reinstallation of the construction perimeter fence.

H. Sandbags for Erosion Control. Sandbags will be paid for at the unit price bid for “Sandbags for Erosion Control” (of the height specified when measurement is by the foot). This price is full compensation for materials, placing sandbags, removal and disposal, equipment, labor, tools, and incidentals.

Removal of sandbags will not be paid for directly but is subsidiary to the installation Item. When the Engineer directs that the sandbag installation or portions thereof be replaced, payment will be made at the unit price bid for “Sandbags for Erosion Control,” which is full compensation for the reinstallation of the sandbags.

I. Temporary Sediment-Control Fence. The work performed and materials furnished in accordance with this Item and measured as provided under “Measurement” will be paid for at the unit price bid for “Temporary Sediment-Control Fence.” This price is full compensation for furnishing and placing the fence; trenching, fence posts, fabric and backfill; removal and disposal; and equipment, labor, tools, and incidentals.

Removal of temporary sediment-control fence will not be paid for directly but is subsidiary to the installation Item. When the Engineer directs that the temporary sedimentation control fence installation or portions thereof be replaced, payment will be made at the unit price bid for “Temporary Sediment-Control Fence,” which is full compensation for the removal and reinstallation of the temporary sediment-control fence.

J. Curb Inlet Gravel Filter. The work performed and the materials furnished as specified herein, measured as provided under “Measurement” will be paid for at the unit price bid per linear foot for “Curb Inlet Gravel Filter,” which payment shall be full compensation for furnishing all materials, labor, tools, equipment and incidentals necessary to complete the work as specified, including maintaining and replacing the gravel bags as required by these
specifications, removal of accumulated silt, and removal and proper disposal of the “Curb Inlet Gravel Filter” upon completion of site stabilization.

540.7. **BID ITEM:**

- Item 540.1 - Rock Filter Dams (Install/Remove) - per linear foot (Type _)
- Item 540.2 - Rock Filter Dams (Install/Remove) - per cubic yard (Type _)
- Item 540.3 - Temporary Pipe Slope Drains - per foot (_ inches in diameter)
- Item 540.4 - Baled Hay - per bale
- Item 540.5 - Temporary Paved Flume (Install/Remove) - per square yard
- Item 540.6 - Construction Exits (Install/Remove) - per square yard
- Item 540.7 - Construction Perimeter Fence - per foot
- Item 540.8 - Sandbags for Erosion Control - per foot (_ inches high)
- Item 540.9 - Temporary Sediment-Control Fence - per foot
- Item 540.10 - Curb Inlet Gravel Filters - per linear foot
ITEM

552 REMOVING AND RELOCATING IRRIGATION SYSTEMS

552.1. DESCRIPTION: This item shall govern for removing and relocating portions of existing sprinkler systems within the City’s right-of-way, which interfere with the proposed construction. Materials shall include PVC of various size, valves, sprinkler heads, specialties, controls, fittings, backflow preventers and wiring for automatic control irrigation system. The piping and sprinklers shall be installed in accordance with the plans and specifications or as directed by the Engineer. The installation of pipe shall include all joints or connections to existing pipes, valves or other appurtenances as may be required to complete the work.

552.2. MATERIALS: Materials shall conform to the following provisions:

A. PVC Pipe. Pipe shall conform to the requirements of ASTM D1785, PVC 1120 Schedule 40; or ASTM D2241, PVC 1120 SDR 21, class 200.

B. PVC Fittings. Solvent welded socket type fittings shall conform to requirements of ASTM D2466, Schedule 40. Threaded type fittings shall conform to requirements of ASTM D 2464, Schedule 80.

C. Solvent Cement. Solvent cement shall conform to the requirements of ASTM D 2564.

D. Backflow Preventers. Backflow preventers with intermediate atmospheric vent shall be in accordance with ASSE 1012. Reduced pressure principle backflow preventers shall be in accordance with ASSE 1013.

E. Accessories and Appurtenances. Pop-up spray heads, gear driven rotary heads, remote control valves, and valve boxes shall match existing equipment in brand model number and nozzles.

552.3. EQUIPMENT: Provide the machinery, tools and equipment necessary for proper prosecution of the work. All machinery, tools and equipment used shall be maintained in a satisfactory and workmanlike manner.

552.4. CONSTRUCTION: Remove portions of sprinkler systems that conflict with the proposed new construction. Re-install sprinkler system after the required site grading has been completed. Perform irrigation system work under the supervision of a person possessing an irrigator’s license issued by the TCEQ. Provide documentation of this license. Follow the codes of the controlling utility authority for water and electrical connection and service. If at all possible, coordinate irrigation system installation with plant installation, when plant installation is specified, to ensure that watering requirements are met. Prevent damage to vegetation, slopes, utilities, structures, and other amenities. Repair any damage within the right of way caused by the Contractor.

A. Excavation and Trenching. Excavate and trench to a sufficient depth to provide for a minimum of 12 in. soil cover for all lines or as shown on the plans. Use common trenches for irrigation lines and wire runs where feasible. Protect trenches and boring pits less than 5 ft. deep using approved methods. Protect trenches and boring pits 5 ft. deep or deeper in accordance with Item 550, “Trench Excavation Safety Protection,” and Item 551, “Temporary Special Shoring.” Trenching around roots shall be hand excavated to pipe grade when roots of 2 inches diameter or greater are encountered. Trench width shall be 4 inches
minimum or 1½ times diameter of pipe, whichever is wider. Backfill shall be hand tamped over excavation.

**B. Pipe and Valve Assembly.** Assemble pipe and fittings as recommended by the manufacturers. Clean pipe and fittings of dust, dirt, and moisture before assembly. Make connections between plastic pipe and metal valves with threaded fittings and plastic adapters. Install backflow preventers as required by ordinances of the controlling water utility authority. Install pipe, valves, and valve boxes a minimum of 12 in. from sidewalks, buildings, walls, and other objects, or as directed.

**C. Sprinkler Heads and Drip Tubing.** Install sprinkler heads and drip tubing in accordance with the manufacturer’s recommendations at locations shown on the plans or as directed.

**D. Controller.** Install controllers in accordance with the manufacturer’s recommendations at locations shown on the plans or as directed.

**E. Closing and Flushing of PVC Pipe.** Cap or plug pipe after installation to prevent entry of foreign materials that would obstruct the flow of water. Leave caps or plugs in place until removal is necessary for completion of the installation. Thoroughly flush all water lines.

**F. Hydrostatic Tests.** Notify the Engineer in writing at least 48 hr. before testing. Center load all pipe with sufficient backfill to prevent arching or slipping while under pressure. After all welded joints have cured for at least 24 hr., test the main lines from the meter to the valves, with all valves closed, for at least 2 consecutive hours by applying a continuous and static minimum 80-psi water pressure. Repair leaks if necessary and retest. Before final approval, maintain the lines under static pressure for 24 hr. without leaks.

**G. Backfill and Compaction.** After the irrigation system is fully operational, and all tests and inspections have been performed and the results approved, backfill trenches and other excavations with soil free of objectionable material. Backfill and compact in 8-in. layers. Smooth and shape disturbed soil to final grade or as directed.

**552.5. MEASUREMENT:** Irrigation systems will be measured per linear foot completed in place.

**552.6. PAYMENT:** The work performed as prescribed by this item will be paid for at the contract unit price bid, per linear foot for “removing and relocating irrigation systems” which price shall be full compensation for removing irrigation systems from their present location and relocation to permanent location as shown on plans or as directed by the Engineer, for furnishing all materials, labor, tools, equipment and incidentals necessary to complete the work.

**552.7. BID ITEM:**

Item 552.1 - Removing and Relocating Irrigation Systems - per linear foot
ITEM

554 EROSION CONTROL MATTING

554.1. DESCRIPTION: This item shall govern for the furnishing and placing of erosion control mat (ECM) of the size and quantity designated to prevent soil erosion in channels and on steep slopes as shown on the plans and in accordance with these specifications.

NOTE: An erosion control mat (ECM) is defined as either a degradable erosion control blanket (ECB), a turf reinforcement mat (TRM), or a high performance turf reinforcement mat (HPTRM). ECB should be used in applications where degradable mats are acceptable and calculated shear stresses are less than or equal to 1½ lbs/ft². TRM or HPTRM should be used when calculated shear stresses are greater than 1½ lbs/ft².

A. ECB. An erosion control mat manufactured from biodegradable materials designed to hold seed and soil in place until vegetation is established in disturbed areas and promote vegetation.

B. TRM. An erosion control mat manufactured from 100% synthetic non degradable materials with a minimum 10 year design life. TRM’s are designed to reinforce the root system of vegetation, and form a high-strength system that helps prevent soil erosion in high velocity channels and on steep slopes.

C. HPTRM. A high survivability turf reinforcement mat manufactured from 100% continuously woven synthetic material with a minimum 25 year design life. HPTRM’s are designed to reinforce the root system of vegetation, and form a high-strength system for applications with high loading and/or high survivability requirements. These applications may include the need for maintenance vehicles within channels, high bed loading, protection of critical structures and/or utility cuts, and projects requiring higher factors of safety.

554.2. MATERIALS: The ECB, TRM or HPTRM supplied shall meet the requirements of Texas Department of Transportation (TxDOT) Standard Specifications Item 169, “Soil Retention Blankets,” of the Class and Type as specified on the plans and are on the approved product lists for TxDOT. Further definition of the Erosion Control Matting, beyond “Class and Type” shall be at the discretion of the Engineer, and may include but not limited to the requirements for performance properties such as maximum shear stress, velocity, functional longevity, design life, UV resistance, tensile strength, and manufacturing process. Materials manufactured of biodegradable components shall be classified as ECB’s. Materials manufactured from 100% synthetic components shall be classified as TRM’s. Materials manufactured from 100% continuously woven synthetic components shall be classified as HPTRM’s.

A. Material Submittals. The submittal requirements for this specification item shall include:

1. The erosion control matting type.

2. The certified Minimum Average Roll Values (MARV) for physical properties, as derived from quality control testing performed by a Geosynthetic Accreditation Institute - Laboratory Accreditation Program (GAI-LAP) accredited laboratory.

3. Documentation of certifiable, independent large-scale testing which support’s Manufacturer’s reported product performance properties.
4. One full set of the Manufacturer’s literature and installation recommendations as well as any special details necessary for the proposed application.

5. A sample will be required.

B. Material Acceptance. The acceptance of the materials shall be at the discretion of the Engineer. Acceptance shall be based upon conformance with this specification and the additional material properties added by the Engineer and included in the Project Documents. Acceptance of materials must be received in writing from the Engineer prior to construction proceeding.

554.3. EQUIPMENT: Provide the machinery, tools and equipment necessary for proper prosecution of the work. All machinery, tools and equipment used shall be maintained in a satisfactory and workmanlike manner.

554.4. CONSTRUCTION:

A. General.

1. Schedule. Prior to start of construction, submit schedules to the Engineer for accomplishment of temporary and permanent erosion control work included in the construction drawings, as are applicable for clearing and grubbing, grading, and installation of erosion control mat. Also submit a proposed method of erosion and dust control on haul roads and a plan for disposal of waste materials.

2. Conflict. In the event of a conflict between these requirements and storm water pollution control laws, rules or regulations of other Federal, State, or Local agencies, the more restrictive laws, rules or regulations shall apply.

B. Site Preparation.

1. ECB. Prepare subgrade by removing large rocks, soil clods, vegetation, and other sharp objects (larger than 2” in diameter) that could keep the ECB from intimate contact with subgrade.

2. TRM/HPTRM.

   a. Grade and compact areas to be treated with TRM/HPTRM and compact. The top 8” of subgrade must be free of rock, debris and consist of a cohesive live soil that meets the requirements of Item 515, “Topsoil.”. The Engineer has final determination of whether or not the soil is “live.” If the existing subgrade does not meet these standards, the contractor is responsible for the import of acceptable material.

   b. Remove large rocks, soil clods, vegetation, and other sharp objects (larger than 2” in diameter) that could keep the TRM/HPTRM from intimate contact with subgrade.

   c. Prepare the 8” compacted seedbed by loosening the top ½” of soil above final subgrade.

   d. Construct, as a minimum, 12 in x 12 in anchor trenches at upstream and downstream ends of the installation to inhibit undermining from stray surface water. (Anchor trenches should be excavated to a depth that matches design scour depth.) Excavate 6 in x 6 in check slots at 25 to 30 feet intervals along length of channel. Cut
longitudinal anchor slots 6 in x 6 in at top of each side slope. The aforementioned dimensions are minimums and the dimensions detailed on the drawings will control.

C. Installation.

1. ECB. Install ECB such that they are shingled downstream. The end of each ECB shall overlap the next downstream ECB by a minimum of 12 inches. Leading edges shall be placed in a trench that is 4 inches wide to a minimum depth of 8 inches. The fabric shall line the trench and then filled with available substrate. Install 2 staples per square yard of ECB using 6 in (depth) x 1 in (width) metal sod staples.

2. TRM/HPTRM.
   a. A mandatory pre-construction conference with an Engineer representing the TRM/HPTRM manufacturer, contractor, and inspector must be completed. The conference is to be scheduled by the contractor with at least one week’s notice to all parties involved. Representatives may be required to be on site for installation assistance. The Contractor is to schedule the Engineer representing the TRM/HPTRM to inspect the site preparation prior to installation and the completed installation and provide a certified letter stating the site meets the manufacture’s recommendations. All permanent TRM/HPTRM’s shall be installed so as to produce root reinforcement of the vegetation. Stem reinforcement of the vegetation will not be accepted.
   b. Install the TRM/HPTRM at elevation and alignment indicated.
   c. The TRM/HPTRM, is to be soiled filled with ½” of top soil, and vegetated by applying the right mixture of seed and soil amendments with a Flexible Growth Medium, protected by a light weight erosion control blanket, or by applying the right mixture of seed and soil amendments with a wood blend fiber mulch, protected by a light weight erosion control blanket, or by placing sod directly on top and secure sod with 8” staples.
   d. Beginning at downstream end in center of channel, place initial end of first roll of TRM/HPTRM in anchor trench and secure with ground anchor devices at 12 in intervals.
   e. Position adjacent rolls in anchor trench in same manner, overlapping proceeding roll minimum 3 in.
   f. Secure the TRM/HPTRM at 12 in intervals along the trench, backfill and compact with specified soil or as directed by the Engineer.
   g. Unroll center strip of TRM/HPTRM upstream over compacted trench. Stop at next check slot or terminal anchor trench. Unroll adjacent rolls of TRM/HPTRM upstream in similar fashion, maintaining 3 in overlap.
   h. Fold and secure the TRM/HPTRM snugly into transverse check slots. Lay material in bottom of slot, and then fold it back against itself as indicated. Anchor through both layers of TRM/HPTRM at 12 in intervals. Backfill with soil and compact. Continue unrolling the TRM/HPTRM widths upstream over compacted slot to next check slot or terminal anchor trench.
i. Secure TRM/HPTRM to channel bottom with ground anchoring devices at a frequency of 2 ½ anchors per square yard. Anchors should be a minimum of 8 gauge and 8” in length or so that they have sufficient ground penetration to resist pullout in a saturated condition. Increased anchoring frequency may be required if site conditions are such that the Engineer determines it necessary.

j. At the Engineers discretion a manufacturer’s designated representative shall be on site for installation assistance.

k. Any installation of angular placement, overlapping around curves, or modified placement methods must be detailed on the construction drawings.

l. The Engineer must approve alternate installation methods prior to execution.

D. Irrigation, Mowing, and Project Acceptance. Prior to project acceptance by the Engineer, it shall be the responsibility of the contractor to establish a minimum of 70% of the area seeded shall be covered with the specified vegetation with no bare or dead spots greater than 10 square feet. The contractor shall be responsible to set up and maintain temporary irrigation, as required, to assist in establishment of vegetation. All areas that erode prior to project acceptance shall be repaired at the expense of the contractor including necessary reseeding, watering, and repair of the TRM/HPTRM. Vegetated areas shall not be mowed prior to establishment of 70% vegetative density and a minimum grass growth of 3 inches. Mower height shall not be set lower than 3 inches. Throughout the duration of the project, the contractor shall be responsible for mowing to facilitate growth and shall not let the vegetation in the seeded areas exceed 18 inches. In addition, the Contractor shall water all grassed areas as often as necessary to establish satisfactory growth and to maintain its growth throughout the duration of the project.

554.5. MEASUREMENT: Measurement of erosion control matting will be made by the square yard of surface area covered, complete in place, and ready for use as an erosion control surface treatment. (Erosion Control Matting necessary for anchorage trenches, overlaps and waste is subsidiary to the design surface area).

554.6. PAYMENT: Erosion control matting, measured as herein specified, will be paid for at the unit Price bid per square yard, which payment shall include furnishing all materials (including topsoil amendment, fertilizer, seed, and material for anchorage trenches, overlaps and waste), labor, and equipment necessary to provide a complete and finished installation as specified.

554.7. BID ITEM:

Item 554.1 - Erosion Control Matting - per square yard
**ITEM**

**556 CAST IN PLACE DETECTABLE WARNING SURFACE TILES**

556.1. **DESCRIPTION:** This item shall govern the furnishing and installation of Cast In Place Detectable Warning Surface Tiles as shown on the plans and in accordance with these specifications. The work shall include all materials, equipment, surface preparation, labor, and other incidentals.

556.2. **MATERIALS:**

A. **Cast In Place Detectable Warning Surface Tiles.** The Cast In Place Detectable Warning Surface Tiles shall comply with the detectable warnings on walking surfaces section of the Americans with Disabilities Act (Title III Regulations, 28 CFR Part 36, Appendix A, “ADA Accessibility Guidelines for Buildings and Facilities”, Section 4.29.2, “Detectable Warnings on Walking Surfaces”).

The Cast In Place Detectable Warning Surface Tile shall be an epoxy polymer or a homogenous glass and carbon reinforced composite which is colorfast and ultra-violet stable. The tile shall incorporate an in-line pattern of truncated domes measuring nominal 0.2 inch height, 0.9 inch base diameter, and 0.45 inch top diameter with a center-to-center spacing of 1.67 inches minimum and 2.35 inches maximum as measured between the most adjacent domes. For wheelchair safety the field area shall consist of a non-slip surface with a minimum of 36 - 90° raised points, 0.045 inch high, per square inch.

B. **Color.** The color of the tile shall be uniform throughout and shall not use any type of paint coating to achieve color stability. The tiles shall contrast visually with adjoining surfaces by using brick red on light surfaces and yellow on dark surfaces.

C. **Packaging.** Tiles shall be suitably packaged or crated to prevent damage in shipment or handling. Finished surfaces shall be protected by sturdy plastic wrappings to protect tile from concrete residue during installation and tile type shall be identified by part number.

D. **Certification.** All material shall conform to Table 1 below. A written certification shall be supplied to the City verifying that the proposed materials meet these specifications.

E. **Warranty.** All materials, workmanship, and labor shall be covered by a manufacturer's guarantee and/or warranty for a period of five (5) years from the date of field application. If failures such as defective work, breakage, deformation, fading, and loosening of the tiles occur during this 5 year period, the Contractor shall bear the cost of removal and reinstallation of said materials to the satisfaction of the City.

556.3. **EQUIPMENT:** Provide the machinery, tools and equipment necessary for proper prosecution of the work. All machinery, tools and equipment used shall be maintained in a satisfactory and workmanlike manner.

556.4. **CONSTRUCTION:** All material shall be placed according to the manufacturer's instructions, and in accordance with the surface condition requirements.

A. **Temperature.** The Contractor shall maintain a minimum temperature of 40°F in spaces to receive tiles for at least 24 hours prior to installation, during installation, and for not less than 24 hours after installation.
B. **Water.** The use of water for work, cleaning or dust control, etc. shall be contained and controlled and shall not be allowed to come into contact with the general public. Provide barricades or screens to protect the general public.

C. **Installation.** Prior to placement of the Cast In Place Detectable Warning Surface Tile system, the Contractor shall review the manufacturer and contract drawings and refer any and all discrepancies to the Engineer.

1. **Safety.** During Cast In Place Detectable Warning Surface Tile installation procedures, ensure adequate safety guidelines are in place and that they are in accordance with the applicable industry and government standards.

2. **Flange System.** The specifications of the structural embedment flange system and related materials shall be in strict accordance with the guidelines set by the manufacturer.

3. **Concrete and Placement of Tile System.** The physical characteristics of the concrete shall be consistent with the contract specifications while maintaining a slump range of 4 - 7 to permit solid placement of the Cast In Place Detectable Warning Surface Tile system. An overly wet mix will cause the tile to float. Under these conditions, suitable weights such as 2 concrete blocks or sandbags (25 lb) shall be placed on each tile.

   The concrete pouring and finishing operations require typical mason’s tools, however, a 4’ long level with electronic slope readout, 25 lb. weights, and a large non-marring rubber mallet are specific to the installation of the Cast In Place Detectable Warning Surface Tile system. If desired, a vibrating mechanism can be employed. The vibrating unit should be fixed to a soft base such as wood, at least 1 foot square.

   The factory installed plastic sheeting must remain in place during the entire installation process to prevent the splashing of concrete onto the finished surface of the tile.

   When preparing to set the tile, it is important that no concrete be removed in the area to accept the tile. It is imperative that the installation technique eliminates any air voids under the tile. Holes in the tile perimeter allow air to escape during the installation process. Concrete will flow through the large holes in each embedment flange on the underside of the tile. This will lock the tile solidly into the cured concrete.

   The concrete shall be poured and finished true and smooth to the required dimensions and slope prior to the tile placement. Immediately after finishing concrete, an electronic level shall be used to check that the required slope is achieved. The tile shall be placed true and square to the curb edge in accordance with the contract drawings. The Cast In Place Detectable Warning Surface Tiles shall be tamped (or vibrated) into the fresh concrete to ensure that the field level of the tile is flush to the adjacent concrete surface. The embedment process should not be accomplished by stepping on the tile as this may cause uneven setting which can result in air voids under the tile surface. The tile field level (base of truncated dome) shall be flush to the adjacent surfaces to permit proper water drainage and eliminate tripping hazards between adjacent finishes.

   Immediately after placement, the tile elevation shall be checked in relation to the adjacent concrete. The elevation and slope should be set consistent with contract drawings to permit water to drain into the street gutter or as the design dictates. Ensure that the field surface of the tile is flush with the surrounding concrete and back of curb so that no ponding is possible on the tile at the back side of curb.
While concrete is workable, a 3/8 inch radius edging tool shall be used to create a finished edge of concrete, then a steel trowel shall be used to finish the concrete around the tile’s perimeter, flush to the field level of the tile.

During and after the tile installation and the concrete curing stage, there shall be no walking, leaning or exerting any other force on the tile that may rock the tile and create a void between the underside of tile and concrete.

D. Placement Tolerances. Following tile placement, the Contractor shall compare installation tolerances to these specifications and adjust the tile before the concrete sets. Two suitable weights of 25 lb each may be required to be placed on each tile as necessary to ensure solid contact of the underside of tile to concrete.

E. Removal of Plastic Sheeting. Following the concrete curing stage, the protective plastic wrap shall be removed from the tile surface by cutting the plastic with a sharp knife, tight to the concrete/tile interface. If concrete has bled under the plastic, a soft brass wire brush shall be used to clean the residue without damage to the tile surface.

F. Bolting. If more than one tile is required, individual tiles can be bolted together using ¼ inch or equivalent hardware. This can help to ensure that adjacent tiles are flush to each other during the installation process. Tape or caulking can be placed on the underside of the bolted butt joint to ensure that concrete does not rise up between the tiles during installation. Any protective plastic wrap which was peeled back to facilitate bolting or cutting, should be replaced and taped to ensure that the tile surface remains free of concrete during the installation process.

G. Cutting/Trimming. If required, tiles can be cut to custom sizes or radial shapes using a continuous rim diamond blade in a circular saw or mini-grinder. Use of a straightedge to guide the cut is advisable where appropriate.

H. Sound Plates. Any sound-amplifying plates on the underside of the tile, which are dislodged during handling or cutting, should be replaced and secured with construction adhesive. The air gap created between these plates and the bottom of the tile is important in preserving the sound-on-cane audible properties of the tile.

556.5. MEASUREMENT: Cast In Place Detectable Warning Surfaces will not be measured for payment.

556.6. PAYMENT: The work prescribed herein will not be paid for directly but shall be included in the unit price bid for the item of construction in which the operation occurs.

556.7. BID ITEM:

N/A
<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>TEST METHOD</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width</td>
<td></td>
<td>24 inch at street access ramp or landing and 36 inch at signalized driveways.</td>
</tr>
<tr>
<td>Length</td>
<td></td>
<td>Full width of the street access ramp, landing, or sidewalk.</td>
</tr>
<tr>
<td>Depth</td>
<td></td>
<td>1.375 inch (+/-) 5% max.</td>
</tr>
<tr>
<td>Face Thickness</td>
<td></td>
<td>0.1875 inch (+/-) 5% max.</td>
</tr>
<tr>
<td>Warpage of Edge</td>
<td></td>
<td>0.5% max.</td>
</tr>
<tr>
<td>Embedment Flange Spacing</td>
<td></td>
<td>≤ 3.1 inch</td>
</tr>
<tr>
<td>Water Absorption</td>
<td>ASTM D 570-98</td>
<td>≤ 0.05%</td>
</tr>
<tr>
<td>Slip Resistance - Combined wet and dry static coefficients of friction on top of domes and field area.</td>
<td>ASTM C 1028-96</td>
<td>≥ 0.80</td>
</tr>
<tr>
<td>Compressive Strength</td>
<td>ASTM D 695-02a</td>
<td>≥ 28,000 psi</td>
</tr>
<tr>
<td>Tensile Strength</td>
<td>ASTM D 638-03</td>
<td>≥ 19,000 psi</td>
</tr>
<tr>
<td>Flexural Strength</td>
<td>ASTM D 790-03</td>
<td>≥ 25,000 psi</td>
</tr>
<tr>
<td>Chemical Stain Resistance - To withstand without discoloration or staining.</td>
<td>ASTM D 543-95</td>
<td>1% soap solution, turpentine, Urea 5% diesel fuel and motor oil 10% other chemicals</td>
</tr>
<tr>
<td>Abrasive Wear: BYK - Gardner Tester</td>
<td>ASTM D 2486-00 With reciprocating linear motion of 37± cycles per minute over a 10 inch travel. The 40 grit sand paper shall be fixed and leveled to a holder. The combined mass of the sled, weight and wood block shall be 3.2 lb.</td>
<td>Average wear depth ≤ 0.060 after 1000 abrasion cycles when measured on the top surface of the dome representing the average of three measurement locations per sample</td>
</tr>
<tr>
<td>Fire Resistance</td>
<td>ASTM E 84-05</td>
<td>flame spread &lt; 15</td>
</tr>
<tr>
<td>Gardner Impact to Geometry &quot;GE&quot; of the standard - A failure is noted when a crack is visible on either surface or when any brittle splitting is observed on the bottom plaque in the specimen.</td>
<td>ASTM D 5420-04</td>
<td>mean failure energy expressed as a function of specimen thickness ≥ 550 inch lbf/inch</td>
</tr>
<tr>
<td>Accelerated Weathering</td>
<td>ASTM G 155-05a for 3000 hours</td>
<td>ΔE &lt;4.5 as well as no deterioration, fading or chalking of the tile surface</td>
</tr>
<tr>
<td>Single wheel HS20-44 loading corresponding to an 8000 lb individual wheel load and a 30% impact factor</td>
<td>AASHTO HB-17</td>
<td>The tile shall exhibit no visible damage at the maximum load of 10,400 lbs.</td>
</tr>
</tbody>
</table>