

Appendices

APPENDICES

Appendix A Nisource's Inadvertent Release Contingency Plan

**APPENDIX A NISOURCE'S INADVERTENT RELEASE
CONTINGENCY PLAN**



NISOURCE

Inadvertent Release Contingency Plan

Woodward Park North Columbus High Pressure
(NCHP) System Pipeline Project

PROJECT NO. 182585

REVISION 2

MAY 22, 2026



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1. Project Background

1.1 Project Description

The Project consists of the installation of approximately 5.3 miles of 20-inch pipeline and 1.4 miles of 12-inch pipeline. Additionally, the Project will involve a new station and several associated lateral connections. Work will begin north of the intersection of Postlewaite Road and Bethel Road. The Project continues east through Bethel Road and Morse Road until it reaches the intersection of Karl Road and Morse Road. The Project will then resume northward until it reaches Karl Road Station which is adjacent to the Columbus Metropolitan Library. The Project proposes to have three HDD crossings highlighted below:

- An HDD across SR 315 and the Olentangy River will run west to east. The entry pit will be within Ohio Department of Transportation (ODOT) right-of-way (ROW) approximately 0.25 miles west of SR 315. The exit pit will be within City of Columbus ROW approximately 0.25 miles east of the Olentangy River. The bore will be approximately 3,330 feet long. It will be a 20-inch steel gas main.
- An HDD across High Street under Rathbone Avenue and Morse Road will run east to west. The entry pit will be within City of Columbus ROW approximately 500 feet east of the intersection of High Street and Morse Road. The exit pit will be within City of Columbus ROW approximately 0.25 miles east of the Olentangy River. The bore will be approximately 1,950 feet long. It will be a 20-inch steel gas main.
- An HDD across Indianola Avenue, CSX and NS Railway RR tracks, Sinclair Road, and Interstate 71 will run east to west. The entry pit will be within private easement approximately 320 feet east of the centerline of Interstate 71. The exit pit will be within private easement approximately 130 feet west of the centerline of Indianola Avenue. The bore will be approximately 1,350 feet long. It will be a 20-inch steel gas main.

Workspaces will include installation portions of the Project, equipment access, and other laydown/staging areas, as needed.

1.2 Environmentally Sensitive Resources

The Olentangy River HDD path will run underneath two delineated streams: the Olentangy River, which is a perennial stream, and an unnamed intermittent stream that flows into the Olentangy River. The bore will also run adjacent to other delineated features, including an additional unnamed intermittent stream and one wetland. The boring will start on the lawn southwest of where Bethel Road overlaps the Olentangy Freeway and end on Rathbone Avenue. Potential inadvertent returns from the drilling phase of this project could have an impact on these features. No environmentally sensitive features are noted within the limits of the High Street/Rathbone HDD or Interstate 71/RR HDD workspaces.

1.3 Environmental Inspection

While drilling or during any activities that may impact the stream or water resource, NiSource requires that an experienced Environmental Inspector be present on-site to monitor activities.

1.4 Drilling Mud

One of the primary components of HDD installation is the drilling mud. Drilling fluids vary but generally consist of a base mixture of water and Wyoming bentonite products. This mixture is referred to as “mud” or “drilling fluid” and can contain many additional additives. The drilling mud enters the borehole through the drill bit and circulates back to either the entry or exit pit through the borehole. The primary functions of the drilling fluid in an HDD are:

- **Hydraulic excavation** – when drilling mud leaves the bit at a high velocity it can excavate soil by erosion
- **Transmission of hydraulic power** – in rock, a mud motor is used and the drilling fluids transmit energy downhole to turn the mud motor and cut rock
- Transportation of soil and cuttings to the surface
- Cleaning and cooling drill bits and reamers
- Reduction of friction
- Borehole stabilization

As mentioned, drilling fluids primarily consist of water and bentonite clay. Bentonite clay is predominantly comprised of montmorillonite which is not listed as a hazardous material/substance as defined by U.S. Environmental Protection Agency’s (USEPA) Emergency Planning and Community Right-to-know Act (EPCRA) or Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) regulatory criteria. If the product becomes a waste, it does not meet the criteria of a hazardous waste, as defined by the USEPA. Bentonite is non-toxic and commonly used in farming practices but has the potential to impact aquatic habitats and wildlife if discharged to waterways in significant quantities due to increases in localized turbidity.

The contractor may elect to use additives in their drilling mud to adjust the behavior and properties of the mud. Additives are supplementary to this mixture and often have more specialized properties for keeping positive balance within the bore. This balance is dictated by and tailored to the prevailing geology and the tooling used to perform the HDD.

It is imperative that the Material Safety Data Sheets for all additives provided to NiSource and the project team for pre-approval. If the Contractor intends to use a product that has not been pre-approved by NiSource and the project team, then the Contractor should submit the required documentation and wait for approval prior to using the product.

When conditions change within the geology or the mud, mud is not maintained, or pressures are not monitored and maintained, a loss in circulation may occur, and drilling fluid can be released. This drilling fluid may be released to the formation or may inadvertently return to the surface.

It is recommended that the contractor provide the MSDS’s for all bentonite/additives (including polymers and surfactants) that will be used or may be used for the duration of the drill.

1.5 Plan Objectives

Numerous steps should be taken in the prevention, monitoring, and reacting to of inadvertent returns. Burns & McDonnell has laid out the following guidelines or recommendations to avoid the inadvertent releases of drilling fluid whilst drilling. This plan should be reviewed by the contractor prior to the beginning of installation and proposed modifications should be discussed by the project team.

1.6 Disposal Considerations

Excess drilling fluids and drill cuttings will need to be managed throughout the construction efforts. The excess fluids and cutting should be disposed of offsite at an approved disposal facility.

2. Inadvertent Release Mitigation Efforts

2.1 Geotechnical Exploration

A geotechnical exploration program was undertaken, consisting of forty two (42) borings along the proposed alignment to: determine the subsurface conditions to the depths of the borings, evaluate the engineering characteristics of the subsurface materials, and provide recommendations for the proposed improvements and design using the results of this field exploration.

2.2 Bore Path Design

The bore path design was developed referencing the geology identified in the geotechnical and geophysical analyses, and in consideration of the risks of an inadvertent release during installation. Typically, the greater soil/rock cover the lower the risk of having an inadvertent drilling fluid release. With these factors in mind, an adequate depth of cover was chosen for the design to minimize the potential for inadvertent drilling release.

2.3 Hydrofracture Analysis

Hydrofracture occurs when the pressure of the drilling fluids in the bore hole exceeds the strength of the surrounding soils. The excess pressures fracture the soil around the bore hole and allow the fluids to escape the bore hole. A hydraulic fracture analysis was performed to evaluate the allowable drilling fluid pressures and how they compare to the anticipated fluid pressures during construction. The results of this analysis were utilized in the development of the designed HDD plan and profile.

2.4 Site Preparation Efforts

The contractor is responsible for preparing the site prior to beginning any drilling, as well as maintaining the site during drilling. Preparation should follow environmental best management practices and consist of some number of thought out and well-placed environmental control devices. Upon arrival, the contractor will walk and evaluate HDD entry and exit, and general centerline to determine which areas have increased potential for inadvertent return. Some of these areas may be locations where water pools naturally, waterways, wetlands, areas of lower depth of cover, areas with transitions, areas that on the surface are loaded with cobbles and boulders, etc. This walk allows the contractor to not only identify areas, but know which areas should be monitored more closely, and evaluate readiness for managing an IR should it occur in any area, regardless of difficulty reaching it. Within workspaces, containments should be set up around stationary equipment and ECDs/ECMs (erosion control measures) should be installed downslope of potential areas of immediate impact.

While Burns & McDonnell respects the means and methods of contractors, recommendations of ECDs/ECMs/precautionary equipment may include the following:

1. Storm drain inlets will be secured by silt sock (securing may be by sandbag).
2. Numerous rolls of vis-queen.
3. Silt fence placed and dug-in downslope of heavy equipment or workspaces.

4. Containment areas, consisting of self-standing enviro-basin, or polyethylene sheeting that can be rolled over straw wattles or four-by-four boards to create a barrier.
5. Spill kits, to deal with other than drilling fluid releases.
6. IR kit, which may contain haybales, trash-bags, additional silt socks, additional silt fence, stakes, stake mallet, etc.
7. It is recommended that these materials be readily available in quantity to replace existing materials or respond to IRs.

3. Inadvertent Release Monitoring Plan

This section of the plan addresses monitoring approaches for early detection and mitigation when high risk circumstances present themselves onsite.

During drilling operations, the contractor will maintain the drilling fluid monitoring equipment onsite, and have personnel who are proficient in their use, having knowledge and experience pertinent to drilling fluid. As such, the personnel should be able to perform the following activities, with ease, or in order to evaluate the fluid properties and make adjustments to improve stability, increase cutting return, and reduce risk of IR:

1. Communicate directly with the driller at the driller's console/chair to receive reports of annular pressure, mud-motor stalls, and changing conditions that can only be immediately felt by the driller.
2. Maintain fluids in the mud tank, check levels, charge pressure, and measure the rate of depletion in relation to the progression of new-bore.
3. Monitor the condition of drill mud at least three times a day, and once for every observed change in material:
 - a. Take mud weight with approved mud test kit and include units in notes.
 - b. Take viscosity with marsh funnel and accurate durational measurement.
 - c. Take sand content measurement by the book to monitor content of superfines that slip through filtration. If the sand content gets too high, disposal and remixure should be considered.
 - d. Take PH measurements to ensure that the platelet content of the drill mud stays high (platelets are the armor that coats the bore-wall in permeable conditions and often help prevent seep progression leading to IR, acidic conditions destroy the ability for drill mud to form platelets and lowers the viscosity).
4. Recommend which surfactants/polymers (such as clay cutters (for balling), stabilizers, etc.) or natural remedies (ex. sawdust) should be used and recognize when deployment is necessary (surfactants and polymers are extremely potent, as in 1 quart can equal 50 bags of bentonite, product knowledge is critical).
5. Monitor the return pit for solids content accumulation as it relates to proper suspension and carrying. A pit that is full of dense cuttings, not being reclaimed by the mud reclaiming pump may indicate that the same situation is present in the bore, thus leading to an eventual build-up of down-hole material, which may cause annular pressure spikes and rises.
6. A competent person should visually inspect the bore path at the completion of each joint and inspect 100 feet upstream and downstream and if possible, laterally, along alignment.
7. Ensure with the driller that annular pressures do not exceed calculated predicted pressure for hydraulic fracturing and that spikes are noted, and steps taken to mitigate or reverse the rise in pressure. Steps can include tripping while rotating pipe, inspecting the degree of balling on tooling if



it is suspected to be occurring, doing a bottoms-up (this is the circulation of mud equating to the entire current bore volume).

8. Inspect waterways and sites previously identified during the site work as areas of concern. When inspecting waterways, look for tan, brown to gray levels of turbidity that stand out and are joining the flow of water. Often, in slower waters, an IR will look like a cloud.
9. Contain all drilling fluids and cuttings for proper disposal at an approved facility and note the volume of cuttings in the spoils pit as it relates to drilled volume. The cutting volume should be within reasonable proximity of the drilled volume.
10. If possible, a vacuum truck with sufficient hoses to reach all areas along the bore alignment will be staged prior to and during drilling activities. If a vacuum truck cannot be staged onsite, the truck will be readily available. An interim pump will be onsite to reach low areas and aid the vacuum truck. It is recommended that this resource be capable of departing and arriving onsite within one hour.

4. Inadvertent Release Contingency Plan

This section of the plan lays out the response if an inadvertent release were to occur.

4.1 Materials

The drilling contractor shall have the necessary fluid containment and clean-up provisions onsite and readily available at all times during drilling operations. Examples of materials that should be kept onsite include:

- Brooms, squeegees, and shovels
- Disposal bags and ties
- Vac trucks
- Spill kits
- Straw bales (weed and invasive free)
- Compost filter sock (12-inch diameter minimum)
- Weighted sediment tube
- Wooden stakes and mallet
- Sand bags
- Silt fence
- Plastic sheeting
- Trash pumps
- Turbidity curtain

The contractor should include a list of proposed inadvertent release response materials in their work plan for review by the project team. Quantities of one-time-use materials may need to be replenished if they are utilized during the course of work.

4.2 Loss of Fluid Returns to Entry Pit

A loss of fluid returns to the entry pit is often the first sign of an inadvertent fluid release. Therefore, if a loss of fluid returns to the entry pit is observed, care should be taken to evaluate the next steps forward.

Should a loss or significant reduction of returns to the entry pit be observed during drilling operations, it is recommended that the following steps be taken:

1. Stop drilling/pumping fluids as soon as a loss of returns is observed.
2. Walk the alignment to see if fluid has returned to the ground surface.

3. Restart mud pumps and trip rods back several joints until returns are re-established.
4. Re-drill the hole while advancing the drill bit paying close attention that fluid returns are maintained.

If this procedure does not re-establish returns, alternative approaches such as a complete trip out or enlarging the borehole may be considered.

4.3 Fluid Release Response

In the event of an inadvertent drilling fluid release, the following procedures can be implemented to contain, minimize, and potentially stop the inadvertent return of drilling fluids:

1. Immediately and simultaneously kill charge pump and back trip (bottom-hole assembly) a full joint length off bottom (bore-face).
2. Get on location and characterize IR. Document location and proximity to centerline, size (volume), breadth, drilling conditions when IR occurred (hard/soft, rock/gravel, mud data, pressure data (over the last several joints) etc.), document setting (high grass, trees, marsh, waterway), and take pictures.
3. Notify individuals whose contact information is listed below, and all appropriate personnel to include EI if onsite (environmental inspector).
4. Next check the return pit. This will be entry pit during pilot, but during ream can also be exit pit. Ensure that volume was as it was before IR. Next check mud recycler and ask when the mud tank was last topped off. Proceed by conveying with driller and move to inspect the remainder of the right-of-way/centerline vicinity (generously).
5. Make the best possible concise statement with the available information of fluid released and fluid lost (ex. T:1530, BHA at release STA 10 + 75, Release at STA 10 + 50 / 20 R off centerline, approx. 500 gal released, approx. 1,000 gal lost to shale formation, gravelly/discolored cuttings in returns, release amongst the pines and high-grass and accessible). Do NOT repeat hearsay.
6. Determine potential threats to the health and safety of workers by initiating cleanup and determine potential threats to the environment.
7. If environmental impacts are observed, remove and/or contain material to minimize affected area while minimizing disturbance to the area.
8. Consider countermeasure contingency simultaneously with consideration for what measures are necessary to monitor and control the potential continued release.
9. Once controls are in place, before resuming, allow formation to rest.
10. Once resuming or deploying LCM (loss circulation material), exercise extreme caution on flow rate and pressure. Check IR activity/dormancy in real-time, and returns, in real-time.
11. Consider other measures such as tripping all the way out or installing a burp-hole to relieve overhead pressure within the bore (ex. bore is 5' below grade in entry pit, lengthen pit so bore begins 10' below grade, ex. dig pit where bore is 10' lower than at entry and lower reclaiming pump to 7' and pump



reclaimed mud to recycler from newly created burp-hole), if tripping all the way out note clay that may be clinging to tooling, take pictures, communicate with mud-engineer.

12. If in the water, consider the use of a containment structure, such as a piece of pile that can be placed over the IR and secured/driven, place pump etc.
13. Inspect all IRs in the presence of all involved parties.
14. Request environmental monitors onsite if needed to ensure environmental requirements are met.

4.4 Notification Contact Information

The following individuals shall be immediately notified in the event of an inadvertent release being observed at the ground surface or within the river.

- Scott Brown (412-676-0329) – NiSource Environmental Coordinator

All inadvertent return incidents shall be reported to Ohio Power Siting Board within 24 hours. Inadvertent return incidents that reach surface water shall also be reported to Ohio Power Siting Board and the Ohio EPA within 24 hours. If inadvertent return incidents occur during HDD construction, the following individuals shall be immediately notified to coordinate Ohio Power Siting Board notification.

- Sarah Poe (614-460-4632) – Columbia Gas of Ohio Manager of Energy Efficiency
- John Ryan (614-285-2220) – Columbia Gas of Ohio Director of Regulatory Policy

If inadvertent return incidents occur during HDD construction, the following individuals shall be notified to coordinate Ohio EPA notification.

- Scott Brown (412-676-0329) – NiSource Environmental Coordinator



Appendix B City of Columbus Standard Excerpts

APPENDIX B CITY OF COLUMBUS STANDARD EXCERPTS

**CITY OF COLUMBUS
PUBLIC SERVICE DEPARTMENT
TRANSPORTATION DIVISION**

**SUPPLEMENTAL SPECIFICATION 1501
COMPACTION TESTING OF SOILS, GRANULAR MATERIALS,
SHALE AND OTHER MATERIALS**

JULY 8, 2002

- 1501.01 General**
- 1501.02 Compaction Testing for Soils**
- 1501.03 Compaction Testing Requiring an Aggregate Correction Factor**
- 1501.04 Compaction Testing for Granular Material**
- 1501.05 Test Section**
- 1501.06 Compaction Testing for Shale**
- 1501.07 Compaction Acceptance**
- 1501.08 Minimum Number of Test**

COMPACTION TESTING OF SOILS, GRANULAR MATERIALS, SHALE AND OTHER MATERIALS

1501.01 General. Perform all compaction testing of soils, granular material, bases or backfill in accordance with this supplement for all applicable work items within the City.

The City's Testing Section will perform the compaction tests unless specifically stated otherwise in the contract documents.

All personnel performing test in a trenching operation must have OSHA approved confined space training.

Perform the in-place density tests by utilizing a nuclear gauge according to ASTM D-2922.

A nuclear gauge standard count shall be performed daily and a record of results maintained.

Nuclear gauges shall be verified for calibration at twelve month intervals.

The Contractor will be responsible for surface preparation of the section to be tested.

It is the Contractor's responsibility to provide and maintain access to the area selected for testing.

The Contractor shall cooperate to the fullest extent to accommodate compaction testing and no extra payment will be allowed for delay or time lost due to the verification of compaction.

1501.02 Compaction Testing for Soils. For nuclear gauge operations, use the direct transmission method. The tested depth will correspond to the compacted depth of the layer of material being tested.

Perform a one-point proctor test in accordance with AASHTO T-272, Method C, if a laboratory- established curve has not been previously developed, a change in soil type is observed, or if test results indicate a verification of materials is required.

Use the Family of Curves prepared by the Ohio State Highway Testing and Research Laboratory.

Plot the proctor wet density and the moisture percent indicated by the nuclear gauge to determine the compaction curve to be used. When the intersection point is between two curves, choose the higher of the curves.

All compaction percentages will be calculated based on the dry densities of the material.

When the material or field conditions warrant, a test section (1501.05) may be performed in lieu of the above procedures.

Use form T-100 to record the compaction results.

1501.03 Compaction Testing Requiring an Aggregate Correction. If the material contains by weight, more than 5 percent and less than 30 percent over size material (material retained on the $\frac{3}{4}$ inch sieve), this procedure must be followed. If the material contains more than 30 percent retained, utilize a Test Section (1501.05).

Obtain a representative sample of the material from directly below the gauge. Sieve the material through a $\frac{3}{4}$ inch (19 mm) sieve. Divide the weight of the material retained on the $\frac{3}{4}$ inch (19 mm) sieve by the weight of the total sample.

Use this percentage to calculate the aggregate correction factor in accordance with AASHTO T-224.

Use form T-110 to record the results.

1501.04 Compaction Testing for Granular Material. Follow the same procedure set forth in section 1501.02 with the following exception:

If required to perform a field one-point proctor test, use Method C of AASHTO T-99 if using the Ohio State Highway Testing and Research Laboratory curves or Method D if applied to a laboratory established curve.

Use form T-100 to record the compaction results.

1501.05 Test Section.

1. Designate a test section of sufficient size to permit the operation of compacting equipment in a normal manner.
2. Spread the material using approved methods, in layers not to exceed 8 inches (200 mm) in thickness (loose depth), unless otherwise specified or authorized in writing by the Engineer.
3. Insure that the moisture content of the material is not less than optimum minus 2 percent and not more than optimum plus 1 percent. Watering, drying or manipulating may be necessary to secure uniform distribution of moisture throughout the material.
4. Compact the material using approved compaction equipment. Keep an accurate record of the number of coverages.
5. Perform a density test in the compacted test section after the initial seating of the material.
6. Further compact the test section with two additional passes.

7. Perform a second density test in the compacted test section near the location of the first test. If the two tests vary by less than 2.0 pounds per cubic foot (32 kgb/m³), the higher of the two tests will be considered a satisfactory test section density.
8. If the density after additional rolling has increased more than 2.0 pounds per cubic foot (32 kgb/m³), repeat this process of compacting and testing until the density increase is less than 2.0 pounds per cubic foot (32 kgb/m³). The resulting highest density will be considered a satisfactory test section density.
9. Determine and record the wet density, dry density and moisture content. For the remainder of the work, the material shall be compacted to at least 98 percent of the dry weight obtained from the test section.

A new test section density may be required if the material characteristics or the supporting materials change appreciably.

A pass is defined as one coverage over the specified area with the compaction equipment.

Use form T-120 to record the details.

1501.06 Compaction Testing for Shale. Severely deteriorated, or weathered shale will be tested in accordance with 1501.02.

Soft or hard shale will be tested according to 703.11(C).

If by weight, less than 25 percent of the material is retained on the ¾ inch (19 mm) sieve, the compaction testing will be in accordance with 1501.02. If 25 percent to 75 percent is retained on the ¾ inch (19 mm) sieve, a test section shall be performed.

If more than 75 percent of the shale is retained on the ¾ inch (19 mm) sieve or when the material does not deteriorate, the shale will be field tested for hardness in accordance with 703.11(C). If less than 40 percent of the shale breaks down, by visual inspection, the material will be considered hard shale. Use the procedure detailed in 203.06 for compaction acceptance. If greater than 40 percent breaks down, perform a test section according to 1501.05.

Use form T-150 to record the results.

1501.07 Compaction Acceptance. Once the initial control data has been established, the remainder of the installation will be verified for specification compliance based on these results.

If a test fails to meet the requirements, the moisture content shall be adjusted, if required, and further compaction effort applied.

1501.08 Minimum Number of Tests. The project work items will be divided into sections and the number of tests will be performed as described below:

Work Item	Minimum Number of Tests	Section Size
203 Embankment	One	500 Cubic Yards (382 Cubic Meters).
204 Subgrade	One	1000 Square Yards (833 Square Meters)
304 Aggregate Base	One	250 Square yards (209 Square Meters)
Controlled Backfill	One	50 Lineal Feet (15 Meters)

The above is a minimum number of compaction tests required, however this number may be increased or decreased at the discretion of the City.

250 PAVEMENT REPAIRS

ITEM 251 PARTIAL DEPTH PAVEMENT REPAIR

[251.01](#) Description

[251.02](#) Removal of Existing Pavement

[251.03](#) Placement of Asphalt Concrete

[251.04](#) Method of Measurement

[251.05](#) Basis of Payment

251.01 Description. This work consists of partial depth removal of existing asphalt pavement in areas exhibiting deterioration at the surface, applying tack coat, and placing and compacting asphalt concrete.

251.02 Removal of Existing Pavement. The Engineer will designate the location and limits of areas to be repaired. Provide the Engineer with aerosol spray paint to outline those areas for repair. Construct rectangular repair areas with dimensions as required to envelop surface deterioration. Unless otherwise specified, extend repair areas the full width of a traffic lane. Remove pavement to the depth shown on the plans.

Remove the pavement to the specified depth within the designated limits without loosening or otherwise damaging adjacent pavement. Dispose of removed pavement according to [202](#).

Trim the limits of the repair to form a vertical face 1.5 inches deep from the surface unless the repair is covered with a mill and overlay within 60 days.

251.03 Placement of Asphalt Concrete. Apply [407.02](#) material to thoroughly coat the exposed surface and to fill cracks and joint openings.

In accordance with [Standard Drawing 1441](#), place and compact approved asphalt concrete meeting the design requirements of the item shown in the pay item description in one or more lifts as necessary to finish flush with the adjacent pavement surface. Place surface course mixes at a maximum 2 inch lift thickness and intermediate courses at a maximum 3 inch lift thickness.

Thoroughly and uniformly compact all lifts using suitable mechanical compaction equipment operated over the entire replacement area to produce a smooth surface flush with the adjacent pavement surface.

Ensure that each lift is thoroughly compacted to a suitable density that will not result in displacement under traffic. If the Contract does not include resurfacing, seal the perimeter surface of the repaired area by applying a nominal 4 inch strip of approved [702.17.B](#) or [702.17.C](#) material.

251.04 Method of Measurement. The City will measure the quantity of Partial Depth Pavement Repair by the number of square yards or cubic yards of pavement repaired in the complete and accepted work, calculated using the dimensions established by the Engineer.

251.05 Basis of Payment. Payment is full compensation for furnishing all materials, including aerosol spray paint, tack coat, asphalt concrete, and perimeter seal; and cutting, removing, and disposing of existing pavement.

The City will pay for accepted quantities at the contract price as follows:

Item	Unit	Description
251	Square Yard	Partial Depth Pavement Repair (441)
251	Cubic Yard	Partial Depth Pavement Repair (441)

ITEM 252 FULL DEPTH RIGID PAVEMENT REMOVAL AND FLEXIBLE REPLACEMENT

[252.01](#) Description

[252.02](#) Removal of Existing Rigid Pavement

[252.03](#) Correction of Subgrade

[252.04](#) Placement of Asphalt Concrete

[252.05](#) Method of Measurement

[252.06](#) Basis of Payment

252.01 Description. This work consists of the full depth removal of existing rigid pavement, correcting the subgrade, placing and compacting asphalt concrete, and restoring the shoulders.

252.02 Removal of Existing Rigid Pavement. Conform to [255.03](#), except the last paragraph does not apply.

252.03 Correction of Subgrade. Shape and recompact the subgrade as the Engineer directs. Clean all vertical faces of the existing pavement, and coat them with asphalt material according to [401.14](#).

252.04 Placement of Asphalt Concrete. In accordance with [Standard Drawing 1441](#), construct the pavement replacement by placing and compacting [Item 301](#) and [441](#) material in two or more lifts.

Thoroughly and uniformly compact all lifts using suitable mechanical compaction equipment operated over the entire replacement area to produce a smooth surface flush with the adjacent pavement surface.

Ensure that each lift is thoroughly compacted to a suitable density that will not result in displacement under traffic.

If the Contract does not include resurfacing, seal the perimeter surface of the repaired area by applying a nominal 4 inch wide strip of approved [702.17.B](#) or [702.17.C](#) material.

After completing repairs, restore the existing shoulders to the condition that existed prior to the repair work.

252.05 Method of Measurement. The City will measure the quantity of Full Depth Rigid Pavement Removal and Flexible Replacement by the number of square yards or cubic yards of rigid pavement repaired in the complete and accepted work, calculated using the dimensions established by the Engineer.

The City will measure the quantity of Full Depth Pavement Sawing by the number of feet of full depth saw cuts in the complete and accepted work. The City will not measure offset saw cuts. The City will not measure additional cuts made to facilitate the removal of the pavement.

252.06 Basis of Payment. Payment is full compensation for furnishing all materials, including aerosol spray paint, removing pavement, correcting the subgrade, placing flexible pavement, sealing, and restoring the shoulders.

The City will not pay for removal, disposal, and replacement of pavement damaged adjacent to the repair.

Include the cost of any additional concrete sawing and removal depths less than 1 inch greater than those shown in the plans.

The City will pay for accepted quantities at the contract prices as follows:

Item	Unit	Description
252	Square Yard	Full Depth Rigid Pavement Removal and Flexible Replacement
252	Cubic Yard	Full Depth Pavement Removal and Flexible Replacement
252	Foot	Full Depth Pavement Sawing

ITEM 253 PAVEMENT REPAIR

[253.01](#) Description

[253.02](#) Removal of Existing Pavement

[253.03](#) Placement of Asphalt Concrete

[253.04](#) Method of Measurement

[253.05](#) Basis of Payment

253.01 Description. This work consists of removing existing asphalt concrete, brick, PCC, or aggregate pavement courses; shaping and compacting the exposed material; and placing new asphalt concrete pavement or aggregate and asphalt concrete pavement courses.

Refer to [Standard Drawing 1441](#) and the plans for details about the repairs and replacement material.

253.02 Removal of Existing Pavement. The Engineer will designate the location and limits of areas to be repaired. Provide the Engineer with aerosol spray paint to outline those areas for repairs. Repair the full depth of the pavement, unless otherwise shown on the plans.

Cut the existing pavement at the limits specified and as necessary to prevent disturbing or undermining the remaining pavement during removal. Completely remove pavement in the repair area to the specified depth without displacing, undermining, or otherwise damaging the remaining pavement. Dispose of removed pavement according to [202](#).

Trim the limits of the repair to form a vertical face 1.5 inches deep from the surface unless the repair is covered with a mill and overlay within 60 days.

253.03 Placement of Asphalt Concrete. Shape and compact the exposed underlying material as the Engineer directs. Before placing specified asphalt concrete, clean all vertical faces of the existing pavement and coat them with asphalt material according to [401.14](#). Place the replacement material in lifts as the Engineer directs. Thoroughly and uniformly compact each lift using suitable compaction equipment as the Engineer directs. Finish the final lift flush with the adjacent pavement surface.

Thoroughly and uniformly compact all lifts using suitable mechanical compaction equipment operated over the entire replacement area to produce a smooth surface flush with the adjacent pavement surface.

Ensure that each lift is thoroughly compacted to a suitable density that will not result in displacement under traffic.

If the Contract does not include resurfacing, seal the perimeter surface of the repaired areas by applying a nominal 4 inch wide strip of approved [702.17.B](#) or [702.17.C](#) material.

After completing repairs, restore the existing shoulders to the condition that existed prior to the repair work.

253.04 Method of Measurement. The Engineer will measure the quantity of Pavement Repair by either the number of square yards or cubic yards of pavement repaired in the complete and accepted work, calculated using the dimensions established by the Engineer.

253.05 Basis of Payment. Payment is full compensation for furnishing all materials, including aerosol spray paint and replacement and restoration materials; cutting, removing, and disposing of existing pavement; shaping and compacting the exposed underlying material; placing new pavement; and restoring the shoulders.

The City will not pay for additional work to repair damage caused by the pavement sawing or pavement removal.

The City will pay for accepted quantities at the contract prices as follows:

Item	Unit	Description
253	Square Yard	Pavement Repair
253	Cubic Yard	Pavement Repair

ITEM 254 PAVEMENT PLANING

- [254.01](#) Description
- [254.02](#) Equipment
- [254.03](#) Planing
- [254.04](#) Surface Patching
- [254.05](#) Surface Tolerances
- [254.06](#) Method of Measurement
- [254.07](#) Basis of Payment

254.01 Description. This work consists of planing asphalt concrete and disposing of the cuttings, and, if specified in the Contract, patching the planed surface.

254.02 Equipment. Use self-propelled planing equipment that has sufficient power and stability to consistently and efficiently meet the requirements of [254.05](#) and the plans. Use equipment with either grinding, sawing, or milling type cutters. Ensure that the cutters are mounted rigidly to the carrier and are adjustable to control the depth of cut and cross-slope. Use equipment with a suitable carrier wheelbase or with an automatic control system having an external reference. Ensure that cross-slope adjustments or automatic controls are capable of producing either a variable or a constant cross-slope, as required.

For small or confined areas, the Contractor may use suitable supplemental equipment or methods approved by the Engineer.

254.03 Planing. Make one or more planing passes, as necessary, over the designated area to the depth specified in the plans. Remove irregularities such as bumps, corrugations, and wheel ruts, when required, to establish a new pavement surface elevation or cross-slope.

Remove cuttings from the surface following each pass. Before opening the completed area to traffic, thoroughly clean the surface of all loose material that would create a hazard or nuisance, or would redeposit into the surface texture. Dispose of cuttings according to [202](#).

Implement effective measures to control dust, pavement contamination, and the scattering of loose particles during planing and cleaning operations.

If planing damages the adjacent pavement, repair the damaged area to the Engineer's satisfaction. Ensure that the repaired area matches the adjacent pavement in terms of smoothness and mix type.

254.04 Surface Patching. Patch areas of the planed surface that the Engineer designates that have spalling or dislodged unsound pavement. Before patching, clean areas of loose material, coat with [407.02](#) asphalt material, and fill with [Item 441](#) Surface or [442](#) 9.5mm or 12.5mm material. Level and compact new material flush to the adjacent planed pavement.

254.05 Surface Tolerances. Plane the surface free from grooves, ridges, gouges, or other irregularities detrimental to the safe operation of vehicles on the planed surface.

If the Contract specifies planing without resurfacing, plane the surface to a smoothness of 1/8 inch in 10 feet. If the Contract specifies resurfacing after planing, plane the surface to a smoothness of 1/4 inch in 10 feet. Match the surfaces at the edges of adjacent passes within 1/8 inch. Ensure that the cross-slope of the planed surface is within 3/8 inch in 10 feet of the specified cross-slope.

254.06 Method of Measurement. The Engineer will measure the quantity of Pavement Planing, Asphalt Concrete by the number of square yards.

The Engineer will measure the quantity of Patching Planed Surface by the number of square yards.

254.07 Basis of Payment. The City will not pay for repairs due to damage caused by planing operations. If the depth of the planed surfaces is increased by more than 3/8 inches, the City will compensate for the additional work.

The City will pay for accepted quantities at the contract prices as follows:

Item	Unit	Description
254	Square Yard	Pavement Planing, Asphalt Concrete
254	Square Yard	Patching Planed Surface

ITEM 255 FULL DEPTH PAVEMENT REMOVAL AND RIGID REPLACEMENT

- [255.01](#) Description
- [255.02](#) Materials
- [255.03](#) Removal of Existing Pavement
- [255.04](#) Correction of Subgrade
- [255.05](#) Placing Dowels and Tiebars
- [255.06](#) Placement of Portland Cement Concrete

[255.07](#) **Wearing Course Replacement**

[255.08](#) **Opening to Traffic**

[255.09](#) **Method of Measurement**

[255.10](#) **Basis of Payment**

255.01 Description. This work consists of full depth removal of existing pavement; removing subbase where specified; compacting the subgrade; furnishing and placing dowels, tiebars, and mesh where specified; placing, consolidating, finishing, and curing new PCC to the level of the adjacent PCC pavement; replacing existing asphalt overlay where required; and restoring affected shoulders.

Refer to [Standard Drawing 1441](#) and the plans for details about the repairs and replacement material.

255.02 Materials. Furnish materials conforming to:

Concrete, Class FSCOC 1, COC MS, COC FS.....	499
Curing materials, Type 2.....	705.07
Non-shrink non-metallic grout	705.20
Reinforcing steel	709.00
Preformed elastomeric joint sealer	705.11
Tiebar	705.01 or 709.00
Dowel bars and basket assemblies	705.01 or 709.13
Expansion shield anchors Type A	712.01
Tack Coat.....	702.04 or 702.13
Crack Seal	705.04
Asphalt	441

Use epoxy coated hook bolt, wiggle bolt, and coupling.

Select and furnish grout from the Qualified Product List issued by the Laboratory that firmly anchors the dowel or tiebar within 30 minutes.

255.03 Removal of Existing Pavement. The Engineer will locate and mark all areas for repair before the start of diamond sawing. Provide the Engineer with aerosol spray paint to outline those areas for repair.

Saw cut the existing rigid pavement to the full depth at the limits of the area designated by the Engineer using a diamond saw blade. Where there is an existing asphalt concrete overlay on top of the concrete pavement to be removed, the Contractor may make either a full depth saw cut through the asphalt concrete overlay and the concrete pavement, or make an offset saw cut through the asphalt concrete overlay. If making an offset saw cut through the asphalt concrete overlay, remove the overlay as necessary to provide clearance for the full depth saw cut through the concrete pavement. The Contractor may elect to make additional cuts to facilitate the removal of the pavement.

Remove pavement in the repair area by the lift-out method without damaging or undermining the remaining pavement. After the repair area is isolated by full depth saw cuts, drill holes through the deteriorated slab, and install lift pins. Vertically lift the pavement out of the repair area. Remove loose debris left behind after lift-out using hand methods. Dispose of removed pavement according to [Item 202](#).

Do not break the pavement and clean out the material using a backhoe unless the Engineer determines that the lift-out method is not feasible due to deteriorated pavement or existing asphalt concrete repairs.

If the bottom face of the adjacent concrete pavement is deteriorated for a height greater than one-fourth (1/4) the thickness of the rigid pavement, make additional full depth saw cuts as directed by the Engineer along the full width of the lane or lanes to remove the deteriorated areas. Repair pavement damaged during the pavement sawing or pavement removal according to [Item 255](#) or [Item 256](#).

255.04 Correction of Subgrade. After removing the pavement full depth and before installing dowels or tiebars, shape and recompact the subgrade to the satisfaction of the Engineer. Use concrete to replace any subgrade material removed as part of the rigid pavement replacement.

255.05 Placing Dowels and Tiebars. Drill dowel and tiebar holes using hydraulic, electric, or pneumatic percussion drills without spalling or damaging the existing concrete. Provide drills capable of independent adjustment of each drill shaft in the horizontal and vertical direction. To drill for dowels, use a device capable of drilling a minimum of three holes at a time. For patches 10 feet or greater in length, provide tie bars or wiggle bolts of the size and spaced as shown on the standard drawings along the longitudinal joint(s). Blow all drilled holes clean with oil-free compressed air. Maintain holes dry and frost free before grouting the dowels or tiebars. Pneumatically inject grout starting at the rear of the drilled holes and drawing a bead of material towards the front. Inject a sufficient amount of grout to fill all voids around the dowels and tiebars. Use a grout retention disc with a radius slot as shown in the standard drawings to retain the grout within the drilled holes. Place the grout retention disc on the dowels and tiebars at the end to be inserted in the hole. Insert dowels and tiebars in the holes and rotate the dowels and tiebars approximately one full revolution. Ensure a small amount of grout extrudes through the radius slot in the grout retention disc when the dowels and tiebars are installed. Hold dowel bars in proper alignment until the grout has hardened.

255.06 Placement of Portland Cement Concrete. Do not place any PCC rigid pavement replacement until the grout around the dowels and tiebars has hardened. Coat dowel bars with bond breaking material conforming to [451.09.B](#). Place PCC according to [451.07](#). Use forms when placing portland cement concrete against asphalt concrete or any unbound material. Cast each patch in one continuous operation. Consolidate the concrete around the perimeter of the patch and within the limits of the patch area using an internal type vibrator. Use approved internal type vibrators capable of visibly affecting the concrete for a distance of 12 inches from the vibrator head.

Screed repairs less than 12 feet in length parallel to the centerline. Screed repairs 12 feet in length and longer perpendicular to the centerline.

While the concrete is still in a plastic state, test the surface for trueness and for being flush with the edges of the adjacent slabs using a 10-foot straightedge. Place the straightedge parallel to the pavement centerline with half of the straightedge resting on the adjacent pavement, and draw the

straightedge across the patch to test the patch edges. Check areas within the patch length in a similar manner. Where the straightedge shows deviations, correct all high or low areas exceeding 1/8 inch in 10 feet. Recheck the concrete surface after making corrections to ensure conformance to the above tolerance. Make additional checks and corrections until patch is within tolerance.

Texture the new concrete surface similar to that of the surrounding pavement.

Apply the liquid membrane-forming curing compound at a minimum rate of 1 gallon of material for each 150 square feet.

255.07 Wearing Course Replacement. Trim the limits of the repair to form a vertical face 1.5 inches deep from the surface. Replace the removed asphalt concrete overlay with an approved [Item 441](#) material, or as shown on the plans. Compact the material as approved by the Engineer using any of the roller types specified in [401.13](#). Apply [Item 407](#) Tack Coat to the replacement surfaces.

Before opening the rigid replacement to traffic, restore the shoulders to the original line and grade. Use either aggregate or asphalt concrete as shown on the plans or as the Engineer directs. Fill the low areas, and compact them flush with the surrounding shoulder.

Seal the perimeter surface of the repaired areas by applying approved [705.04](#) material.

If the contract includes resurfacing, one lift of intermediate course may be used up to 3 inches to match the existing pavement and it is not required to seal the perimeter surface.

255.08 Opening to Traffic. Do not open the rigid replacement to traffic until the concrete attains a split tensile strength of 350 pounds per square inch, as tested per ASTM C496.

If maintaining traffic in adjacent lanes, schedule work in order to place the concrete in the prepared repair area within 48 hours after removing pavement.

If unable to complete placement of the concrete in the exposed repair area by the end of a daily work shift, fill or cover repair areas less than 4 feet from the traveled lane. Fill using a temporary patch material suitable to the Engineer or cover unfilled repair areas 10 feet or less in length with a steel plate.

Do not leave repair areas unfilled with concrete when work is suspended on weekends or holidays. If unable to complete placement of the concrete in the exposed repair area before suspending work for a weekend or holiday or within the 48-hour time specified above, fill the repair area with an asphalt concrete mixture or other suitable temporary patch material with a durable surface as the Engineer directs. Maintain the temporary patches while they are in service.

255.09 Method of Measurement. The City will measure the quantity of Full Depth Pavement Removal and Rigid Replacement by the number of square yards or cubic yards repaired in the complete and accepted work.

The City will measure the quantity of Full Depth Pavement Sawing by the number of feet of perimeter full depth saw cuts in the complete and accepted work. The City will not measure offset saw cuts. The City will not measure additional cuts made to facilitate the removal of the pavement.

255.10 Basis of Payment. Payment is full compensation for furnishing all materials, including paint; removing pavement by any method; removing subbase for undercut replacement; compacting subbase and subgrade; placing rigid pavement, including concrete necessary to replace removed subbase or subgrade; furnishing and placing dowels, tiebars, and mesh; placing, maintaining, removing, and disposing of temporary patches, and restoring the shoulders.

The City will not pay for additional concrete sawing and removal depths within 1 inch greater than those shown on the plans.

The City will not pay for additional work to repair damage caused by pavement sawing, pavement drilling or pavement removal.

Payment is full compensation for furnishing all materials, including tack coat and asphalt concrete.

The City will pay for accepted quantities at the contract prices as follows:

Item	Unit	Description
255	Square Yard	Full Depth Pavement Removal and Rigid Replacement, Class ____
255	Cubic Yard	Full Depth Pavement Removal and Rigid Replacement, Class ____
255	Foot	Full Depth Pavement Sawing

ITEM 256 BONDED PATCHING OF PORTLAND CEMENT CONCRETE PAVEMENT

- [256.01](#) Description
- [256.02](#) Materials
- [256.03](#) Equipment
- [256.04](#) Removal of Unsound Concrete
- [256.05](#) Preparation of Patch Area
- [256.06](#) Bonding Grout Installation
- [256.07](#) Placing Patching Material
- [256.08](#) Curing and Loading
- [256.09](#) Method of Measurement
- [256.10](#) Basis of Payment

256.01 Description. This work consists of bonded patching of PCC pavements at spall areas adjacent to cracks or joints or other areas of the pavement as designated by the Engineer. This work involves removing all loose and unsound concrete and asphalt material patches; removing sound concrete as directed; preparing the surface; applying a bonding grout if required; reconstructing the joint or crack; and mixing, placing, finishing, and curing of the patching material called out in the pay item description.

256.02 Materials. Furnish materials conforming to:

Portland cement.....	701.05
Fine aggregate.....	703.02
Coarse aggregate, No. 8 size.....	703.02
Curing material.....	705.07
Air-entraining admixture	705.10
Quick setting concrete mortar.....	705.21

256.03 Equipment. Use a milling machine, concrete saw, jackhammers, or other approved equipment to remove existing surface material. Provide oil and moisture free compressed air for cleaning and abrasive blasting the prepared area. Provide an on-site concrete mixer capable of mixing a minimum of 2-cubic foot batches of patching material. Provide chipping hammers not heavier than the nominal 35-pound class.

256.04 Removal of Unsound Concrete. The Engineer will locate and mark all areas to be repaired prior to concrete sawing. Provide the Engineer with aerosol spray paint to outline the areas for repair. Repair areas will be rectangular or square in shape with dimensions as required to envelope the surface deterioration.

Saw the perimeter of all areas designated for removal to a depth of 1 inch to produce a vertical or slightly undercut face. Make additional saw cuts as required to facilitate removal. Remove all unsound concrete, all asphalt material, and all obviously loose and disintegrated concrete within the patch area. Remove sound concrete where required to achieve the minimum depth within the patch area. Remove concrete by jack hammering or milling. The minimum depth of any partial depth repair is 1 1/2 inch except at the perimeter saw cuts. Operate chipping hammers at an angle of less than 45 degrees measured from the surface of the pavement. During removal of unsound concrete, remove all pavement reinforcing exposed in the patch areas using a cutting tool or a torch.

256.05 Preparation of Patch Area. Before placing the patching material or before applying the bonding grout, if used, abrasive blast the exposed concrete surfaces to which the patching material is to bond until free of loose particles, oil, dust, traces of asphalt concrete and joint sealer, and other contaminants. Do not begin abrasive blasting operations until implementing reasonably available engineering controls to limit fugitive dust that are acceptable to the Engineer. Conform to State, regional, and local government agency requirements regarding control of dust generated by the blasting operation. Remove all sandblasting residue with compressed air just prior to placing the patching material or just prior to applying the bonding grout, if used. For Types B and C patching materials that do not use water as the activator, perform additional surface preparation according to the patching material manufacturer's recommendations.

Recreate joints and cracks through or along the patch using a joint board that extends below the prepared surface and has a width equal to the existing joint or crack. One hour after placing the patching material, remove the joint board in a manner that does not damage the patch.

256.06 Bonding Grout Installation. For bonding Type A patches, use grout that consists of equal parts, by volume, of portland cement and sand, mixed with sufficient water to form a stiff slurry. Using a stiff brush or broom, apply a thin, uniform coating of grout to the prepared surface. Scrub the grout onto the dry surfaces of the prepared area to be patched immediately before placing the patching material. Do not allow excess grout to collect in low spots. Do not allow the grout to dry before placing the new concrete. Paint grout over all sawed joints between the patch and adjacent concrete immediately after completing the finishing.

For bonding Types B and C patches, conform to the patching material manufacturer's recommendations.

256.07 Placement of Patch Material. Use Type A, B, or C patch material as follows:

- A. **Type A.** Provide patch material consisting of one part high early strength portland cement, one and a half parts fine aggregate, and one and a half parts coarse aggregate by volume. Add sufficient air-entraining admixture to maintain an air content of 8 ± 2 percent. Add enough water to obtain the minimum slump practical for placing, and do not allow slump to exceed 4 inches. Mix the materials on site. Do not use ready-mixed concrete. Place the concrete mixture in the patch area while the bonding grout is still wet. Slightly overfill, vibrate, and strike off the concrete.
- B. **Type B.** Provide patch material consisting of quick setting concrete mortar [705.21](#), Type 1 or 2. Mix and place the mortar according to the manufacturer's recommendations. Add coarse aggregate, as needed, according to the manufacturer's instructions. Place the concrete mixture in the patch area. If the manufacturer's requirements specify using bonding grout, place the concrete mixture while the bonding grout is still wet. Slightly overfill, vibrate, and strike off the concrete.
- C. **Type C.** Provide patch material consisting of a blend of quick setting concrete mortar [705.21](#), Type 2 and selected aggregates with an activator. Mix and place these materials according to the manufacturer's recommendations. Add coarse aggregate, as needed, according to the manufacturer's instructions. Place the concrete mixture in the patch area. If the manufacturer's requirements specify using bonding grout, place the concrete mixture while the bonding grout is still wet. Slightly overfill, vibrate, and strike off the concrete.

Screed patches 12 feet and less in length parallel to the centerline. Screed patches over 12 feet in length perpendicular to the centerline.

While the concrete is still in a plastic state, test the surface for trueness and for being flush with the edges of the adjacent slabs using a 10-foot straightedge. Place the straightedge parallel to the pavement centerline with the ends resting on the adjacent pavement and draw the straightedge across the patch. Where the straightedge shows deviations, correct all high or low areas exceeding 1/8 inch in 10 feet. Recheck the concrete surface after making corrections to assure that the patch area meets the surface tolerance before the patching material hardens.

Texture the new concrete surface similar to that of the surrounding pavement.

256.08 Curing and Loading. Cure Type A patches according to [451.11](#), except allow the patch to attain a split tensile strength of 350 pounds per square inch, as tested per ASTM C496, before opening to traffic. Cure Types B and C patches according to the manufacturer's recommendations.

256.09 Method of Measurement. The City will measure the quantity of Bonded Patching of Portland Cement Concrete Pavement, Type ___ by the number of square feet of the exposed surface of all patches, irrespective of the depth of the patch, repaired in the complete and accepted work. If the actual measured area of a patch is less than 2 square feet, the Engineer will increase each such measurement to 2 square feet.

256.10 Basis of Payment. The City will pay for accepted quantities at the contract price as follows:

Item	Unit	Description
256	Square Feet	Bonded Patching of Portland Cement Concrete Pavement, Type ___

ITEM 257 DIAMOND GRINDING PORTLAND CEMENT CONCRETE PAVEMENT

[257.01](#) Description

[257.02](#) Equipment

[257.03](#) Construction

[257.04](#) Final Surface Finish

[257.05](#) Method of Measurement

[257.06](#) Basis of Payment

257.01 Description. This work consists of diamond grinding and texturing PCC pavement longitudinally to substantially eliminate joint and crack faulting and to restore proper riding characteristics to the pavement surface.

257.02 Equipment. Provide grinding equipment that is a power driven, self-propelled machine that is specifically designed to smooth and texture PCC pavement with diamond blades or diamond impregnated cylinder rings. Mount the blades or cylinder rings on an arbor head. Provide a grinding head at least 3 feet wide. Ensure the equipment is capable of grinding the surface in the longitudinal direction without causing spalls or other damage at cracks, joints and other locations. Ensure the equipment is capable of correcting the pavement profile and providing proper cross slope on the concrete pavement.

Provide equipment with an effective wheelbase of at least 12.0 feet; a set of pivoting tandem bogey wheels at the front of the machine and rear wheels that travel and track in the fresh cut pavement. Ensure the center of the grinding head is no further than 3.0 feet forward from the center of the back wheels. Ensure the equipment is of a shape and dimension that does not encroach on traffic movement outside of the work area.

257.03 Construction. The plans will designate the areas of pavement surfaces to be ground. Grinding of bridge decks, approach slabs, and roadway shoulders will not be required unless indicated on the plans or required to provide drainage. Perform grinding in a manner that eliminates crack or joint faults while providing positive lateral drainage by maintaining a constant cross-slope between grinding extremities in each lane. Transition auxiliary or ramp lane grinding as required from the mainline edge to provide positive drainage and an acceptable riding surface.

Ensure the operation results in pavement that conforms to the typical cross-section and the requirements specified for the final surface finish, however, it is the intention of this specification that the faulting at joints and cracks be eliminated and the overall riding characteristics be restored within the limits specified. To accomplish the smoothness required, grinding may not be required on 100 percent of the pavement surface.

During initial grinding operations, use the profiler to test the pavement surface as soon as the concrete has been ground full lane width. This initial testing is to aid the Contractor in evaluating the grinding methods and equipment being used. Subsequent to the initial testing, run daily profiles of each day's grinding the next working day.

Remove all grinding residue. Remove solid residue before it is blown by traffic action or wind. Do not allow residue to flow across lanes used by the traveling public or into gutters or drainage facilities.

257.04 Final Surface Finish. Produce a pavement surface that is true to grade with the ground area consisting of a longitudinal corduroy-type texture. Ensure the peaks of the ridges are approximately 1/16 inch higher than the grooves with 53 to 57 evenly spaced grooves per foot.

Provide the necessary traffic control and survey stationing for initial measurements or any subsequent measurements. Measure the entire length of pavement, event marking the profile runs such that the data can later be identified when the profile sensor(s) is within 1.0 foot of any bridge deck, pressure relief joint, approach slab, or pavement not included in the grinding area identified in the plans or established by the Engineer.

Ensure transverse joints and cracks are flush with adjacent surfaces. The Engineer will visually inspect transverse joints and cracks to ensure that adjacent surfaces are in the same plane. Adjacent sides of joints or cracks within 1/16 inch of each other will be considered flush. Ensure the transverse slope of the pavement is uniform to a degree that no depressions or misalignments of slope greater 1/4 inch in 12 feet are present. Use a straightedge placed perpendicular to the centerline to measure depressions and misalignments. Straightedge requirements do not apply outside of area ground.

257.05 Method of Measurement. The City will measure diamond grinding by the number of square yards of pavement ground and accepted. The quantity of diamond grinding will be determined by multiplying the width specified on the plan by the total length of the diamond ground surface.

257.06 Basis of Payment. Payment is full compensation for furnishing all labor, materials, tools, equipment and incidentals and for doing all work involved in grinding the existing surface, removing residue, cleaning the pavement, and testing with a profiler.

The City will pay for accepted quantities at the contract price as follows:

Item	Unit	Description
257	Square Yard	Diamond Grinding Portland Cement Concrete Pavement

ITEM 259 PERMANENT PAVEMENT REPLACEMENT

259.01 Description

259.02 General

259.03 Classification

259.04 Construction

259.05 Brick Pavements

259.06 Method of Measurement

259.07 Basis of Payment

259.01 Description. This work consists of removal and replacement of permanent street or driveway pavements as indicated in the plans or as directed by the Engineer. This item shall also be used for replacement of pavement damaged by the Contractor or its agents and pavement cuts for placing of conduits or other structures beneath a permanent pavement or asphalt replacement related to curb. Permanent pavement as herein used shall mean any hard surface type pavement including asphalt, PCC, brick, surface treated macadam and similar materials.

259.02 General. The Engineer will select the type of pavement replacement to be provided to most nearly duplicate the pavement removed. The pavement types to be provided are shown in [259.03](#). In the event of a conflict between the type of replacement shown on the plans and that selected by the Engineer, the Engineer's selection shall govern. With the approval of the Engineer, the Contractor may use alternative surfaces, bases, or both, at no additional cost to the City. Do not perform any repaving under this item without the Engineer's approval.

259.03 Classification. Based upon the Engineer's selection as described in [259.02](#), furnish one of the following pavement types:

Permanent Pavement Replacement ([Standard Drawing No. 1441](#))

- Type I - Asphalt
- Type III - Brick
- Type V - Concrete

Driveway Pavement Replacement ([Standard Drawing No. 2160](#))

- Type IIIA - Asphalt Driveways
- Type IIIB - Concrete Driveways
- Type IIIC - Gravel Driveways

259.04 Construction. Cut the edges vertical and trim to provide a straight line juncture between the existing and new pavement, containing no ragged edges. Finish concrete surfaces to match as nearly as possible the adjacent surfaces. Where the edge of the repair is less than 2 feet from the curb, remove and replace the wearing surface up to the curb.

259.05 Brick Pavements. This work shall consist of excavation of brick or concrete patches in brick pavements and replacement with TYPE III pavement according to [259.03](#).

A. Materials. Remove all salvageable bricks without unnecessary damage, and clean and store in a safe place for reuse. When excavations are performed on streets with historical bricks, any additional bricks needed to complete the repair shall be historical solid fireclay brick (4 x 8 x 4 inches). When excavations are performed on newer style roadway pavers, comply with [Supplemental Specification 1524](#). Prior to starting, submit 3 samples of bricks that closely match the existing brick. The Engineer will review for color and texture only. Compliance with all other requirements is the responsibility of the Contractor.

B. Installation. Set brick in reasonably close conformity to the patterns of the existing brick pavement.

259.06 Method of Measurement. The City will measure street and driveway permanent pavement replacement by the volume in cubic yards actually placed except that in no case shall measurements extend beyond the limits of 1 foot exterior to the limiting lines shown for excavation on standard drawings, unless otherwise approved by the Engineer.

259.07 Basis of Payment. Payment is full compensation for furnishing all materials, labor, tools, equipment, and incidentals necessary to complete this work, including both surface and base construction and temporary pavement removal.

The City will pay for accepted quantities at the contract price as follows:

Item	Unit	Description
259	Cubic Yard	Permanent Pavement
259	Cubic Yard	Driveway Pavement Replacement, Type __

300 BASES

ITEM 301 ASPHALT CONCRETE BASE

[301.01](#) Description

[301.02](#) Composition

[301.03](#) Mixing

[301.04](#) Spreading and Finishing

[301.05](#) Spreading and Surface Tolerances

[301.06](#) Basis of Payment

301.01 Description. This work consists of constructing a base course of aggregate and asphalt binder, mixed in a central plant and spread and compacted on a prepared surface.

The requirements of [Item 401](#) apply, except as modified by this specification.

301.02 Composition. Furnish aggregate for the mix that conforms to the following gradation:

Sieve Size	Total Percent Passing
2 inch	100
1 inch	75 to 100
1/2 inch	50 to 85
No. 4	25 to 60
No. 8	15 to 45
No. 16	10 to 35
No. 50	3 to 18
No. 200	1 to 7

Submit a proposed JMF according to [441.02](#). Submit for the Laboratory's approval the desired percentage of the aggregate passing the No. 4 sieve and blend of individual components. The Contractor may use reclaimed asphalt concrete pavement according to [401.04](#). The Laboratory will establish the required binder content within a range of 4.7 to 7 percent. Do not make changes in these JMF values due to unsatisfactory results or other conditions except as authorized by the Laboratory. Obtain a new JMF approval for any desired change to an existing JMF.

301.03 Mixing. If using a batch plant, use screens with openings of sizes that result in a reasonably balanced separation of the dried and heated aggregate into a minimum of two bins.

301.04 Spreading and Finishing. Ensure that the maximum compacted depth of any one layer is 6 inches. Ensure that the temperature of the mixture when delivered to the paver is a minimum of 250°F if a hot mix asphalt and 230 °F if a warm mix asphalt according to [402.04](#). Ensure the temperature of the mixture is sufficient for the roller coverage to be effective in compacting the mixture.

301.05 Spreading and Surface Tolerances. Do not exceed 3/8 inch in surface variation from the testing edge of a 10-foot straightedge. If using [Item 301](#) Asphalt Concrete Base as a subbase for a rigid pavement or base, do not exceed a variation of 1/4 inch.

Correct variations in excess of slope or surface tolerances by adding or removing material in a manner satisfactory to the Engineer. The Contractor may use asphalt concrete approved by the Engineer.

301.06 Basis of Payment. The City will pay for accepted quantities, complete in place, at the contract price as follows:

Item	Unit	Description
301	Cubic Yard	Asphalt Concrete Base

ITEM 302 ASPHALT CONCRETE BASE

[302.01](#) Description

[302.02](#) Composition

[302.03](#) Mixing

[302.04](#) Spreading and Finishing

[302.05](#) Spreading and Surface Tolerances

[302.06](#) Basis of Payment

302.01 Description. This work consists of constructing a base course of aggregate and asphalt binder, mixed in a central plant and spread and compacted on a prepared surface.

The requirements of [Item 401](#) apply, except as modified by this specification.

302.02 Composition.

A. **General.** Furnish a mixture that conforms to the following gradation:

Sieve Size	Total Percent Passing
2 inch	100
1 1/2 inch	85 to 100
1 inch ^[1]	68 to 88
3/4 inch ^[1]	56 to 80
1/2 inch ^[1]	44 to 68
3/8 inch ^[1]	37 to 60
No. 4	22 to 45
No. 8	14 to 35
No. 16	8 to 25
No. 30	6 to 18
No. 50	4 to 13
No. 200	2 to 6

[1] Provide aggregate to retain a minimum of 7 percent of the material on each of these sieves. This requirement applies to the gradation of the JMF and the mix production according to [Item 403](#).

In the design of the asphalt concrete base, the requirements of [Item 441](#) apply, except as follows:

The Contractor may use reclaimed asphalt concrete pavement according to [401.04](#). Should problems with proper coating or other material issues related to the use of reclaimed asphalt concrete pavement be evident, the Laboratory may restrict the allowable percentage of reclaimed asphalt concrete pavement to the reduced limits shown in [tables 401.04-1](#) and [401.04-2](#). In this case, the Laboratory will adjust the virgin binder content.

Add hydrated lime in the dry form at a rate of 0.75 percent by the dry weight of aggregate for asphalt concrete base, if antistripping additive is required and hydrated lime is used.

Design the asphalt concrete base to yield 4.0 percent air voids and the following properties:

Property	Acceptable Range of Values	
	Minimum	Maximum
Binder Content, %	[Note 1]	6.0 [Total]
Stability, lb, 70 blow	3000	--
Flow, 0.25 mm, 70 blow	--	28
Voids in Mineral Aggregate %	12.0	--

Note 1: See tables in [401.04](#)

Use equipment that meets the requirements of a Level 3 laboratory as specified in [City Supplement 1041](#). Ensure that the following equipment is designed and manufactured according to ASTM D5581 to prepare and test a Marshall specimen with a 6.0-inch diameter and a 3.75 ± 0.05 inch height:

1. Specimen mold assembly.
2. Specimen extractor.
3. Compaction Hammer.
4. Compaction pedestal specimen mold holder.
5. Marshall test apparatus.

Produce batches of asphalt concrete base in the amount that will result in a compacted specimen 3.75 ± 0.05 inch in height. This amount is about 4050 grams.

B. Compaction of Specimens. Fill the mold with asphalt concrete base by placing approximately one-half of the batch in the mold and spading it vigorously with a heated spatula or trowel 15 times around the perimeter and ten times over the interior. Place the second half of the batch in the mold and spade the mixture in the same manner.

Compact the specimen on both sides with 70 blows.

C. Stability Correlation Ratios. Convert measured stability values for specimens that depart from the standard 3.75-inch thickness to an equivalent 3.75-inch value by multiplying the stability value by the appropriate correlation ratio as follows:

Approximate Thickness of Specimen, inches	Correlation Ratio
3 -1/2	1.12
3 -9/16	1.09
3 -5/8	1.06
3 -11/16	1.03
3 -3/4	1.00
3 -13/16	0.97
3 -7/8	0.95
3 -15/16	0.92
4	0.90

302.03 Mixing. Conform to the requirements of [301.03](#).

302.04 Spreading and Finishing. Ensure that the compacted depth of any one layer is a minimum of 4 inches and a maximum of 7.75 inches. If the plan thickness is 7.0-7.75 inches and Laboratory confirms the JMF and mixture production has 95% passing the 1.50 inch sieve, the [302](#) may be placed in two lifts if requested by the Contractor. One lift of plan thickness will be required if top size aggregate dragging occurs. Ensure that the temperature of the mixture when delivered to the paver is a minimum of 250 °F if a hot mix asphalt and 230 °F if a warm mix asphalt according to [402.04](#). Ensure the temperature of the mixture is sufficient for the roller coverage to be effective in compacting the mixture.

302.05 Spreading and Surface Tolerances. Conform to the requirements of [301.05](#).

302.06 Basis of Payment. The City will pay for accepted quantities, complete in place, at the contract price as follows:

Item	Unit	Description
302	Cubic Yard	Asphalt Concrete Base

ITEM 304 AGGREGATE BASE

[304.01](#) Description

[304.02](#) Materials

[304.03](#) Before Spreading

[304.04](#) Spreading

[304.05](#) Compaction

[304.06](#) Finished Surface

[304.07](#) Method of Measurement

[304.08](#) Basis of Payment

304.01 Description. This work consists of furnishing, placing, and compacting one or more courses of aggregate on a prepared surface, including furnishing and incorporating all water required for compaction.

304.02 Materials. Furnish materials conforming to [703.17](#).

304.03 Before Spreading. The Engineer will sample the Contractor's stockpile to determine the initial moisture content to be used for compaction. The Engineer will develop a moisture-density curve according to [Supplemental Specification 1501](#) to determine the optimum moisture content.

Use material that has reasonably uniform moisture content. Ensure the moisture content is not less than 2 percent below the optimum moisture content before spreading. Add water to the stockpile if necessary to meet this moisture requirement.

Handle the material in a manner to minimize segregation. If segregation occurs, thoroughly mix or regrade the stockpile.

304.04 Spreading. Spread the material on the prepared surface. Do not use frozen material and do not spread on frozen surfaces.

Do not exceed a compacted lift thickness of 8 inches when using vibratory rollers with effective weights greater than 12 tons. Do not exceed a compacted lift thickness of 6 inches when using vibratory rollers with effective weights from 10 to 12 tons. Do not exceed a maximum compacted lift thickness of 4 inches when these vibratory rollers are not used. The effective weight of a vibratory roller is the weight plus the centrifugal force from vibration. Submit documentation from the manufacturer that shows the vibratory roller meets the minimum effective weight requirements.

Place the material in two or more approximately equal lifts when the specified compacted thickness exceeds the maximum allowed.

Place the material with self-propelled spreading machines capable of placing the material true to line and grade. Spreading machines such as spreader boxes or pavers are allowed. Do not use graders or dozers without spreader boxes to spread the material except for areas described in the next paragraph. Spread the material such that it minimizes segregation and requires minimal blading or manipulation. The City may perform in-place gradation testing in areas that are visually segregated according to [City Supplement 1090](#) as directed by the Engineer.

The Contractor may use hand-placing methods, dozers or graders when the total area of the material is 2,000 square yards or less or in small areas where self-propelled spreading machines are impractical. Small areas include lane widths less than 12 feet or lengths less than 1,000 feet. The City will not take in-place gradation tests in these small areas.

The City may test for in-place gradation after spreading but before compaction testing according to [City Supplement 1090](#) as directed by the Engineer.

304.05 Compaction. The City will measure compaction according to [Supplemental Specification 1501](#).

Add water or dry the material to bring it to within 2 percent of the optimum moisture content before compacting. Maintain the moisture content within this range during all compaction operations. The Engineer will determine the percentage of moisture to apply or to be dried from the material. Uniformly apply the water or dry the material throughout the lift and in a manner that does not soften or disturb the lower courses. Reduce the moisture content if the material becomes unstable during the compaction operation.

Compact each lift of material immediately after spreading. Use rollers that correspond with the lift thickness as described in [304.04](#). The Contractor may use lighter rollers or vibratory equipment in small areas as specified in [304.04](#) or when heavier rollers are not practical. Approved compaction equipment may consist of vibratory rollers, static rollers, or vibratory equipment.

At the beginning of the compaction operation, construct a test section. The Engineer will determine the density requirements according to [Supplemental Specification 1501](#). Use a minimum compactive effort of eight passes to construct the test section. Use and adjust the vibration on the vibratory rollers to maximize the density and stability. Construct a new test section when the material changes or when the supporting materials change appreciably.

The Engineer will use 98 percent of the test section maximum dry density for acceptance of the production material. Use at least the same number of passes and compactive effort used to obtain the test section maximum dry density for the production material. At a minimum, use eight passes in the production area. The Engineer may reduce the minimum passes if the passes are detrimental to compaction.

The Engineer may check the production material density before or after the finishing operations.

Maintain the surface of each lift during the compaction operations in such a manner that the surface texture is reasonably uniform and the material is firmly keyed.

Cover the aggregate base with the next layer of pavement before the end of the construction season. If the aggregate base is not covered up, then assume all liability for contamination of, damage to and instability of the base, subgrade and underdrains.

Provide drainage and maintain the material according to [203.04.A](#).

304.06 Finished Surface. Ensure that the finished surface does not vary more than 3/8 inch from a 10-foot straightedge parallel to the centerline or more than 1/2 inch from a template conforming to the required cross-section. Furnish straightedges, templates, or other devices satisfactory to the Engineer, and check the surface for conformance with these requirements.

Do not construct the aggregate base at a consistent depth below the required minimum compacted depth thickness. When the depth is found to be less than the required depth, provide the Engineer with a written corrective action plan for approval.

304.07 Method of Measurement. The City will measure Aggregate Base by the number of cubic yards computed from the profile grade and typical sections, compacted in place.

Where variable depth is specified, the City will measure the number of cubic yards of aggregate base by converting from weight using the following conversion factors:

TABLE 304.07-1

Material	Conversion Factor
Crushed stone	4000 lb/yd ³
Crushed gravel	4000 lb/yd ³
Crushed slag ^[1]	
less than 90 lb/ft ³	3600 lb/yd ³
90 to 100 lb/ft ³	4000 lb/yd ³
more than 100 lb/ft ³	4500 lb/yd ³
Granulated slag	2800 lb/yd ³
[1] Based on average dry rodded weight of standard size of slag aggregates on record at the Laboratory. The conversion factors listed are the long gradation weights. These numbers are based on the dry rodded weights of No. 67, 57, or 8 gradation. The City will determine slag weights based on weights obtained from the original source.	

The City -may verify that the moisture content of the delivered material is less than 2 percent above saturated surface dry (SSD) as directed by the Engineer. If the moisture content is greater than 2 percent above SSD, then the City will calculate the number of cubic yards based on the dry density and dry weight.

The City may determine the pounds per cubic yard for aggregate mixtures by using 100 percent of the test section maximum dry density obtained in [304.05](#) as directed by the Engineer.

304.08 Basis of Payment. The City will pay for accepted quantities at the contract price as follows:

Item	Unit	Description
304	Cubic Yard	Aggregate Base

ITEM 305 PORTLAND CEMENT CONCRETE BASE

- [305.01](#) Description
- [305.02](#) Construction
- [305.03](#) Method of Measurement
- [305.04](#) Basis of Payment

305.01 Description. This work consists of constructing a portland cement concrete base on a prepared surface.

305.02 Construction. The requirements of [Item 451](#) apply, except as follows.

Do not comply with the requirements of [451.08](#).

Load transfer devices are not required.

Do not place construction joints within 6 feet of another parallel joint.

Modify the curing membrane application rate specified in [451.11](#) to 200 square feet per gallon of treated pavement surface.

Produce a final surface with a uniform, gritty, longitudinal, or transverse texture using a broom drag in either direction.

Ensure that pavement surface variations do not exceed 1/4 inch in 10 feet.

Impressing station numbers into the plastic concrete as specified in [451.10](#) is not required.

305.03 Method of Measurement. The City will measure Concrete Base by the number of square yards completed and accepted in place. The width equals the base width shown on the typical cross-section of the plans plus additional widening as the Engineer directs in writing. The City will field measure the length along the centerline of each roadway or ramp.

305.04 Basis of Payment. For base found deficient in thickness, the City will pay a reduced price according to [451.18.A](#) and [table 451.19-1](#).

The City will not make additional payment over the Contract unit price for any base with an average thickness in excess of that shown on the plans.

For base found deficient in strength, the City will pay a reduced price according to [451.18.B](#) and [table 451.19-2](#).

The City will pay for accepted quantities at the contract price as follows.

Item	Unit	Description
305	Square Yard	___inch Concrete Base

ITEM 306 PORTLAND CEMENT CONCRETE BASE – RESIDENTIAL

- [306.01](#) Description
- [306.02](#) Method of Measurement
- [306.03](#) Basis of Payment

306.01 Description. This work consists of constructing a PCC base on a prepared subgrade or base course. This work shall conform to the requirements of [Item 305](#) and [Item 451](#) except that:

1. For concrete proportioning, meet the requirements of [Item 499](#), Concrete, Class COC 7 or COC MS.
2. Conform to the opening-to-traffic requirements as specified in [451.16](#) except that the split tensile strength shall be 350 pounds per square inch, as tested per ASTM C496.

306.02 Method of Measurement. The City will measure Concrete Base – Residential according to [305.03](#).

306.03 Basis of Payment. The City will pay for accepted quantities at the contract price according to [305.04](#) and as follows.

Item	Unit	Description
306	Square Yard	___inch Concrete Base - Residential

ITEM 307 ROLLER COMPACTED CONCRETE BASE (RCC)

- [307.01](#) Description
- [307.02](#) Materials
- [307.03](#) Mix Design
- [307.04](#) Contractor Certification
- [307.05](#) Test Strip
- [307.06](#) Equipment

- [307.07 Construction Requirements](#)
- [307.08 Joints](#)
- [307.09 Quality Control and Assurance](#)
- [307.10 Opening to Traffic](#)
- [307.11 Pavement Evaluation](#)
- [307.12 Remedial Action](#)
- [307.13 Method of Measurement](#)
- [307.14 Basis of Payment](#)

307.01 Description. This work consists of the production and construction of Roller Compacted Concrete Base (RCC) for City streets. In addition to this specification, [Items 305, 306, 451, and 452](#) apply.

307.02 Materials. All materials shall be from approved sources as documented on the “Approved Materials List” on file in the Laboratory.

Portland cement shall conform to [701.01, 701.02, 701.04, and 701.05](#).

Fly Ash shall conform to [701.13](#).

Ground Granulated Blast Furnace Slag (GGBFS) shall conform to [701.11](#).

Chemical admixtures shall conform to [705.10 and 705.12](#).

Curing Compounds shall conform to [705.07](#).

Fine and course aggregates shall meet the requirements of [703.02](#). The aggregates shall be well graded to conform to the following composite gradation.

Sieve Size	Percent Passing
1”	100
¾”	95 – 100
½”	70 – 90
3/8”	60 – 85
#4	40 – 70
#16	20 – 40
#100	5 – 20
#200	2 – 8

Mixing water shall be clean, potable and free from oil, acid and strong alkalis or organics.

307.03 Mix Design. The Contractor/Supplier shall develop an RCC mixture proportioned in accordance with this specification and procedures discussed in ACI 325.10R-95 (Re-approved 2001) “Report on Roller-Compacted Concrete Pavements” sections 4.2, 4.3, and 4.4. Once the mix has been designed, certified test data shall be submitted to the City from a recognized testing laboratory that shows the proposed mix design will meet the following requirements.

A. Roller Compacted Concrete Base

Compressive Strength, Cores: 4000 psi @ 28 days.
 Splitting Tensile Strength, Cores: 400 psi @ 5 days.

The minimum Portland cement content shall be 350 pounds per C.Y.

B. Roller Compacted Concrete Base – Residential

Compressive Strength, Cores: 3000 psi @ 28 days.
 Splitting Tensile Strength, Cores: 300 psi @ 5 days.

The minimum Portland cement content shall be 300 pounds per C.Y.

Submit Certifications for aggregate source quality and sizing, Portland cement, and supplementary cementitious materials as required by the specification.

Secondary Cementations material shall not be considered as a substitute for any deficiency in the #100 sieve in section.

Strength properties shall be based on field extracted cores.

The Contractor’s Independent Testing Laboratory will develop a moisture/density relationship of the actual job materials in accordance with ASTM D 1557. Optimum moisture content and maximum wet densities shall be established and copies of the moisture-density curves shall be provided to the City with the mix design submittal.

The proposed mix design shall be submitted to the City for approval at the beginning of each year. A list of approved mix designs will be kept on file in the Laboratory.

Only use mix designs accepted by the City and issued a JMF number.

307.04 Contractor Certification.

RCC Contractors must perform a test strip per [307.05](#) for certification to place RCC on City of Columbus projects. Upon successful completion of the test strip, the City will certify the Contractor to place RCC on City projects. A list of approved Contractors will be maintained on the City's website.

For any compacted lift thickness greater than 10", a separate test strip of the planned thickness must be performed to certify the Contractor's ability to meet these specifications. Separate Contractor certifications will be issued by the City for compacted thicknesses greater than 10".

The Contractor shall not commence placement of RCC until all testing has been completed on the test strip and the City has verified the results are acceptable.

Material changes in the Contractor's operations or failure to comply with the specifications will be grounds for rescission of certification at the discretion of the City.

307.05 Test Strip. The Contractor shall construct a test strip with at least 100 tons of RCC at a depth of approximately 10" with the paver(s) and mix(es) proposed for use. The test strip will be used to certify the Contractor's ability to place RCC on City projects. The test strip shall be constructed at a location chosen by the Contractor at least 30 days prior to the start of any paving operations. The Contractor must demonstrate the ability to achieve a smooth, hard, uniform surface free of excessive tears, ridges, spalls and loose material. The Contractor must also be able to consistently achieve 90% of the maximum wet density directly out of the paver and 98% of the maximum wet density after final rolling.

During construction of the test strip, the Contractor shall establish an optimum rolling pattern and procedure for obtaining a density of not less than 98% of the maximum wet density. After completion of the test strip, cores will be extracted by the City to verify mix compliance. During the trial placement, the City's testing personnel shall calibrate their nuclear density gauges in accordance with ASTM C 1040, with a sample of the test strip mix. Moisture readings of the gauge shall be calibrated using oven dry samples of the plant-mixed RCC.

307.06 Equipment.

- A. Mixing Plants:** Mixing plants shall be of a design that can produce an RCC pavement mixture of the proportions defined in the approved mix design and within the specified tolerances in ASTM C 94 and ASTM C 685. The mixing plant may be a Central-Mix Drum or a Stationary Continuous-Mixing Twin-Shaft Pug Mill mixer. The plant shall have a minimum manufacturer's rated capacity of 200 tons per hour.
- B. Pavers:** RCC shall be placed with a high-density asphalt paver subject to approval by the Engineer. The paver shall be capable of placing the RCC at a minimum of 90% of the maximum wet density in accordance with [307.07.E](#). The paver shall be of suitable weight and stability to spread and finish the RCC material, without segregation to the required thickness, smoothness, cross-section and grade. Work in areas inaccessible to paving machines shall be performed according to [307.07.F](#).
- C. Vibratory Rollers:** Vibratory rollers shall be self-propelled, double drum, steel wheel vibratory rollers having a static weight of at least 10 tons. Each roller drum shall be equipped with a properly operating scraper and brush. The rollers shall transmit a dynamic impact to the surface through smooth steel drums by means of revolving weights, eccentric shafts or other equivalent methods. The roller drum shall be between 4 and 5-1/2 foot in diameter and 5-1/2 to 8 feet in width.

Finish rollers shall be self-propelled, double drum, steel wheel rollers having a static weight of between 3 and 10 tons. Each drum shall be equipped with a properly operating scraper and brush. A single drum vibratory roller with a vulcanized rubber coating may be utilized for finish rolling, at the approval of the Engineer.

- D. Dump Trucks:** Dump Truck boxes shall be kept free of contaminants while hauling any RCC and shall have weatherproof cable tarp covers properly secured until discharge into the paver.

307.07 Construction Requirements.

- A. Preparation of Sub-grade/Sub-base:** Prepare the entire sub-grade according to [Item 204](#) prior to placing any RCC. If required, construct a granular base according to [Item 304](#). Test roll the entire subgrade according to [204.061](#), except that the maximum allowable rutting or deflection shall be 1/2-inch. This will provide a proper base to place and compact the RCC.

Moisten the surface of the sub-grade or base without creating mud or ponding water, to minimize absorption of water from RCC mix to be deposited.

- B. Transportation:** Transport the RCC mixture to the site in dump trucks which meet the requirements of [307.06.D](#). The trucks shall dump directly into the hopper of the paver. Hauling over the freshly placed RCC will not be permitted except in multi-lift operations to the extent required to dump the fresh RCC into the paver.
- C. Placing RCC:** Place RCC to the thickness, grade, and lines indicated in the plans. Achieve a minimum of 90% of the maximum wet density out of the paver and 98% of the maximum wet density after final rolling. No compacted lift thickness shall be in excess of ten (10) inches or less than four (4) inches for single or multiple-lift applications unless approved by the City. Co-ordinate RCC delivery so the mix can be spread and rolled within the specified time limit and to ensure uniform progress of the paver until the paving operation is complete. The time between mixing and compacting shall not exceed ninety (90) minutes, for all RCC placed, provided the temperature of the RCC does not exceed 90° F.

Operate the paver in a manner that will prevent segregation and will produce a smooth continuous surface without tearing, pulling or shoving. If segregation occurs, suspend the paving operation until the cause is determined and corrected. Areas of segregated RCC shall be removed and replaced as specified in [307.11](#).

Scarify all areas that require broadcasting or fanning of RCC. The surface must be scarified at least one inch deep prior to broadcasting fresh RCC over the top. Broadcasting must be completed in the allotted time within these specifications.

- D. For multiple-lift placement,** the total pavement thickness shall be as specified on the plans. The second lift must be placed within sixty (60) minutes of the completion of the first lift. If more than sixty (60) minutes has elapsed, the interface between the first and second lifts shall be considered a cold joint and shall be prepared in accordance with [307.08.D](#). Placement of the second lift must be delayed until the first lift has attained design strength as specified in [307.03](#).
- E. Compaction:** Achieve at least 90% of the maximum wet density, as determined in the laboratory according to ASTM D 1557, directly out of the paver and at least 98% of the maximum wet density after final rolling. The Contractor shall begin compaction operations within fifteen (15) minutes after spreading of the RCC mix. Any additional delay will result in the coring of the affected area at the Contractor's expense to ensure that it meets the requirements of this specification.
- F. Rolling:** The Contractor shall establish a rolling pattern that will achieve the required density with a minimum number of roller passes. During vibratory compaction, the roller shall not be started, stopped, or left standing in vibratory mode. Stagger the stopping point of successive rolling passes to avoid forming depressions on the surface.

The Contractor shall continually check the RCC surface while still plastic to ensure surface and grade tolerances are met. Immediately correct excessive variations in accordance with the spreading requirements. The Contractor shall remove any roller marks on the surface using a steel drum roller in static mode. Each lane edge shall be constructed with a face within 15-degrees of vertical.

The Contractor shall spread RCC mix by hand in areas not accessible by the paver and compact to the requirements of [307.07.E](#).

- G. Curing:** Keep the RCC surface continuously moist by water, fog spray, wet burlap, an approved membrane-forming curing compound applied at 1.5 times the rate specified by the manufacturer, or polyethylene sheeting for a period of five (5) days or until the core strengths have met the requirements of [307.03](#).
- H. Weather Limitation:** RCC shall not be placed on any surface containing frost or frozen material. RCC shall only be placed when the ambient temperature is a minimum of 32F and rising, unless the procedures set forth in [451.071](#) are strictly enforced. During periods of hot weather or windy conditions, special precautions shall be taken to minimize moisture loss due to evaporation.

Do not place RCC when rain is imminent. If rain occurs during placement of RCC, cease all operation.

307.08 Joints.

- A. Fresh Vertical Joint:** A vertical joint shall be considered a fresh joint when an adjacent RCC lane is placed within 90 minutes of plant mixing. The Contractor shall ensure that the contact face is moist and not segregated. Before rolling, the vertical joint surface should be hand-finish as necessary immediately behind the paver to produce a tight surface. When placing RCC with a fresh longitudinal joint, leave the outer 12 to 18 inches of the paving lane uncompacted during the initial rolling operation. The uncompacted edge is then used to set the height of the paver screed for paving the adjacent lane. After the adjacent lane is placed, the joint is compacted by centering the roller drum over the joint and compacting adjacent lane edges simultaneously. Roll extra passes as necessary to achieve the required density and smoothness in the joint area.
- B. Cold Vertical Joint:** A cold vertical joint is made when either side of the joint is not compacted within 90 minutes of plant mixing. Saw cut the edge of the previous lane back to sound RCC (minimum 6 inches) to form a vertical face prior to placing the next pass. Trimming by grader blade is permitted, if done prior to the end of the workday. Prior to placing fresh RCC mixture against a compacted cold vertical joint, the joint shall be thoroughly cleaned of any loose or foreign material. The vertical joint face shall be wetted and a moist condition immediately prior to placement of the adjacent lane.
- C. Fresh Horizontal Joint:** For multiple-lift applications, a horizontal joint is considered a fresh joint when a subsequent RCC lift is placed within sixty (60) minutes of placing the previous lift. The surface of the lower lift shall be kept clean and continually moistening the surface prior to placement of the subsequent lift.
- D. Cold Horizontal Joint:** For multiple-lift applications, a horizontal joint is considered a cold joint when the placing of the subsequent RCC lift is delayed by more than sixty (60) minutes of placing the previous lift. Immediately prior to placing the second lift of RCC, a cement/sand slurry or grout shall be applied to the contact surface of the first lift. The Contractor shall delay placing the second lift of RCC until the first lift attains design tensile strength as specified in [307.03](#).
- E. Contraction Joints:** Transverse and Longitudinal contraction joints shall be made as soon as possible after placement of RCC without damaging the pavement, according to City of Columbus [Standard Drawing 2170](#) or as approved by the Engineer, except that transverse joints shall be spaced at a maximum of 30 foot intervals, or at intervals directed by the Engineer. All pavements shall have at least one sawed longitudinal contraction joint constructed according to [Standard Drawing 2170](#).

307.09 Quality Control and Assurance. The Contractor shall maintain equipment and qualified personnel required to monitor and ensure the various properties of the RCC produced meet the specifications throughout production. The Contractor shall notify the Engineer a minimum of 24 hours prior to start of RCC paving.

Testing at the plant and the paving site is the responsibility of the Contractor and shall be performed by a private Independent Testing Laboratory approved by the City. The Contractor and Supplier shall provide safe and convenient access, acceptable to the Engineer, for the inspection and sampling of the RCC and constituent materials, at both the production plant and the paving site and shall cooperate in the inspection and sampling process at all times.

- A. **During Placement:** The Contractor shall ensure quality control at the plant, by controlling materials, obtaining test samples and ensuring segregation is not occurring while loading haul trucks. The Contractor, in cooperation with the Contractor’s Independent Testing Laboratory, shall ensure that compaction and grade specifications are met and time limits are adhered to.
- B. **Field Density:** The Laboratory will perform density testing of the RCC in accordance with ASTM C 1040, direct transmission mode, directly behind the paver. Only wet density will be used for evaluation. At least five (5) tests will be performed at the back of the paver and after final compaction for each 250 cubic yards placed. The required density shall be as specified in [307.07.E](#) out of the back of the paver and after final rolling. The Contractor shall be responsible for verifying required densities are achieved by the paver and after final rolling.

If density test results do not meet the requirements of [307.07.E](#), the Contractor shall determine the source of the problem and take immediate steps to correct the problem. If the problem cannot be resolved to the satisfaction of the Engineer, placement shall be suspended.

307.10 Opening to Traffic. The RCC pavement may be opened to traffic or asphalt surfaced as specified on the plans a minimum of five (5) days after placement or once the Splitting Tensile strength requirements of [307.03](#) have been met.

307.11 Pavement Evaluation. For the purpose of coring, the City will consider the entire pavement area of a specified thickness for each day’s production a pavement unit. After placement, the Engineer will measure longitudinally along the centerline of the roadway and divide the pavement unit into six (6) equal sublots with one random core located in each subplot per [Table 307.11-1](#). Sublots shall be laid out to represent each section of pavement while adjusting the subplot lengths as needed to ensure no sublots are split across two pavement sections. The City will core nine (9) four-inch diameter cylindrical specimens to represent the pavement unit. One core taken from each subplot to be used for thickness and compressive strength evaluation and three (3) cores to be used for splitting tensile strength evaluation. Sublot layout can be adjusted by the Engineer for multiple paving lanes as necessary.

TABLE 307.11-1 CORE LOCATION GUIDE

Coring Location Guide		
Sublot Width	Core Location Quadrant 1	Core Location Quadrant 2
	Core Location Quadrant 3	Core Location Quadrant 4
RT	Sublot Length (1/6 total production length) ⁴ Up Station →	

1. Sublot cores shall be taken randomly from one of the quadrants of each of the six sublots.
2. If the initial subplot core shows a thickness deficiency greater than 0.375 inches or a strength deficiency greater than 5%, except as noted in [307.11.B](#) and [307.11.C](#), one additional core will be taken from each of the three remaining quadrants of the subplot for a total of four cores to represent the subplot.
3. Split Tensile cores taken in Sublots 1, 3, 6 and shall be taken 3’ transverse from the subplot core.
4. Cores will avoid contraction joints, castings and other surface appurtenances by a distance of at least 3’.

- A. **Sublot Evaluation:** Length measurements of the cores and compressive strength testing shall be in accordance with ASTM C 42. Splitting tensile testing shall be in accordance with ASTM C 496.

Compressive Strength Testing: The six (6) subplot cores obtained for thickness verification will also be tested for compressive strength at 28 days.

Splitting Tensile Strength: The three (3) cores obtained for splitting tensile strength verification will be tested at five (5) days or as determined by the Engineer.

Each subplot will be evaluated based on the compressive strength and thickness results of the core(s) taken from the subplot. If the subplot core indicates deficiencies subject to payment deductions or removal per the criteria in [Table 307.11-2](#) and/or [307.11-3](#) the subplot will require further evaluation per [307.11.B](#) and/or [307.11.C](#)

- B. **Deficient RCC Coring - Thickness:** If any subplot core shows a deficiency in thickness of more than 0.375 inches, determine the subplot average thickness by taking three additional cores; one taken from each of the remaining three core locations (quadrants) per [Table 307.11-1](#). For projects that are not subject to payment deductions, the three additional cores would be required if the subplot core is deficient by more than one inch. The subplot will be evaluated based on the average thickness of the four (4) cores. Cores that exceed the specified thickness by more than ½ inch will be considered as the specified thickness plus ½ inch. Each subplot shall be evaluated for thickness according to [Table 307.11-2](#).

TABLE 307.11-2 PAVEMENT THICKNESS DEFICIENCY

Average Deficiency in Thickness as Determined by Cores	Payment Deduction Factor
≤ 0.375	0%
Greater than 0.375 to 0.5 inch	10%
Greater than 0.5 to 1.0 inch	20%
Greater than 1.0 inch	Remove and Replace

C. Deficient RCC Coring - Strength: If any subplot core shows a deficiency in compressive strength of more than 5%, determine the subplot average strength by taking three additional cores; one taken from each of the remaining three core locations (quadrants) per [Table 307.11-1](#). For projects that are not subject to payment deductions, the three additional cores would be required if the subplot core is deficient by more than 15%. The subplot will be evaluated based on the average strength of the four (4) cores. Cores that exceed the specified strength by more than 10% will be considered as the specified strength plus 10%. Each subplot shall be evaluated according to [Table 307.11-3](#).

TABLE 307.11-3

Average Deficiency in Strength as Determined by Cores	Payment Deduction Factor
Less than 5%	0%
5% to 10%	10%
Greater than 10% - 15%	20%
Greater than 15%	Remove and Replace

D. Remove and Replace: If the average of the four cores taken for either Strength or Thickness are found to meet the criteria of the [307.11.B](#) (greater than 1 inch deficient) or [307.11.C](#) (greater than 15% deficient) the entire subplot shall be removed and replaced per [307.12](#).

307.12 Remedial Action. Correct deficiencies while RCC is still plastic; otherwise, do repairs after five (5) days. After five (5) days, the deficient RCC shall be removed by saw cutting full depth before removal. Remove RCC to the nearest transverse joint in approximation to the limits of the subplot. Provide a Corrective Work Plan (CWP) for the replacement of the removed RCC to the City for approval prior to beginning the corrective work.

Any RCC pavement found to be of unacceptable thickness or strength, or deficient in any testing done in accordance with this specification, shall be subject to removal and replacement by the Contractor, at no cost to the City, including removal and replacement of any intermediate and surface asphalt courses as well as any pavement markings affected by the removal.

Grind off high surface variations to a finish acceptable to the Engineer.

Filling of low areas with fresh RCC is not permitted.

If asphalt surfacing is specified, low areas accepted by the Engineer shall be made up with additional asphalt material without extra payment. All repairs are subject to the Engineer’s approval.

Following any RCC removal, the Engineer shall evaluate the cross-section of the remaining RCC, both transverse and longitudinally, to determine if removal limits have adequately addressed the deficient RCC depth. In the case that the cross-section reveals deficiencies the Engineer shall direct further investigation and evaluation of the RCC including and up to additional RCC removal.

307.13 Method of Measurement. The City will measure RCC by the number of square yards completed and accepted in place. The width equals the pavement width shown on the typical section of the plans plus additional widening as the Engineer directs in writing. The City will field measure the length along the centerline of each roadway or ramp. The City will determine the area based on the width and length.

307.14 Basis of Payment.

- A. The accepted quantities of RCC pavement will be paid for at the contract unit price per square yard, which price and payment shall be full compensation for furnishing and placing all materials. The City will pay a reduced price, according to [307.11](#), for RCC pavement found deficient in thickness and/or strength.
- B. No additional payment over the unit contract bid price will be made for any pavement which has an average thickness in excess of that shown on the plans.
- C. In the case of a pavement area having deficiencies in thickness and strength, both deductions shall be applied to the respective subplot.
- D. The City will pay for accepted quantities, complete in place, at the contract price as follows:

Item	Unit	Description
307	Square Yard	___ inch Roller Compacted Concrete Base
307	Square Yard	___ inch Roller Compacted Concrete Base - Residential

ITEM 320 RUBBLIZE AND ROLL

- [320.01](#) Description
- [320.02](#) Materials
- [320.03](#) Equipment
- [320.04](#) Construction Details
- [320.05](#) Method of Measurement
- [320.06](#) Basis of Payment

320.01 Description. This work consists of rubblizing and rolling reinforced concrete pavement before placing an asphalt concrete pavement.

320.02 Materials. Furnish filler aggregate conforming to [Item 304](#).

320.03 Equipment. Use a self-contained and self-propelled unit of either the resonant frequency type or the multiple head breaker type for rubblizing the concrete pavement.

If using a resonant frequency unit, ensure that it is capable of producing low amplitude, 2000-pound-force blows at a rate of not less than 44 blows per second.

If using a multiple head breaker unit, ensure that it has the capability of rubblizing the full 12-foot lane width in a single pass. Ensure the breaking head consists of 12 to 16 hammers, each weighing 1000 to 1500 pounds). Attach each hammer to a hydraulic lift cylinder that operates as an independent unit, develops 2000 to 12,000 foot-pounds of energy depending on lift height selected, cycles at a rate of 30 to 35 impacts per minute, and has a maximum lift height of 60 inches.

Use a vibratory steel wheel roller having a total weight of not less than 10 tons.

320.04 Construction Details. Make a full depth saw cut or cut load transfer devices at joints on ramps or mainline where the rubblizing abuts concrete pavement or approach slabs that are to remain in place permanently or temporarily for maintenance of traffic.

Before the rubblizing operations begin, the Engineer will designate a test section. Rubblize the test section according to this specification. After rubblizing, excavate a test pit, where the Engineer designates, to check for proper particle size throughout the thickness of the concrete. Fill in the test pit using the excavated material and additional filler aggregate as necessary. Compact the test pit as part of the rolling operation. Excavate at least one test pit, at the location designated by the Engineer, for each production day or every 7040 square yards, whichever is greater.

Adjust the rubblizing procedure to maintain the proper particle sizes. Control the operating speed of the rubblizing equipment such that: 75% of the rubblized particles above the reinforcing steel are reduced to 3 inches in their largest dimension, 90% of the rubblized particles below the reinforcing steel do not exceed 9 inches in their largest dimension, and no particles exceed 12 inches in their largest dimension.

Before placing the initial asphalt concrete course, compact the rubblized pavement with two passes of the vibratory roller. Operate the roller in the vibratory mode and at a speed not to exceed 6 feet per second.

Leave steel reinforcement in place in the rubblized pavement. However, cut off any exposed steel reinforcement below the surface and remove it from the site.

Fill depressions 1 inch or greater in depth compared to the immediate surrounding area resulting from the rubblizing, the compactive effort, or the steel reinforcement removal, with the filler aggregate. Strike off excess aggregate level with the surrounding area. Compact filled depressions with the same roller and compactive effort previously described.

Do not allow traffic on the rubblized pavement before the asphalt concrete base and intermediate courses are in place.

Do not allow more than 48 hours to elapse between rubblizing the pavement and placing the initial asphalt concrete course. However, in the event of rain, the Engineer may waive this time limitation to allow sufficient time for the rubblized pavement to dry to the Engineer's satisfaction. If the Engineer waives the time limitation, cease rubblizing the pavement until the Engineer allows paving to resume.

320.05 Method of Measurement. The City will measure Rubblize and Roll by the number of square yards. The Engineer will use the width of the concrete pavement prior to rubblizing and will measure the length along the centerline of each roadway or ramp.

The City will measure the Filler Aggregate by the number of cubic yards furnished, placed, and compacted.

320.06 Basis of Payment. The City will pay for accepted quantities at the contract prices as follows:

Item	Unit	Description
320	Square Yard	Rubblize and Roll
320	Cubic Yard	Filler Aggregate

ITEM 321 CRACKING AND SEATING NON-REINFORCED CONCRETE PAVEMENT

[321.01](#) **Description**

[321.02](#) **Equipment**

[321.03](#) **Construction Details**

[321.04](#) **Method of Measurement**

[321.05](#) **Basis of Payment**

321.01 Description. This work consists of cracking and seating non-reinforced concrete pavement or concrete base before placing an asphalt concrete pavement.

321.02 Equipment. Use devices for cracking the concrete capable of producing the desired crack pattern without extensive spalling or excessive shattering. Extensive spalling is spalling over 1 1/4 inches in depth. Do not use whippammers.

Use watering equipment capable of wetting the cracked surface uniformly to reveal the crack pattern.

Use a 50-ton pneumatic tire roller conforming to the requirements of [Item 204](#) for seating the cracked concrete slabs. Use pneumatic tire towing equipment capable of moving the roller forward and backward along predetermined lines.

321.03 Construction Details. Demonstrate, to the Engineer's satisfaction, the ability of the selected equipment and procedures to produce cracking of acceptable quality by cracking at least three, but no more than five, concrete slabs. When cracking the test slabs, furnish and apply water to dampen the cracked concrete to enhance visual determination of the cracking pattern. In addition to [107.07](#), provide positive provision to contain any flying debris during cracking operations.

Crack concrete into nominal 4 × 4-foot segments. In the event panels are already cracked into segments, crack these segments further into nominally equal-sized square or rectangular pieces having longitudinal and transverse dimensions not more than 5 feet and not less than 3 feet, wherever feasible. Do not allow the cracking equipment to impact the slabs within 1 foot of another break line, joint, or the edge of the concrete.

Furnish and apply water to a check section of three to five slabs at least once each day to verify that a satisfactory crack pattern is being maintained. Make adjustments to the energy or striking pattern when the Engineer deems it necessary, based on the check sections.

Roll the cracked concrete until the concrete pieces are firmly seated. Perform rolling with at least two coverages as specified in [Item 204](#). The Engineer will determine the maximum number of coverages of the roller on the test sections to ensure seating without damage to the concrete.

Before placing the asphalt concrete, remove all loose pieces of broken concrete that are not firmly seated. Repair all voids, such as spalls, removed loose pieces, joints, or cracks that, in the Engineer's opinion, will make uniform compaction of the first asphalt concrete course difficult. Repair voids by applying [Item 407](#) tack coat, filling with asphalt concrete, and compacting as directed by the Engineer.

Do not allow traffic on the cracked concrete before the asphalt concrete base and intermediate courses are in place.

321.04 Method of Measurement. The Engineer will measure the area of non-reinforced concrete pavement or concrete base satisfactorily cracked and seated in square yards. The Engineer will use the width of the concrete pavement prior to cracking and will measure the length along the centerline of each roadway or ramp.

321.05 Basis of Payment. Include the cost of all crack pattern test and check sections including water; and for repairing of joint, cracks, spalls, and voids in the contract unit price for Cracking and Seating Non-Reinforced Concrete Pavement.

The City will pay for the accepted quantities at the contract price as follows.

Item	Unit	Description
321	Square Yard	Cracking and Seating Non-Reinforced Concrete Pavement

400 FLEXIBLE PAVEMENT

ITEM 401 ASPHALT CONCRETE PAVEMENTS—GENERAL

- [401.01](#) Description
- [401.02](#) Mix Design and Quality Control
- [401.03](#) Materials
- [401.04](#) Reclaimed Asphalt Concrete Pavement
- [401.05](#) Mixing Plants
- [401.06](#) Weather Limitations
- [401.07](#) Notification
- [401.08](#) Asphalt Binder
- [401.09](#) Aggregate Preparation
- [401.10](#) Mixing
- [401.11](#) Hauling
- [401.12](#) Spreading Equipment
- [401.13](#) Rollers
- [401.14](#) Conditioning Existing Surface
- [401.15](#) Spreading, Finishing and Night Work
- [401.16](#) Compaction
- [401.17](#) Joints
- [401.18](#) Asphalt Binder Compatibility
- [401.19](#) Spreading and Surface Tolerances
- [401.20](#) Asphalt Binder Price Adjustment
- [401.21](#) Method of Measurement
- [401.22](#) Basis of Payment

401.01 Description. This specification is applicable to all types of asphalt concrete pavements irrespective of gradation of aggregate, kind, and amount of asphalt binder, or pavement use. Deviations from these general requirements are covered in the specific requirements for each type according to the appropriate contract item or items.

Work consists of one or more courses of asphalt concrete constructed on a prepared foundation. The asphalt concrete consists of a mixture of graded aggregate and specified type and grade of asphalt binder.

Control all production processes to assure the Engineer that the mixture delivered to the paving site is uniform in composition, conforms to the specification requirements and that the placed mixture is free of any defect (ex. segregation, tenderness, lack of mixture and texture uniformity, raveling, flushing, rutting, holes, debris etc.) within the Contractor's control at project completion.

The asphalt concrete pavement thickness shown on the plans or stated in the Proposal is for the exclusive use in calculating the weight required to be placed per unit of surface area.

401.02 Mix Design and Quality Control. Use an approved Job Mix Formula (JMF). The quality control and acceptance requirements of [Item 403](#) apply unless otherwise specified.

If required to perform the mix design or quality control, provide a laboratory and personnel meeting the requirements of [City Supplement 1041](#) to perform mix design and quality control tests.

Calibrate asphalt content nuclear gauges according to [City Supplement 1043](#) using personnel with a minimum Level 2 approval according to [City Supplement 1041](#). Mix and test the calibration verification sample with a City employee present.

Provide and dispose of the solvent used for cleaning the asphalt content nuclear gauge pans.

401.03 Materials. Furnish materials conforming to:

Asphalt binder (asphalt concrete, 401.14 , 401.15)	702.01
Asphalt material (401.14 , 401.18)..... ODOT SS875.02 , 702.01 , 702.04 , or 702.13
Aggregates (base courses).....	703.04
Aggregates (intermediate and surface courses)	703.05
Mineral filler	703.07

Sample aggregate, asphalt binder, asphalt material, and mineral filler according to [106.01](#).

Take prompt corrective action if mixture delivered to the paving site is not uniform in composition, does not conform to the specification requirements or is not free of any defect (ex. segregation, tenderness, lack of mixture and texture uniformity, raveling, flushing, rutting, holes, debris etc.) within the Contractor's control as determined by the Engineer. The Engineer will stop conditional acceptance of the asphalt concrete for failure to correct problems.

401.04 Reclaimed Asphalt Concrete Pavement. The Contractor may blend reclaimed asphalt concrete pavement (RAP) into the mix according to the following requirements. Failure to follow these requirements will result in a rejection of the Contractor QCP ([403.03](#)); restriction of RAP use at the facility; or shutting down production at the facility.

Job Mix Formula. The Contractor may use a blend of new materials in combination with RAP obtained from verifiable City of Columbus, ODOT projects. If the RAP is not from the above sources or the source is unknown, process and blend the RAP into a single uniform stockpile, test according to Level 3 Asphalt Mix Design requirements and obtain City approval for use. Obtain Laboratory written approval for use of unusually large, old RAP stockpiles of unknown content and/or age. Include approved methods in the QCP for ongoing processing and testing of these piles. Ensure no foreign or deleterious material ([703.04](#), [703.05](#)) is present in RAP.

Ensure that the JMF falls within the specified limits of the required mix item. Ensure the JMF submittal includes the percentages of RAP, virgin aggregates, and virgin asphalt binder required for the mix item. Report all RAP test results, including binder blend analysis, in the JMF submittal. Identify the RAP in the JMF submittal as to project origin and mix type(s).

Determine RAP properties and uniformity as follows. Determine the final RAP gradation and asphalt binder content on a minimum of four separate stockpile (or roadway for concurrent grinding) samples all agreeing within a range of 0.4 percent for asphalt binder content and 5 percent passing the No. 4 sieve. If fractionated RAP is used, use a suitable sieve for determining gradation uniformity. Determine RAP binder content from a centrifuge extraction test. Do not use reflux extraction or oven burnoff.

RAP Usage Limits and Requirements. Process and use RAP as follows.

Process and use RAP by one of the following two methods. Note on the JMF submittal RAP page which of Method 1 or Method 2 methods described below apply to the RAP. Use PG64-28 virgin binder in all [442](#) intermediate courses regardless of the percentage of RAP used. If greater than 25 percent RAP is used in a JMF submittal, use PG58-28 or PG64-28 virgin binder. If 26-30 percent RAP is used in the JMF submittal, the Contractor may submit a 3000 gram RAP sample along with a blend chart, according to Level 3 Mix Design procedures, to determine the grade of virgin asphalt binder to use. The City may request RAP samples or binder properties at any time.

A. Method 1 Standard RAP. Include RAP in a JMF submittal according to the Standard RAP Limits [Table 401.04-1](#) unless specified differently in the applicable mix specification. For mixes that will contain up to 10 percent RAP, the JMF submittal is not required to include the RAP except when a virgin polymer asphalt binder is used in a surface course. For surface course JMFs having polymer asphalt binder only submit at 0 or 10 percent RAP.

TABLE 401.04-1 METHOD 1 – STANDARD RAP LIMITS

Asphalt Mix Application	Percent RAP by Dry Weight of Mix, Max.	Total Virgin Asphalt Binder Content, Min.	Comments
442 Polymer Surface Course	10%	5.2	Polymerized binder is virgin. (For non-polymer virgin binder allow 20% max RAP.)
441 Surface Course	20%	5.0	Polymer or non-polymer virgin.
441, 442 Intermediate Course	35%	3.0	Any mix type used as an intermediate course.
301 Base Course	50%	2.7	The Laboratory will establish the asphalt binder content.
302 Base Course	40% (30%)	2.0	A lower RAP limit of 30 percent will be required if poor production mixing or coating is evident.

RAP Processing for [Table 401.04-1](#) Method 1-Standard RAP. For surface courses process RAP to less than 0.75 inch and place a 0.75 inch screen on the cold feed. For other courses place a 2-inch screen on the cold feed. Ensure that the RAP is the proper size to allow for complete breakdown in the plant. If mixing is incomplete, place a smaller screen on the cold feed.

B. Method 2 Extended RAP. Include RAP in a JMF submittal according to the Extended RAP Limits [Table 401.04-2](#) unless specified differently in the applicable mix specification. Only use Method 2 with counter flow drum plants or mini-drum batch plant configurations meeting [Item 402](#). For mixes that will contain up to 15 percent RAP, the JMF submittal is not required to include the RAP unless a virgin polymer asphalt binder is used in a surface course. For JMFs having polymer asphalt binder do not submit at 1 through 9 percent RAP.

TABLE 401.04-2 METHOD 2-EXTENDED RAP LIMITS

Asphalt Mix Application	Percent RAP by Dry Weight of Mix, Max.	Total Virgin Asphalt Binder Content, Min.	Comments
442 Polymer Surface Course	15%	5.0	Polymerized binder is virgin. (For non-polymer virgin binder allow 25% max RAP.)
441 Surface Course	25%	5.0	Polymer or non-polymer virgin.
441, 442 Intermediate Course	40%	3.0	Any mix type used as an intermediate course.
301 Base Course	55%	2.5	The Laboratory will establish the asphalt binder content.
302 Base Course	45% (35%)	1.8	A lower limit of 35 percent will be required if poor coating is evident. The virgin requirement of 302.02 does not apply.

RAP Processing for [Table 401.04-2 Method 2-Extended RAP](#). Process RAP by means of fractionation or by additional in line processing. Include in the QCP additional methods and procedures to dictate how this is to be accomplished at plants. Specify documentation method for RAP measurement. Fractionation is the process of creating separate piles of RAP from one pile when split over a specific sieve or sieves. Test fractionated piles to show uniformity. For additional in line processing only process RAP from a uniform, tested and approved stockpile by passing the RAP over a double deck screen placed in-line between the RAP cold feed bin and the mixer. Use a 9/16 inch screen for surface and intermediate mixes and a 1.5 inch screen for base mixes. Do not use concurrent project RAP in a stream process.

RAP QC and Management Requirements.

Always note on the daily quality control report how much RAP is actually being used. Apply a tolerance of ± 5.0 percent on the amount of RAP used if needed for a quality control adjustment but do not exceed the limits of [Table 401.04-1](#) or [Table 401.04-2](#), whichever applies. If this adjustment is not adequate for maintaining control of the mix submit a new JMF for approval.

Include in the QCP methods to be used to meet Method 1 and Method 2 requirements above and the following requirements:

1. Provide enough space for meeting all RAP handling requirements at a hot mix facility.
2. Provide a clean, graded base for stockpiles that does not collect water.
3. Test blended RAP stockpiles to assure uniform gradation and asphalt binder content.
4. Ensure uniform stockpile properties match the JMF submitted RAP properties unless the uniform stockpile will be processed into the asphalt plant using plant cold feed in line processing.

If the uniform stockpile will be processed into the asphalt plant using plant cold feed in line processing determine the processed RAP properties for use in the mix design. Record in the JMF submittal both the uniform stockpile and in line processed RAP properties.

When applying Method 1 Standard RAP requirements, the Contractor may use concurrent City or ODOT project RAP in a stream process in place of stockpiling and testing for uniformity. Take Concurrent project RAP from one existing mix type on the concurrent project or two existing mix types if both mix types are taken at the same time in one pass of the milling machine. Submit a new JMF for each existing mix type on the project (or each milling pass of two types) desired for use as concurrent project RAP. Include in the QCP methods of validating RAP properties when using concurrent project RAP. If these requirements are not met, blend and test for uniformity and apply the stockpile requirements of this specification.

Maintain in the plant lab and control room an up to date and dated site map of all tested and untested RAP stockpiles. Give each stockpile a unique identification. Provide in the plant lab RAP properties for each uniform, blended stockpile cross referenced with its identification. In addition, provide the date the stockpile processing was completed and the stockpile estimated size in tons. Provide signage at all RAP piles. Do not add to a stockpile once it is tested for uniformity. Provide signage at all uniform stockpiles to inform haulers that uniform piles are not to be added to.

Stockpiles and processing methods are subject to inspection and approval by the Engineer at any time. Rejection of stockpiles can occur for the presence of foreign or deleterious materials, lack of uniformity, incomplete mixing in the asphalt mixture, adding to piles, or moving RAP in a way not traceable through the QCP records and methods. The Laboratory will resolve disputes over acceptability of RAP.

401.05 Mixing Plants. The City will approve mixing plants before preparation of the mixtures. Schedule a date with the City for approval inspection to be at least 1 week before mix production. Do not produce mixtures for projects from un-approved plants. General requirements for

asphalt concrete mixing plants are specified in [Item 402](#). Set the asphalt binder controls for the computerized plant at the virgin asphalt binder content of the JMF at all times unless change is authorized by the Laboratory.

Asphalt mixtures may be produced using the warm mix asphalt method according to [402.04](#), except as restricted by specification.

401.06 Weather Limitations. Place asphalt concrete only if the surface is dry and if weather conditions are such that proper handling, finishing, and compaction can be accomplished. Never place asphalt concrete if the surface temperature is below the minimum established in [Table 401.06-1](#). Chemical warm mix asphalt (WMA) additives on the [Approved List](#) may be used to allow placement in colder temperatures and to place asphalt concrete later in the year. Water-injected WMA does not apply.

TABLE 401.06-1 WEATHER LIMITATIONS

Course Thickness	Minimum Surface Temperature	
	Without Chemical WMA	With Chemical WMA ⁽²⁾
3.0 inches and over	36 °F ^[1]	32°F
1.5 to 2.9 inches	40 °F	32°F
1.0 to 1.4 inches	50 °F	40°F
Less than 1.0 inch	60 °F	50°F
Variable Intermediate, 0 to 3.0 inches	40 °F	32°F

[1] When paving on an aggregate base or subgrade, use a minimum air temperature of 40 °F (5 °C), or a minimum air temperature of 32 °F (0 °C) when using chemical WMA.

[2] Only use chemical WMA additives on the [ODOT Approved List](#). Chemical WMA additive must be in-line blended per [Supplement 1053](#).

In addition to the above surface temperature requirements, do not place surface courses if the air temperature is less than 40 °F or 32°F with chemical WMA. For any surface course with a polymer modified asphalt binder, ensure that the paving surface is at least 50 °F without chemical WMA or at least 40°F with chemical WMA and the air temperature is at least 50 °F. Item 424 mixes shall have air and surface temperatures at least 60°F without chemical WMA or at least 50°F air and surface temperatures with chemical WMA.

Do not schedule the placement of any surface course with a polymer modified asphalt binder after November 1, regardless of pavement or air temperature.

401.07 Notification. Notify the Engineer at least 24 hours before starting paving on a project. After starting, if paving operations are stopped for 1 week or more, notify the Engineer at least 24 hours before resuming paving on a project.

401.08 Asphalt Binder. Heat the asphalt binder and deliver it to the mixer within the temperature range specified in [Table 702.00-1](#). Do not use asphalt binder while it is foaming in a storage tank. Take samples using correct new containers from the binder line between the last piping ‘tee’ and inlet into the plant unless a different storage method requires a different sampling location.

401.09 Aggregate Preparation. Feed aggregates in their proper proportions and at a rate to permit correct and uniform control of heating and drying. Remove all aggregates in the plant that will produce a mix outside the temperature limits or that contain excessive moisture or expanding gases causing foaming in the mixture, and return them to the proper stockpiles.

401.10 Mixing. Maintain the temperature of the mix at the plant within the range in JMF or according to the specification. Ensure the mixture is workable and temperature is sufficient for compaction at the point of placement. The Engineer will verify the required temperature of the mixture on arrival at the project site based on the temperature range in the JMF and heat losses in transit.

For batch plants, after all of the aggregate is in the mixer, add the asphalt binder in an evenly spread sheet over the full length of the mixer. The mixing time is defined as the interval between the start of application of the asphalt binder and the opening of the mixer gate. Discharge all asphalt binder required for one batch in 30 seconds or less. After the asphalt binder is added, apply the mixing time determined by the Laboratory but not less than 30 seconds.

401.11 Hauling. Use trucks for hauling asphalt concrete that have tight, clean, smooth metal beds from which the entire quantity of mixture is discharged smoothly into the spreading equipment.

Dump truck beds shall be kept free of contaminants while hauling any asphalt concrete and shall have weatherproof cable tarp covers properly secured until discharge into the paver.

Before loading, apply a thin coating of an approved release agent to the inside surfaces of the truck bed to prevent adhesion of mixture to the bed surfaces. The Laboratory maintains a list of approved release agents. Do not use fuel oil for this purpose. Drain truck beds after applying the release agent and before loading. Load trucks in manner to minimize segregation of the mixture according to the approved QCP.

Do not clean out truck beds on the roadway ahead of the paver. Provide a location away from the roadway or off the project for cleaning trucks. If there is excessive sticking of material in truck beds, the sticking is in areas of the truck that would indicate excessive cooling of the mix (front corners, bottom, etc.) due to a long haul, and it is not resolved in a reasonable time, the Engineer will require an insulated bed. The Contractor may only make procedure changes for better mix handling at the discretion of the Laboratory.

If transporting hot asphalt concrete at prevailing air temperatures below 50 °F or if the length of haul exceeds 20 miles, insulate all truck beds to maintain workable mix temperature, and ensure that all covers are fastened to exclude the wind. Do not exceed a distance of 50 miles from the asphalt concrete plant to the paving site except by specific permission of the City.

401.12 Spreading Equipment. Use self-contained spreading equipment of sufficient size, power, and stability to receive, distribute, and strike-off the asphalt concrete at rates and widths meeting the typical sections and other details shown on the plans. Use spreading equipment that has automatic control systems that maintain the screed in a constant position relative to profile and cross-slope references. Ensure control of the screed position is reasonably independent of irregularities in the underlying surface and of the spreader operation. Equip asphalt spreading equipment to prevent the segregation of coarse aggregate from the remainder of the asphalt concrete when the material moves from the hopper to the screed. Use means and methods approved by the asphalt spreader manufacturer consisting of but not limited to any combination of chain curtains, deflector plates, or other such devices.

The Engineer will base final approval of spreading equipment on the demonstrated capability of the equipment to place the mixture to the required cross-section, profile and alignment in an acceptable, finished condition ready for compaction.

Where the use of standard full-scale spreading equipment is impractical due to the size or irregularity of the area to be paved, use specialized equipment or hand methods approved by the Engineer to spread the asphalt concrete.

401.13 Rollers. Use only steel wheel and pneumatic tire types of rollers meeting the minimum requirements of the following tables. Conform to manufacturer’s specifications for all ballasting.

TABLE 401.13-1 ROLLER CAPACITY

Roller Type	Maximum Capacity square yards per hour
Tandem	700
Three-Wheel	700
Trench	15 per inch width
Pneumatic Tire, Type I	1000
Pneumatic Tire, Type II	700
Vibratory, Vibrating Roll	15 per inch width
Vibratory, Static Roll (not vibrating)	3 per inch width

TABLE 401.13-2 STEEL WHEEL ROLLERS

Roller Type	Three-Wheel	Tandem	Vibratory Static	Trench
Total weight, tons	10	8 to 12	8 to 12	
Compression rolls, pounds per inch width, minimum	300	200	120	300

TABLE 401.13-3 PNEUMATIC TIRE ROLLERS

Type I	
Tire size, minimum	9.00 × 20 in
Wheel load, minimum	5000 lb
Average tire contact pressure, minimum	85 psi
Type II	
Tire size, minimum	7.50 × 15 in
Wheel load, minimum	2000 lb
Average tire contact pressure, minimum	55 psi

For pneumatic tire rollers, use self-propelled, reversible units with vertical oscillation on all wheels on at least one axle. Determine the tire inflation pressure necessary to meet the specified minimum contact area and contact pressure requirements. Furnish the tire manufacturer’s charts or tabulations to the Engineer for verification of the required inflation pressure. Check tire inflation pressure as the Engineer directs and maintain it within 5 pounds per square inch of the required pressure.

Provide rolls and wheels with the necessary accessories to prevent adhesion of the mixture, and keep them properly moistened with water, water containing a detergent, or water containing an approved additive. Do not use excess liquid.

401.14 Conditioning Existing Surface. Clean the surface on which the asphalt concrete is to be placed, and keep it free of accumulations of materials that would, in the judgment of the Engineer, contaminate the mixture, prevent bonding, or interfere with spreading operations. Where approved subgrade or pavement courses previously constructed under the Contract become loosened, rutted, or otherwise defective, correct the deficiency according to the contract item or items involved before the spreading of a subsequent pavement course.

If a quantity of asphalt concrete is specified for use in spot leveling or patching, spread and compact the material needed to effect the corrections as directed by the Engineer.

If placing asphalt concrete against a vertical pavement face, curb, gutter, manhole, or other structure, clean the surface of foreign material and apply a thick, uniform coating of [702.01](#) PG binder, [ODOT Supplemental Specification 875.02](#) Hot Applied Asphaltic Joint Adhesive, or [702.13](#) SBR Asphalt Emulsion to provide 100 percent coverage, except do not use [702.13](#) for longitudinal pavement joints.

401.15 Spreading, Finishing and Night Work.

A. Spreading and Finishing. Do not co-mingle multiple JMFs in the same asphalt paver. Spread the mixture at a rate calculated using the specified thickness and the compacted width of the pavement course being placed, and the weight-to-volume conversion factors established in [401.21](#). Maintain the actual rate of spreading the mixture equal to the required calculated rate within the tolerance specified in [401.19](#). For pavement courses specified for leveling, the actual rate of spreading the mixture may vary from the required calculated rate as approved by the Engineer to accomplish the intended purpose.

For intermediate courses, make the maximum compacted depth of any one layer 3 inches.

Spread and finish the mixture using approved equipment or methods such that compaction can follow immediately. Preheat screeds and extensions before placing any asphalt concrete. Use side plates sufficient to contain the mixture laterally during spreading. Use only screed extensions, rigid or extendable, having the same features as the main screed including, but not limited to, vibration, heating, prestrikeoffs, and tamping bars. When using front-mounted hydraulically extendable screeds at a fixed paving width, use full width auger extensions and full tunnel extensions. When using fixed screed extensions, use full width auger extensions and full tunnel extensions. Do not allow a buildup of excess material in front of the screed. Where excessive buildup of material is not controlled, the Engineer will require paver changes to correct the problem.

Ensure the paver operation, screed, screed extension, and, or, mix design provide a mat, prior to compaction, that is free of texture inconsistencies, shadowing, streaking, tearing, pulling, or other deficiencies. Take immediate action to correct the paver operation, screed, screed extensions, or, mix design. The Engineer may stop placement until corrections are completed.

Use strike-off plates/strike-off extensions only on irregular areas such as mailbox turnouts, driveway turnouts, and other irregular non-travelled roadway areas. The Engineer may approve the use of strike-off plates/extensions on variable width shoulders if the use of a standard extendable screed extension with the same features as the main screed is not practicable. Perform supplemental hand forming and tamping where irregularities develop and where placing the mixture by hand methods.

Take prompt corrective action if placed mixture exhibits any defect (ex. segregation, tenderness, lack of mixture and texture uniformity, raveling, flushing, rutting, holes, debris etc.) within the Contractor's control and as determined by the Engineer. Remove and replace, or otherwise correct in a manner satisfactory to the Engineer, any portion of the pavement course found to be defective in surface texture or composition before or after compaction. Coordinate the spreading operation with the rate of production and delivery of the mixture to attain uniform, continuous progress. Avoid erratic spreader operation due to irregular contact with the hauling vehicle, surging in the feed and distribution of the mixture, or other cause. Maintain sufficient control of the spreading equipment with regard to line and grade references so that the pavement course, when compacted as specified, is in reasonable conformance with the Contract Documents.

Do not displace or damage bridge deck waterproofing membranes during spreading operations on the membranes.

Do not allow traffic on the compacted mixture until it has cooled sufficiently to prevent glazing as determined by the Engineer.

After completion of the surface course, seal gutters with asphalt binder as directed by the Engineer. Apply the material at a uniform width of approximately 4 inches and at a rate just sufficient to fill surface voids.

B. Night Work. Do not start night work or carry on day work into night work without operating an adequate and approved lighting system.

Night work is defined as work performed from 30 minutes after sunset to 30 minutes before sunrise.

Operation of adequate lighting system consists of furnishing, installing, operating, maintaining, moving, and removing night time lighting to illuminate construction work areas for night work. Obtain the Engineer's approval of the lighting at the beginning of the project and before starting the paving operation by measuring the luminance.

Provide an illuminated zone around all operating machinery. Provide an illuminated zone of at least 5 Foot-candles of lighting luminance in the immediate vicinity of pavers, rollers, grinding equipment, material transfer vehicles, etc., and at least 1 Foot-candle at 25 feet from this equipment. Provide an illuminated zone of at least 5 Foot-candles of lighting luminance in the immediate vicinity of coring equipment and at least 1 Foot-candle at 10 feet. Position the light sources so they do not interfere with or impede traffic in any direction and do not cause glare for motorists or point onto adjacent properties. Provide a photometer capable of measuring the level of luminance on each night project. Take luminance measurements at a height of 20 inches above the roadway.

Obtain the luminance level any time requested by the Engineer. Test the illumination levels on the site each time a change in lighting configuration is made. Replace non-functioning lamps immediately. Check the luminaires aiming daily. Clean the luminaires regularly. Correct any deficient lighting within one hour or the Engineer will terminate construction activities.

401.16 Compaction. Immediately after spreading the asphalt concrete and adjusting any surface irregularities, compact the mixture uniformly using rollers conforming to [401.13](#). Do not use a spreading rate that exceeds the total of the specified capacities of the rollers in use. However, if compacting a mixture spread as an intermediate or pre-leveling course less than 1-inch thick, do not use a spreading rate that exceeds twice the total capacity of the rollers in use.

Coordinate the spreading of the mixture with the required roller coverage, considering the rate of cooling of the mixture as affected by lift thickness and environmental conditions. Complete the required roller coverage during the period of time in which the temperature of the mixture is sufficient for the roller coverage to be effective in compacting the mixture.

Compact base mixtures using a combination of both steel wheel and Type I pneumatic tire rollers; however, in small areas, compact these mixtures as the Engineer approves using any of the rollers specified in [401.13](#).

Compact intermediate and surface mixtures using a three-wheel roller in the breakdown position (roller immediately behind the paver) of the roller train; however, in small areas, compact these mixtures as the Engineer approves using any of the roller types specified in [401.13](#).

Compact variable depth courses using a combination of both steel wheel and pneumatic tire rollers; however, in small areas, compact these mixtures as the Engineer approves using any of the roller types specified in [401.13](#).

For surface courses using a polymer modified asphalt binder, give a copy of the JMF approval letter containing the design compaction temperature to the Laboratory before any mix is placed. Unless otherwise specified, ensure that the mix temperature immediately before rolling is not less than 290 °F if placing hot mix asphalt, and not less than 250 °F if placing warm mix asphalt according to [402.04](#). Do not compact polymer asphalt concrete surface courses with pneumatic tire rollers.

When using pneumatic tire rollers, ensure for any mix that surface deviations and deformations caused by the tires are removed with steel wheel rollers. Do not use pneumatic tire rollers if any resultant surface deformations cannot be removed.

Do not use vibratory rollers on courses with a thickness under 1 1/2 inches.

If using vibratory rollers, supplement them with three-wheel or pneumatic tire rollers.

Unless otherwise directed, begin rolling at the sides and proceed longitudinally parallel to the centerline at a slow, uniform speed. After each coverage or complete round trip, move the roller towards the crown of the road to begin its next pass, overlapping the previous pass by at least one-half the width of the previous pass. On superelevated curves, begin rolling at the low side and progress toward the high side. Where a longitudinal joint is being made, roll the joint then follow the applicable rolling procedure.

Continue rolling until full coverage of the course is complete and all roller marks are eliminated. Take care to prevent displacement of the edgeline and grade. Where displacement occurs, correct the area immediately in a manner satisfactory to the Engineer.

Cease production if compaction causes bumps in the mix or the mix is excessively tender.

Along curbs, headers, walls, and in other areas not accessible to rollers, thoroughly compact the mixture with hot, hand tampers or with mechanical tampers. On depressed areas, the Contractor may use trench rollers or rollers fitted with compression strips.

Replace mixture that becomes loose, broken, contaminated, or otherwise defective with fresh, hot mixture. Compact it to match with the surrounding area.

401.17 Joints. Place the asphalt concrete mixture as continuous as possible. Set up joints at the proper height above the adjacent construction to receive maximum compaction. Where the edge of the new pavement is significantly rounded by the action of traffic, trim it to a vertical face before placing the adjacent pavement. On projects where traffic is allowed to cross the edge of the new pavement lane, complete the longitudinal joint of the adjacent lane or shoulder within 24 hours.

Construct longitudinal joints using string line or other controls as a point of reference to provide a straight longitudinal joint. Prior to placing adjacent pavement, trim any locations along the longitudinal joint that deviate horizontally from the point of reference. Maintain a consistent overlap of 1 to 1 1/2 inches on adjacent pavement when closing longitudinal joints. Where phasing for maintenance of traffic will not allow lapping cold longitudinal joints according to [ODOT's Standard Drawing BP-3.1](#), provide a minimum of 6 inches offset between cold joints for each course placed.

Form hot longitudinal joints using pavers operating in contiguous lanes, one just ahead of the other. Maintain the distance between pavers in adjacent lanes such that it does not exceed the distance that a normal size load of mixture will cover. Alternate loads of mixture between the pavers. Do not allow rollers performing the initial rolling operation in one lane closer than 12 inches to the longitudinal joint until the adjacent lane is placed.

Instead of hot joint construction using multiple pavers, the Contractor may use full width construction with a single unit paver.

For surface courses, form or cut all transverse construction joints to a vertical.

Seal all longitudinal construction joints by coating the entire face of the joint with a certified [702.01](#) PG binder or [ODOT Supplemental Specification 875.02](#) Hot Applied Asphaltic Joint Adhesive to provide 100 percent coverage of the joint. Overlap the joint edges by at least 1/2 inch. Seal all transverse construction joints with a certified [702.01](#) PG binder, [ODOT Supplemental Specification 875.02](#) Hot Applied Asphaltic Joint Adhesive or [702.13](#) SBR Asphalt Emulsion to provide 100 percent coverage of the joint or with a certified [702.04](#) asphalt material applied at a rate of 0.25 gallon per square yard.

401.18 Asphalt Binder Compatibility. If excess fat spots, regular random areas of flushing, or excess drain down occur on a project that are not attributable to over rolling, plant operation, or mix quality compared to the JMF, the City will consider the asphalt binder incompatible. The City will reject any on-hand asphalt binder because of incompatibility. The City may use its discretion in determining if problem areas can be corrected, or if removal and replacement is required. Demonstrate to the Laboratory through reporting actual testing analysis the compatibility of another asphalt binder and that proper equipment is in place in order to be allowed to resume.

401.19 Spreading and Surface Tolerances. If a uniform course is specified, make checks and adjustments to maintain the rate of spreading within a tolerance of ±5 percent of the required calculated weight per unit of area.

If a variable depth course is specified, place the mixture as shown on the plans.

If a longitudinal profile is specified by elevations on the plans, do not allow the completed pavement surface to deviate more than 1/2 inch at any point from parallel with the specified profile. Before placing the surface course, check the profile of the preceding course at 50-foot intervals along the outside edge of each traffic lane and along any additional line described in superelevation tables, and submit a tabulation of all results that includes documentation of all deviations from the above tolerance to the Engineer. Perform corrective work necessary for compliance with the profile tolerance before placing the surface course. The requirements of this paragraph do not apply to small incidental areas of pavement less than 500 feet in length.

Do not vary the transverse slope of the surface of the completed course from the specified slope by more than 3/8 inch in 10 feet.

Do not vary the surface of each completed intermediate or surface course from the testing edge of a 10-foot rolling straightedge by more than 1/4 inch. Furnish straightedges, straightedges equipped with levels, or other devices. Equipment will be satisfactory to the Engineer.

Check the surface course for variations in slope or surface at locations where bumps are suspected when directed by the Engineer.

Correct variations in excess of slope or surface tolerance by removing mixture to neat lines and replacing, or by surface grinding in a manner satisfactory to the Engineer.

401.20 Asphalt Binder Price Adjustment. A Contract Item is eligible for a price adjustment when the Contract’s proposal specifically includes an Asphalt Binder Price Adjustment note.

401.21 Method of Measurement. The Contractor is responsible for recording the net weight of each truckload of mixture to the nearest 100 pounds in triplicate on plant ticket forms approved by the City. If the pay quantities are established by platform scales, provide a tare weight for each truck at the beginning of each day’s operation and a minimum of every 4 hours of operation each day. The Engineer may require additional tare weight measurements at any time. The Engineer will have the right to monitor all weighing operations and may require reweighing trucks at any time or location. Correct any discrepancies immediately. Continued non-compliance will result in the City taking necessary and appropriate action, such as, but not limited to, assigning a City ticket writer to the plant. Send one copy of the plant ticket with each load delivered to the paver and present it to the Engineer.

The Engineer will convert the total of the weights recorded on the plant tickets representing mixture finished according to contract requirements to cubic yards using a conversion factor established by the Laboratory. The Laboratory will establish this conversion factor from the approved JMF. However, if a mix design is not available, the Laboratory will use the conversion factors in [Table 401.21](#). If a uniform course is specified, the City will not pay for a number of cubic yards that exceeds the quantity calculated from plan lines and dimensions.

TABLE 401.21

Aggregate	lb/yd ³
Gravel and stone	4000
Slag less than 90 lb/yd ³ [1]	3600
Slag 90 to 100 lb/yd ³ [1]	4000
Slag more than 100 lb/yd ³ [1]	4300
[1]Based on average dry rodded weight at the Laboratory.	

401.22 Basis of Payment. The City will pay for all work performed and measured as specified above according to the appropriate contract items for each type.

The cost of sealing the joints is included in the unit price bid for the asphalt concrete.

The City will assess all costs against the Contractor that it incurs as a result of taking necessary and appropriate action due to the Contractor’s continued non-compliance.

The City will not pay for removing and replacing incompatible asphalt binder areas.

ITEM 402 ASPHALT CONCRETE MIXING PLANTS

[402.01](#) Description

[402.02](#) Calibration

[402.03](#) Polymer Binders

[402.04](#) Water Injection System for Warm Mix Asphalt

402.01 Description. This specification consists of the minimum requirements for an asphalt concrete mixing plant to produce asphalt concrete mixes according to City specifications.

Ensure asphalt concrete mixing plants conform to the requirements of [City Supplement 1101](#) and ASTM D 995 in addition to the following.

402.02 Calibration. Ensure the plant is calibrated according to [City Supplement 1101](#) when producing any asphalt concrete for the City. Ensure that the calibration is accurate within 1.0 percent. When performing a complete calibration for City projects, notify the Laboratory 24 hours in advance of the calibration. Submit a letter to the Laboratory verifying the plant has been calibrated in accordance with [City Supplement 1101](#).

402.03 Polymer Binders. If an asphalt binder is modified by SBR at an asphalt concrete mixing plant, equip the plant with an automated SBR flow control and monitoring system. Obtain the Laboratory's approval of the system before operating and demonstrate the system calibration to the City. If the City waives the demonstration, provide a letter documenting calibration data for the flow system to the Engineer for each project. Obtain written approval from the Laboratory for the use of SBR and ensure the QCP contains methods for properly controlling and sampling SBR binder blends.

For drum mix plants, introduce the SBR directly into the asphalt binder line through means of an in-line motionless blender or other device approved by the Laboratory which is able to provide a homogeneous blend. Ensure the in-line motionless blender design provides aggressive interaction of asphalt binder and SBR emulsion to provide a homogenous blend at the sampling port. Some blenders such as 'swirl' type blenders do not accomplish proper blending. The Astec in line SBR blender or similar design accomplishes proper blending. Locate a sampling valve between the in-line blender and the plant drum, at least 12 ft downstream of the in-line blender and at least 5 ft downstream of a piping elbow. Ensure the sampling valve port is at least 1 in in diameter. Ensure the sampling valve can be opened quickly for maximizing sample flow for the purpose of obtaining a proper sample. In place of an in-line sampling valve, a sample may be taken from a 3 to 5 gal surge tank as long as the tank is downstream of the required blender and the in-line flow can be quickly and directly diverted to the surge tank. Contents of the tank should be drained into a 5 gal sampling bucket and stirred before filling the required sample container. Provide a sampling valve port that is in a position to safely obtain the required sample volume in the required 5 gal sampling bucket. Provide a stable sampling rack to obtain a sample.

For batch plants, add the SBR after the aggregate has been completely coated with asphalt binder. Continue mixing for a minimum of 20 seconds after SBR is added and long enough to provide a uniform mixture.

Ensure the SBR pumping and metering system is capable of adding the SBR within the limits of [702.01](#). For drum plants ensure the SBR pump is automatically controlled by an independent computer and interfaced with the asphalt binder flow to automatically maintain the SBR flow within specification limits. Produce asphalt mixtures for placement in automatic SBR control mode only.

Ensure the SBR meter is accurate to +/- 2.0 percent over a flow range typical of that used at the asphalt plant (typically 0.8 to 12 gpm at drum plants and 10 to 25 gpm at batch plants). Ensure the SBR meter is a magnetic flow meter consisting of a metering flow tube which utilizes Faraday's Law of Induction to measure the flow and includes a transmitter to transmit the flow signal to a totalizer located in the control room of the asphalt plant. Locate the SBR meter downstream of any recirculation lines. Provide a means for removing the SBR line at the in-line blender to be able to obtain a sample of the SBR for calibration purposes.

Obtain Laboratory approval for use of any other type of SBR meter. Ensure the totalizer displays total volume measured and flow rate in standard engineering units. Ensure the totalizer is interfaced with a data logger that produces printouts of the logged data every five minutes for a drum plant or every batch for a batch plant. Ensure the logged data includes time, date, flow rate, and flow total except flow rate is not necessary for batch plant production.

Balling or wadding of SBR or uncoated aggregate indicates improper mixing; cease production immediately and until corrected to Laboratory satisfaction.

402.04 Water Injection System for Warm Mix Asphalt.

When allowed by specification, use a City approved water injection system for the purpose of foaming the asphalt binder and lowering the mixture temperature. Only use equipment that has been proven stable and effective through project use on non-City projects. Ensure equipment for water injection meets the following requirements:

- A. Injection equipment computer controls are in the plant control room and are tied to the plant computer metering.
- B. Injection equipment has variable water injection control controlled by the plant operation rate and the water injection can never exceed 2.2 percent by weight of asphalt binder.
- C. Water injection rate cannot be manually overridden by the plant operator once in the computer.
- D. Injection equipment stops water flow when a control or equipment failure in the injection system occurs.
- E. The water injects into the asphalt binder flow before the asphalt binder spray hits aggregate. Do not allow water to touch aggregate before the binder spray.
- F. Injection equipment includes water storage and pump control tied to the injection computer controls.
- G. Water storage low water alarm installed in the control room.
- H. Provide a PG binder sampling valve between the last piping tee on the tank side of the line and the injection equipment to sample PG binder before water is injected.

ITEM 403 ASPHALT CONCRETE QUALITY CONTROL AND ACCEPTANCE

[403.01](#) Description

[403.02](#) General

[403.03](#) Quality Control Program (QCP)

[403.04](#) Plant Calibration

[403.05](#) Quality Control Tests

[403.06](#) Verification Acceptance (VA)

[403.07](#) Not Used

403.08 Acceptance

403.01 Description. This specification outlines the Contractor requirements for controlling asphalt concrete, asphalt concrete base, or other asphalt mixtures as specified.

403.02 General. The City will verify quality control by City Verification Acceptance (VA) tests and monitoring reviews as specified. If the Contractor fails to operate according to its Quality Control Program (QCP), the City will shut down production.

Acceptance does not relieve the Contractor of responsibility for supplying and installing a finished product conforming to all requirements of the Contract.

Follow [City Supplement 1041](#) for the administration of a Quality Assurance Program on the Project.

403.03 Quality Control Program (QCP). Create and implement a Quality Control Program (QCP) for each paving season. The QCP will cover processes conducted to provide an asphalt mixture at the paving site that is uniform in composition, conforms to the specification requirements and that when placed is free of any defect (e.g. segregation, lack of mixture and texture uniformity, raveling, rutting, holes, debris etc.) within the Contractor's control at project completion. A minimum of 1 week before mix production, submit a hard copy of the proposed QCP to the Laboratory for review and acceptance.

Send a hard copy and a digital copy (if available) of the acceptance letter and accepted QCP to the Engineer. Keep copies of the letter and the QCP in each Contractor plant laboratory and plant operation control room. Digital copies of the QCP and letter in pdf format are allowed in each Contractor plant laboratory and plant operation control room with the following requirements: The file icon must be appropriately labeled and be on the computer desktop of a computer in each area, the QCP must contain page numbering and a Table of Contents inside the front cover locating all sections by page number, and out of date QCPs must be removed from the computer desktop.

Failure to comply with the approved QCP may result in removal of personnel in accordance with [City Supplement 1041](#), removal from VA, and adversely affect the Contractor's Prequalification rating.

The QCP is a reflection of a Contractor's sincerity and ability in producing a quality product. Development of this program beyond the minimum requirements specified below is encouraged and is taken into consideration by the City Engineer when reviewing Contractor plant operation for qualification for VA.

Include in the program:

- A. The assignment of quality control responsibilities. Quality control includes all efforts required to achieve a product meeting specifications. List individuals as required below and note their designated responsibilities to meet QCP requirements. Provide a Quality Control Manager holding a [City Supplement 1041](#) Level 3 approval and who is a company employee. Assign Level 2 technicians for all Level 2 QC testing duties, and provide a list designating their responsibilities and expected actions. Ensure only approved personnel handle and test samples at all times. If Level 2 consultant technicians are used provide a document in the QCP and to them listing designated responsibilities and expected actions (if different from employee expectations). Define who is responsible at plants and specific methods for ensuring haul vehicles meet all requirements and proper bed release products are used. Provide a Field Quality Control Supervisor (FQCS), holding [City Supplement 1041](#) Field Quality Control Supervisor approval and who is a company employee, who is routinely and usually at the paving site during placement of any non-temporary asphalt concrete pavement. Ensure personnel obtaining and handling cores at the project site are approved Level 2 technicians, FQCS or personnel approved by the Laboratory.
- B. Means for annual training of company and consultant technicians and their supervisors in ethical conduct according to company expectations. Document how and when training is given, what the expectations are, how expectations are communicated and list all personnel trained. Describe the QC Manager's and technician supervisor's responsibilities and methods in ensuring ethical conduct is maintained throughout the year.
- C. Provisions to meet the City mix specifications.
- D. Procedures for extra testing (e.g., job start, responses to poor test results or field mix problems, aggregate stock testing, reclaimed asphalt concrete pavement checks, moistures) and any other testing necessary to control materials not already defined in these Specifications.
- E. Specify warning bands to be used by technicians for all tests and give specific instruction how the warning bands will be used for tests in concert with [Table 441.10-1](#) specification requirements.
- F. Methods to maintain all worksheets, including all handwritten records, and other test and sample records from the plant or project for the duration of the contract or 5 years, whichever is longer. Define the test record process. Define company records retention requirements. Provide copies of all test reports and forms used in the quality control process.
- G. Procedures for equipment calibration and documentation for Level 2 lab equipment. Provide documentation that all Level 2 lab equipment has been calibrated at the time of the Level 2 lab approval inspection. Procedures for calibration record storage.
- H. Method of Quick Calibration and documentation for each plant type.
- I. Procedure for random sampling to be used at the plant and documentation method. Procedures for sample taking, tracking, handling and documentation method for all samples taken at the project paving site including taking of all cores used for density determination or density gauge correlation.
- J. All procedures to meet the processing, testing and documentation requirements for RAP in [401.04](#) including test forms, record keeping, technician responsibilities, etc.

- K. Procedure for ensuring that every Contractor employee involved in the testing of asphalt mix and operation of the asphalt plant facility has read the QCP and has on site access to all applicable City specifications, proposals, policies, and the current approved JMF.
- L. Procedure for ensuring asphalt binder Bills of Lading with BOL load number, binder source and grade are reviewed against running JMFs and record of review listing the above information be kept in the plant lab for the duration of the project. Means to meet the handling and storage requirements of [402.03](#) and asphalt binder suppliers for all asphalt binders.
- M. Means to meet delivered mixture uniformity/coating and hauling/trucking requirements.
- N. Define the roles and responsibilities of the Field Quality Control Supervisors. List approved Field Quality Control Supervisors.
- O. Signature of the Quality Assurance Manager and, if different, the person in authority to enforce all operations covered by the QCP as outlined in this subsection.

403.04 Plant Calibration. Conform to the requirements of [Item 402](#).

Before manufacturing asphalt concrete, demonstrate to the Laboratory that the Contractor's facility adequately meets the specification requirements. Calibrate the plant using procedures approved by the City. Perform initial calibrations in the presence of the Laboratory. The Laboratory may request a letter of certification and certified data documenting the calibration results, instead of having the Laboratory present.

Verify the calibrations biweekly using a Quick Calibration. However, the City may request additional Quick Calibrations if there are mix production problems or plant operation concerns. The Quick Calibration is a quality control procedure developed by the Contractor that verifies the accuracy of a facility to proportion materials to meet the current JMF. Include the Quick Calibration procedure and data forms in the QCP in accordance with [403.03.H](#). If the difference between current calibration and the Quick Calibration is within ± 2 percent, then the current calibration is acceptable. If the 2 percent variation is exceeded, perform a recalibration of the facility. Document the Quick Calibration procedure as specified in the QCP and post the procedure and results in plain view in the plant control room and plant laboratory for reference by the Laboratory. Document all data from calibrations in a format approved by the Laboratory, and retain the data for review by the Laboratory.

If asphalt concrete is being produced from a batch type facility, verify the accuracy of the aggregate and asphalt binder weighing devices on a biweekly basis. Include the verification procedure in the QCP. Document the verification procedure as specified in the QCP and post the procedure and results in plain view in the plant control room and plant laboratory for reference by the Laboratory. Do not allow the deviation between the plant recorded weights and actual weights to exceed 1 percent. Record all data from verification of weighing devices in a format approved by the Laboratory, and retain the data for review by the Laboratory.

403.05 Quality Control Tests. Perform quality control tests to control the asphalt concrete mix within the appropriate specifications.

Perform all [Item 448](#) mix testing and quality control according to [441.09](#).

For mixes that do not use [Item 448](#) acceptance (e.g. [Items 301](#), and [302](#)), test the mix according to [441.09](#) for asphalt binder content and gradation (Basic). Other requirements of [441.09](#) and [441.10](#) do not apply. Control the Basic mixes as follows:

- A. If a single asphalt binder content is more than ± 0.5 percent beyond the JMF, immediately take and test an additional sample.
- B. If two consecutive asphalt binder content tests are more than ± 0.5 percent beyond the JMF, notify the Laboratory and cease production until the problem is corrected.
- C. If the Range difference in any three consecutive asphalt binder content tests is greater than 0.7 percent (for [302](#) mix) or 0.6 percent (Basic mix, other than [302](#)) immediately notify the Laboratory.
- D. If the Range difference in any three consecutive gradation tests for the No. 4 sieve is greater than 10.0 percent, immediately notify the Laboratory.
- E. If Range deviations as specified in [403.05.C](#) or [403.05.D](#) continue, cease production.

Range is defined as the difference between the largest and the smallest test result.

403.06 Verification Acceptance (VA). The City will perform VA testing. If the random City VA sampling and testing verifies the accompanying Contractor tests, the average of the Contractor's quality control tests for each day or night) will be used to determine acceptance.

- A. **Sampling.** The City will perform the VA by testing independent and split samples taken and tested by the City.

For [441](#) quality control testing, the Contractor's technician will randomly select the truck in which to take a sample by using a random number procedure as outlined in the QCP. The Contractor's technician will give no indication to anyone of the time that the sample is to be taken. For other than job start, previous mix production problems, low production tonnage, or as requested by the Laboratory, exclude the first three trucks from sampling. Include the random number, sample tonnage location, and time of sampling on the daily Quality Control Report (Contractor form TE-199) with each test. Tests, other than the required random sample tests, are at the Contractor's discretion according to the QCP.

Provide a clean area of sufficient size and a hard surface to perform sample splitting. Split samples by quartering and recombining only as described in AASHTO T 248, Method B for hard surfaces for the City and Contractor's sample. The City split sample size required is generally 22 to 27 pounds. A mechanical quartering device approved by the City may be used in lieu of the above but only split according to the procedure outlined in the Contractor QCP. Ensure that every quality control or daily production sample taken by the technician has a labeled split for the City. Wrap and label the City split samples as time, location (tonnage), and accompanying Contractor test identification. The Laboratory will pick up all City split samples within 4 workdays. Sample mishandling (careless identification, changing sample size, consistency, or pre-testing) will result in shutdown of production.

For all mixes, conform to the procedures of City Supplements [1038](#), [1039](#), and [1043](#) except take samples from a truck at the plant. If workmanship problems continue on the project (segregation, etc.) or if quality control problems persist, the Laboratory may require sampling on the road. Split and test all samples taken by the Contractor from locations selected by the Engineer. The Contractor may test a QC sample at the required sample location as both a QC and day's production test provided the sample is tested for all required quality control properties. Test results will apply for both QC and day's production requirements. A change in the location of the sample must be approved by the City and be reasonably close to the original location. This allowance does not apply to any other samples including City VA sample locations selected by the Laboratory. Label City split samples as day's production or quality control samples. Where more than one plant is simultaneously producing material for the job, the day's production sizes shall apply separately for each plant.

- B. Reporting.** Report all testing performed and sample identification on a Quality Control Report (Contractor form TE-199). Record on the TE-199 if the mixture produced was ran at the asphalt plant as a hot mix asphalt (HMA) or as a warm mix asphalt (WMA) produced according to [402.04](#) or another approved method. Deliver (fax, e-mail, hand) completed Quality Control Reports by the end of each day in which testing is conducted. If desired by the Laboratory and always for unsigned E-mail versions, mail the originals. After startup adjustments, report any plant operation changes on the Quality Control Report. Ensure that each Quality Control Report contains technician comments as to production quality, input materials received, and condition and includes any other quality control activities as specified in the QCP. Ongoing problems with inadequate, incomplete, or illegible reporting will result in shutdown of production. The Contractor's technician must sign each Quality Control Report.

Report test results to the accuracy of the following decimal places. When the figures to be dropped in rounding off are exactly one-half of unity in the decimal place to be retained, round the value up to the nearest number in the decimal place to be retained.

	Single Test	Ave Range
Asphalt Binder Content	0.1	0.01
No. 200 sieve	0.1	0.01
Other sieves	Whole number	0.1
BSG	0.001	0.001

Attach computerized plant printouts representing samples tested to that day's report, if desired by the Laboratory, or otherwise keep them with the quality control records. Ensure that the technician notes on the accompanying printout from which tonnage the quality control sample was taken with accompanying test results for AC content and percent passing the No. 4 sieve. Keep remaining printouts in the plant laboratory for the duration of the project. Keep a copy of all quality control reports for a project in the Contractor's plant laboratory.

- C. City Verification Testing and Monitoring.** The Laboratory will randomly choose one City sample in a maximum of every four production days for VA testing to confirm Contractor testing and mix control. More frequent VA samples can be taken when desired. The City VA sample location will be chosen randomly by the Laboratory, including where in the truck to take the sample, if applicable. The Contractor technician will take the sample from the truck with the Laboratory witnessing. The Laboratory will keep the sample in the City's possession until delivered to the Laboratory or testing is complete. The Laboratory will have enough samples taken to split with the Contractor. The Laboratory will split the sample in the Contractor lab. The Laboratory will have the sample tested in the Laboratory or as noted below. The Contractor will test his split of the VA sample with the Laboratory witnessing. The City will use its VA test result, the Contractor result of the split, as well as the most recent previous day (or night) Contractor quality control and/or day's production test in the comparison for the City VA testing.

The Laboratory may opt to test the City VA sample in the plant laboratory with the Contractor's permission, according to the Contractor's safety practices, and with the restriction of only the Contractor's technician physically placing a sample pan in the AC Gauge. However, if the Laboratory tests VA samples on Contractor equipment, test a VA sample on City equipment a minimum of one time in 15 production days from a given plant regardless of the number of projects or JMFs tested in the Level 2 lab. Record the results and testing location in the project record. One day may be added to the above City sample testing frequency for each day production is less than 500 tons.

For all mixes, the City may increase the number of VA testing samples if desired.

All City VA test results will be given to the Contractor by a reasonable arrangement acceptable to both. City VA sample testing not completed in a timely manner is of no value in verifying quality control testing quality for Contractor test acceptance and/or investigating problem causes. As such, if not completed in a timely manner, Contractor tests will automatically stand and the Engineer will note the problem in the City's VA record.

TABLE 403.06-1 VERIFICATION ACCEPTANCE AND QUALITY CONTROL TEST COMPARISON

	Percent Asphalt Binder		Percent Passing No. 4		MSG Comparison
	VA ^[1]	QC/day's production test ^[2]	VA ^[1]	QC/day's production test ^[2]	VA ^[3]
Basic	±0.3	±0.4	±4.0	±5.0	
448	±0.3	±0.3	±4.0	±4.0	
446					0.010
[1] City VA mix test deviation from Contractor split and from the approved JMF. For Basic mixes, use the tolerances in Table 403.06-2 when comparing City VA to JMF.					
[2] City VA mix test deviation from most recent previous day (or night) QC and/or lot test.					
[3] Deviation of City MSG VA compared to QC MSG daily average.					

If the City VA tests confirm Contractor testing is within the verification tolerances, but a pattern of high or low results exist that suggests mix control is not at the JMF, then investigate with the Laboratory's assistance to correct the problem to the Laboratory's satisfaction. Direct any questions regarding interpretation of circumstances to the Laboratory.

D. Contractor Tests are Verified. Production is acceptable if:

1. The Laboratory verifies the Contractor's QCP is being fully followed; and
2. The City VA tests are within the limits specified in [403.06.C](#); and
3. For Basic mixes, the remaining sieves do not exceed the limits of the applicable specification.

Failure on the Contractor's part to respond to and resolve Laboratory concerns will result in shutting down production.

Acceptance is based on [Table 403.06-2](#).

TABLE 403.06-2 MIX ACCEPTANCE

Mix Type	Acceptance Tolerances or Method		
		Deviation from JMF ^[1]	Range
Basic Mixes (no acceptance limits stated in appropriate specification)	Asphalt Binder Content	± 0.5%	1.0
	No. 4 sieve	± 6%	12
Basic Mixes (acceptance limits stated in appropriate specification)	Use acceptance limits in appropriate specification		
448 Acceptance Mixes	Calculate pay factor according to 403.08		
446 Acceptance Mixes	Calculate pay factor according to 446.04		
[1] Based on the average of the day or night QC Tests			

E. Contractor Tests not Verified. If the City VA test does not verify the accompanying Contractor tests within the verification tolerances, then the Laboratory will investigate.

If the deviation between the City and Contractor test is greater than the limits in [Table 403.06-3](#), immediately cease production until resolved. If the deviation is less than the limits in [Table 403.06-3](#) and discrepancies continue, perform additional tests to aid in problem solving.

TABLE 403.06-3 DEVIATION LIMITS

Property	Mix	Limits
Asphalt Binder Content	All	± 0.5 %
No. 4 sieve	All, except 302	± 6.0%
	302	± 7.0%

Additional tests may include any testing necessary to resolve the problem. If the additional testing does not resolve the problem by one-half production day or 500 tons, whichever occurs first, to the Laboratory's satisfaction, the Engineer may stop production until problems are

resolved. Contact the Laboratory for assistance in resolving problems. If the City testing program is confirmed by the additional tests and Laboratory investigation and no reason to question the original test exists, then the original City VA tests will stand.

After the above investigation, one of the three following actions will occur:

1. **Mix Production Compares Well to the JMF.** If the City test and investigation shows mix is actually controlled well compared to the JMF in spite of the Contractor test, the City does not have to test additional samples if the Contractor testing problem is corrected.
 2. **Mix Production Does Not Compare Well to the JMF.** If the City tests and investigation shows lack of Contractor mix control compared to the JMF, the City will test the remaining City split samples for the days represented by the original tests. The City will use the test results to calculate the acceptance. While working with the City, immediately take steps to correct the problem according to the QCP. Failure to achieve a quick resolution will result in shutting down production.
 3. **Testing Problem.** If the City testing program has a problem as confirmed by the additional testing and City review, the City will correct the problem, throw out the original City test results and take new samples from the samples representing the days in question for the VA tests.
- F. **Contractor Removal, Restoration.** If repeated problems with poor comparison of tests are not the City’s fault; or poor comparison of Contractor tests to the JMF; or with plant operation, input materials, or any of the other requirements of City specifications occur in a single project or successive projects, the Laboratory will request an opinion of the City Engineer before notifying the Contractor of removal from City VA. The Laboratory will immediately notify the Contractor of the removal with a follow up letter from the Engineer. Restoration of the VA procedures may occur on a future project with a Laboratory recommendation to the City Engineer based on consistent improved plant operation and mix control, a review of the Contractor problems and resolutions, and a review of the QCP.

403.07 Not Used.

403.08 Acceptance. Mixes will be accepted as follows:

- A. **Acceptance Tables for 448 Mixes.** A day’s production is considered acceptable for gradation and asphalt binder content if the deviation of the mean from the JMF and the Range is no more than the tolerances shown in [Table 403.08-1](#).

TABLE 403.08-1 DEVIATION FROM THE JMF AND RANGE TOLERANCES ^[1]

Mix Property	Deviation from JMF (Percent)	Range (Percent)
Asphalt Binder Content	0.3	1.0
1/2 inch sieve	6	15
No. 4 sieve	5	15
No. 8 sieve	4	15
[1] Based on the average of all daily acceptance tests.		

If the average of all daily acceptance tests for a particular sieve or sieves, or for asphalt binder content deviates from the JMF by more than the tolerances shown in [Table 403.08-1](#), but falls within the tolerances shown in [Table 403.08-2](#), then the day’s production is considered reasonably acceptable and may remain in place with payment at a reduced pay factor as show in [Table 403.08-2](#).

If the Range of the daily production acceptance tests for asphalt binder content or for any particular sieve, or sieves, exceeds the tolerance shown in [Table 403.08-1](#), the City will apply a pay factor of 0.95.

TABLE 403.08-2 448 ACCEPTANCE SCHEDULE ^[1]

Mix Property	Pay Factor	1 Test	2 Tests	3 Tests
Asphalt Binder Content	1.00	0 to 0.47	0 to 0.36	0 to 0.30
	0.98	0.48 to 0.54	0.37 to 0.42	0.31 to 0.35
	0.90	0.55 to 0.61	0.43 to 0.48	0.36 to 0.40
	0.80	0.62 to 0.68	0.49 to 0.54	0.41 to 0.45
	0.60	0.69 to 0.75	0.55 to 0.59	0.46 to 0.50
	[2]	> 0.75	> 0.59	> 0.50
1/2 inch sieve	1.00	0 to 8.5	0 to 6.9	0 to 6.0
	0.99	8.6 to 9.9	7.0 to 8.1	6.1 to 7.0
	0.97	10.0 to 11.3	8.2 to 9.2	7.1 to 8.0
	0.94	11.4 to 12.7	9.3 to 10.4	8.1 to 9.0
	0.90	12.8 to 14.1	10.5 to 11.5	9.1 to 10.0
	[3]	> 14.1	> 11.5	> 10.0
No. 4 sieve	1.00	0 to 7.1	0 to 5.8	0 to 5.0
	0.99	7.2 to 8.5	5.9 to 6.9	5.1 to 6.0

Mix Property	Pay Factor	1 Test	2 Tests	3 Tests
	0.97	8.6 to 9.9	7.0 to 8.1	6.1 to 7.0
	0.94	10.0 to 11.3	8.2 to 9.2	7.1 to 8.0
	0.90	11.4 to 12.7	9.3 to 10.4	8.1 to 9.0
	[3]	> 12.7	> 10.4	> 9.0
No. 8 (2.36 mm) sieve	1.00	0 to 5.7	0 to 4.6	0 to 4.0
	0.99	5.8 to 7.1	4.7 to 5.8	4.1 to 5.0
	0.97	7.2 to 8.5	5.9 to 6.9	5.1 to 6.0
	0.94	8.6 to 9.9	7.0 to 8.1	6.1 to 7.0
	0.90	10.0 to 11.3	8.2 to 9.2	7.1 to 8.0
	[3]	> 11.3	> 9.2	> 8.0
[1] Based on average of all daily acceptance tests from the JMF. [2] Remove and replace material [3] Engineer will determine if the material may remain in place. Pay factor for material allowed to remain in place is 0.70.				

The City will determine payment for the day's production by multiplying the contract unit price by the pay factor. When any pay factors for a specific day's production are less than 1.00, use the lowest pay factor to calculate the payment.

B. Acceptance of 301, 302, and 424 Type A Mixes. Acceptance is based on [Table 403.08-3](#).

TABLE 403.08-3 DEVIATION FROM THE JMF AND RANGE TOLERANCES ^[1]

Mix Property	Deviation from JMF (Percent)	Range (Percent)
Asphalt Binder Content	0.5	1.0
No. 4 sieve	6	12
[1] Based on the average of all daily acceptance tests.		

ITEM 405 BITUMINOUS COLD MIX

- [405.01](#) Description
- [405.02](#) Composition
- [405.03](#) Materials
- [405.04](#) Mixing Plants
- [405.05](#) Weather Limitations
- [405.06](#) Bituminous Material Preparation
- [405.07](#) Aggregate Preparation
- [405.08](#) Mixing
- [405.09](#) Hauling
- [405.10](#) Bituminous Pavers
- [405.11](#) Rollers
- [405.12](#) Conditioning Existing Surface
- [405.13](#) Spreading and Finishing
- [405.14](#) Compaction
- [405.15](#) Joints
- [405.16](#) Spreading and Surface Tolerances
- [405.17](#) Method of Measurement
- [405.18](#) Basis of Payment

405.01 Description. This work consists of constructing 1 or more courses of aggregate and bituminous material mixed in a central or traveling plant, spread and compacted on a prepared surface.

The general plant mix specifications, [401](#), shall apply; deviations from these are as follows.

405.02 Composition. Use Nos. 57, 67 or 8 size aggregate for the mixture as specified. Use Nos. 8 or 9 size aggregate for choke as specified.

For material mixed by travel plant, the Engineer will adjust the estimated quantity of bituminous material to be added to the aggregate to produce a satisfactory mixture.

To adequately fill the surface voids without excess, the Engineer may adjust the estimated quantity of aggregate to be applied as choke on the surface of the compacted mixture.

The Engineer will base acceptance of the mixture on observed uniformity of mixing and coating of the aggregate particles.

405.03 Materials. Bituminous material of the type and grade specified shall meet the applicable requirements of [Item 702](#). When 2 or more grades of one type of bituminous material are specified, the Engineer will determine the grade to be used.

The City may take pavement samples according to [106.02](#).

The Contractor may use coating agents conforming to AASHTO T 59 with the prior approval of the Engineer.

405.04 Mixing Plants. To prepare the bituminous mixture, the Contractor may use mixing plants of either the stationary batch or continuous type or the traveling continuous type. Obtain the Engineer’s approval for the mixing plants prior to preparation of the mixtures. General requirements for bituminous concrete mixing plants are on file with the Laboratory.

405.05 Weather Limitations. Do not place bituminous cold mix under any of the following conditions: (a) when the surface is wet, (b) when the air temperature is below 40° F, or (c) when weather conditions otherwise prevent proper handling, finishing, or curing of the mixture.

405.06 Bituminous Material Preparation. Deliver bituminous material to the mixer at a uniform temperature within the range specified in [Item 702](#).

405.07 Aggregate Preparation. Deliver aggregate to the mixer at a temperature of not less than 40° F and in a surface dry condition, except as follows.

When asphalt emulsions are used in the mixture, maintain any aggregate surface moisture that may be present, uniformly within such limits so as to obtain an acceptable coating of bituminous material.

The Contractor may treat specified liquid grades of asphalt with a coating agent. When use of such an agent is approved by the Engineer, aggregate surface moisture may be present only to the extent that the treated bituminous material will form an acceptable coating during the mixing process.

405.08 Mixing. Proportion aggregate and bituminous material and mix for the directed time so as to produce a mixture having a uniform distribution of the bituminous material and coating of the aggregate.

405.09 Hauling. Haul the bituminous mixture using trucks conforming to [401.11](#).

405.10 Bituminous Pavers. Use bituminous pavers for placing central mixed material conforming to [401.12](#). Provide spreading, leveling and strike off equipment for the traveling plant conforming to [405.04](#).

405.11 Rollers. Use rollers conforming to [401.13](#). Use a minimum of 2 rollers of the types listed, except in small areas a single tandem roller may be used. The capacity of each roller shall be considered to be 30 tons of aggregate placed per hour for steel wheel rollers and 60 tons per hour for pneumatic tire rollers. For this work, pneumatic tire rollers shall have an average tire contact pressure of not less than 55 psi and the tire contact area requirement does not apply.

405.12 Conditioning Existing Surface. Condition the existing surface according to [401.14](#), except that painting or coating of contact surfaces shall not be required.

405.13 Spreading and Finishing. Spread and finish the mixture according to [401.15](#), except place the aggregate at the weight per square yard specified.

Immediately following the initial rolling, apply the choke aggregate uniformly with adjustable, hopper equipped, revolving drum type spreaders at the specified rate or as directed by the Engineer.

Should a delay in choke application occur that would prevent adequate bonding, the Engineer may require a light application of the bituminous material used in the mix prior to the application of the choke aggregate.

405.14 Compaction. Compact the mixture according to [401.16](#). The Engineer may delay rolling to avoid lateral displacement. Continue final rolling until the choke aggregate is thoroughly embedded and roller marks are eliminated.

405.15 Joints. Construct joints as specified in [401.17](#).

405.16 Spreading and Surface Tolerances. Meet the spreading and surface tolerances specified in [401.19](#). The variation of the surface from the testing edge of the 10 foot straightedge shall not exceed 3/8 inch.

405.17 Method of Measurement. The City will measure aggregate and bituminous material according to [Item 109](#). The City will measure aggregate by weight in tons.

When the mixture is prepared in a stationary plant, the City will use batch or truck weights of the mixture to compute the aggregate weight by deducting the weight of bituminous material in the mixture.

405.18 Basis of Payment. The City will pay for accepted quantities of bituminous cold mix, complete in place, at the contract prices as follows:

Item	Unit	Description
405	Ton	Mix Aggregate
405	Ton	Choke Aggregate
405	Gallon	Mix Bituminous Material

ITEM 407 TACK COAT

- [407.01](#) **Description**
- [407.02](#) **Materials**
- [407.03](#) **Equipment**
- [407.04](#) **Weather Limitations**
- [407.05](#) **Preparation of Surface**
- [407.06](#) **Application of Asphalt Material**
- [407.07](#) **Method of Measurement**
- [407.08](#) **Basis of Payment**

407.01 Description. This work consists of preparing and treating a paved surface with asphalt material, and cover aggregate if required.

407.02 Materials. Conform to the applicable requirements of [Item 702](#) for the asphalt material and use one of the following types: [702.04](#) RS-1, SS-1, SS-1h, CRS-1, CSS-1, or CSS-1h; [702.12](#) Non-Tracking Asphalt Emulsion or [702.13](#) SBR Asphalt Emulsion.

Supply [702.12](#) Non-Tracking Asphalt Emulsion any time [Item 407](#) Non-Tracking Tack Coat is specified.

Conform to [703.06](#) for cover aggregate.

407.03 Equipment. Provide adequate cleaning equipment, spreader boxes, and distributors.

Use distributors designed, equipped, maintained, and operated to apply asphalt material at the specified rate per square yard with uniform pressure over the required width of application. Ensure that the distributor includes a tachometer, pressure gauges, and an accurate volume measuring device or a calibrated tank. Mount an accurate thermometer with a range covering the specified application temperature for asphalt material at approximately center height of the tank with the stem extending into the asphalt material. Ensure that the distributor has a full-circulating system with a spray bar that is adjustable laterally and vertically. Ensure that the spray bar will maintain a constant height above the pavement under variable load conditions. Supply each distributor with suitable charts showing truck and pump speeds and other pertinent application data necessary to obtain the required results.

Do not use equipment that cannot obtain the correct tack application.

407.04 Weather Limitations. Do not apply the asphalt material if the surface temperature is below the minimum placement temperature for the pavement course to be placed, as specified in [401.06](#).

407.05 Preparation of Surface. Ensure that the surface is thoroughly clean and dry to the Engineer’s acceptance before the asphalt material is applied. Remove material cleaned from the surface and dispose of it as the Engineer directs.

When tack material is being applied, protect the exposed surfaces of the curb and gutter and all structures from being marred or defaced.

407.06 Application of Asphalt Material. Uniformly apply the asphalt material with a distributor having clean nozzles functioning properly.

For irregular areas such as driveways and intersections, apply the asphalt material using a method the Engineer approves.

Apply the asphalt material in a manner that offers the least inconvenience to traffic. Only apply the asphalt material to areas that will be covered by a pavement course during the same day. Ensure the tack breaks before releasing to construction traffic unless the paver is equipped with a spray bar system to apply tack just prior to mat placement.

Apply asphalt material to obtain uniform coverage within the range specified in [Table 407.06-1](#), as directed by the Engineer. Obtain the Engineer's approval for the quantity, rate of application, temperature, and areas to be treated before application of the asphalt material. The Engineer will determine the actual application in gallons per square yard by a check on the project.

**TABLE 407.06-1 TYPICAL TACK COAT
APPLICATION RATES**

Existing Pavement	Application Rate gal/yd ²
New Asphalt	0.05 to 0.10
Oxidized Asphalt	0.08 to 0.10
Milled Asphalt Surface	0.08 to 0.10
Milled PCC Surface	0.06 to 0.10
PCC Surface	0.06 to 0.10

The application is considered satisfactory when the actual rate is within ±10 percent of the required rate and the material is applied uniformly with no visible evidence of streaking, ridging or pickup by construction traffic. The Engineer will require proper correction when ridging, streaking, pickup or other non-uniform coverage is observed. Correct non-uniform tack only in areas of non-uniform coverage. Do not reapply tack in areas where the tack meets uniformity and application requirements.

If the coverage is not uniform and not corrected the total square yardage of non-uniform application will be considered non-specification material. The Engineer will determine the number of gallons for non-payment by using the approved rate of application times the total square yards of non-uniform application.

The application rates for the non-tracking tack coats shall be the same as regular tack.

407.07 Method of Measurement. The City will measure Tack Coat and Non-Tracking Tack Coat by the number of gallons of undiluted asphalt material applied for each according to [Item 109](#).

407.08 Basis of Payment. The cost of cover aggregate is incidental to Tack Coat.

The City will not pay for non-uniformly applied materials as defined in [407.06](#).

The City will pay for accepted quantities at the contract prices as follows:

Item	Unit	Description
407	Gallon	Tack Coat
407	Gallon	Non-Tracking Tack Coat
407	Tons	Cover Aggregate

ITEM 408 PRIME COAT

[408.01](#) Description

[408.02](#) Asphalt Material

[408.03](#) Cover Aggregate

[408.04](#) Weather Limitations

[408.05](#) Equipment

[408.06](#) Preparation of Surface

[408.07](#) Application of Asphalt Material

[408.08](#) Application of Cover Aggregate

[408.09](#) Method of Measurement

[408.10](#) Basis of Payment

408.01 Description. This work consists of preparing and treating an existing surface with asphalt material, and cover aggregate if required.

408.02 Asphalt Material. Conform to the applicable requirements of [Item 702](#) for asphalt material and use one of the following types: [702.02](#) MC-30, MC-70, or MC-250; or [702.03](#) Primer 20.

408.03 Cover Aggregate. Use cover aggregate conforming to No. 9 size or gradation requirements of [703.05](#) or [703.06](#).

408.04 Weather Limitations. Do not apply asphalt material on a wet surface, or when rain is forecasted within 24 hours after applying the asphalt material. Do not apply prime coats for asphalt concrete or surface treatment work when the atmospheric temperature is below 50 °F or when the air temperature within the preceding 24 hours has been 40 °F or lower. Do not apply prime coats on stabilized or granular base courses when the atmospheric temperature is below 40 °F.

408.05 Equipment. Use equipment conforming to [407.03](#).

408.06 Preparation of Surface. Shape the surface to be primed to the required grade and section. Ensure the surface is free from all ruts, corrugations, segregated material or other irregularities and is smooth and uniformly compacted at the time of application of the asphalt material. Clean the surface in a manner that will thoroughly remove all mud, earth, and other foreign material. Take care to clean the edges of road to be primed to ensure uniform application of the asphalt material directly onto the existing base or pavement surface. Remove material cleaned from the surface and dispose of it as the Engineer directs.

When bituminous material is being applied, protect the exposed surfaces of the curb and gutter and all structures from being marred or defaced.

408.07 Application of Asphalt Material. Apply asphalt material in a uniform manner spread to the width of the section to be primed by means of a distributor conforming to [407.03](#). Take care that the application of asphalt material at the junction of spreads is not in excess of the specified amount. Squeegee excess asphalt material from the surface. Correct skipped areas or deficiencies.

Do not allow traffic on the prime coat until the asphalt material has been absorbed by the surface and will not be picked up. Obtain the Engineer's approval for the quantity, rate of application, temperatures and areas to be treated before application of the prime coat.

408.08 Application of Cover Aggregate. If, after applying the prime coat, the asphalt material fails to penetrate and traffic must use the roadway, spread cover aggregate in the amount required to absorb any excess asphalt material.

408.09 Method of Measurement. The City will measure Prime Coat by the number of gallons according to [Item 109](#).

408.10 Basis of Payment. The cost of cover aggregate is incidental to Prime Coat.

The City will pay for accepted quantities, complete in place, at the contract price as follows:

Item	Unit	Description
408	Gallon	Prime Coat

ITEM 409 SAWING AND SEALING ASPHALT CONCRETE PAVEMENT JOINTS

[409.01](#) Description

- [409.02](#) **Materials**
- [409.03](#) **Construction Details**
- [409.04](#) **Method of Measurement**
- [409.05](#) **Basis of Payment**

409.01 Description. This work consists of saw cutting and sealing the finished surface of the asphalt concrete pavement and shoulders directly over and in line with transverse joints in the underlying portland cement concrete pavement.

409.02 Materials. Use joint sealant conforming to [705.04](#) and approved by the Laboratory before shipment to the project.

409.03 Construction Details. Saw cut, clean, and seal transverse joints as a continuous operation. If the surface course is not placed within 5 days after the intermediate course is placed, make a 1/8-inch wide saw cut that is one-fourth the depth of the intermediate course over contraction joints and a 1/2-inch wide cut that is one-fourth the depth of the intermediate course over expansion joints.

Saw joints in the surface course as soon as the saw can be operated without damaging the asphalt concrete, but no later than 48 hours after the asphalt concrete is placed.

Locate the sawed joints directly over each transverse pavement joint in the concrete pavement, including joints at full-depth pavement repairs. Accurately locate joints with pins or stakes before paving. Pre-mark the saw cut on the new asphalt with a chalk line or other acceptable method. Obtain the Engineer's approval of the method for locating and accurately marking the proposed saw cuts before starting any resurfacing operations.

Saw all transverse joints and create a joint sealant reservoir according to [Table 409.03-1](#). Use either dry or wet cutting. Make one or two passes to create the saw cut and joint sealant reservoir.

TABLE 409.03-1

Measurement	Inch
Saw cut depth	2
Joint sealant reservoir	
Width	3/8
Depth	3/4
Recess below surface course	1/8

Clean dry sawed joints with compressed air to remove dirt, dust, or deleterious matter. Use an air compressor with a minimum rated capacity of 100 pounds per square inch and sufficient hose for continuous cleaning operations.

Clean wet sawed joints with a water blast to remove sawing slurry, dirt, or deleterious matter. Dry wet sawed joints with a propane torch or lance unit capable of producing a blast of hot air at 2000 °F and with a gas velocity of 2000 feet per second.

Extend the transverse saw cut joints the full width of the asphalt over the concrete pavement and paved shoulders.

Do not allow traffic to knead together or damage the sawed joints before sealing.

Heat joint sealant material in a kettle or melter constructed as a double boiler, with the space between the inner and outer shells filled with oil or other heat transfer medium. Provide positive temperature control and mechanical agitation.

Heat the material according to the manufacturer's recommendation. Consider the first gallon of material that flows out of the applicator wand at the start of the day spoil, and discard it into a container so designated.

After cleaning, immediately seal the joints with sealant applied through a nozzle projected into the sawed joint, filling from the bottom up. Ensure that the sealant completely fills the joint such that after cooling, the level of the sealant is below the surface by less than 1/8 inch). Fill any depression in the seal greater than 3/16 inch to the specified limit by adding additional sealant. Do not overfill the joints. Take care in the sealing of the joints so that the final appearance will present a neat line.

409.04 Method of Measurement. The City will measure Sawing and Sealing Asphalt Concrete Pavement Joints by the number of feet of joints sawed and sealed.

409.05 Basis of Payment. The City will not pay for saw cuts in the intermediate course.

The City will pay for accepted quantities at the contract price as follows:

Item	Unit	Description
409	Foot	Sawing and Sealing Asphalt Concrete Pavement Joints

ITEM 410 TRAFFIC COMPACTED SURFACE

- [410.01](#) **Description**
- [410.02](#) **Materials**
- [410.03](#) **Conditioning of the Subgrade**
- [410.04](#) **Spreading and Shaping**
- [410.05](#) **Maintaining**
- [410.06](#) **Method of Measurement**

410.07 Basis of Payment

410.01 Description. This work consists of furnishing and placing an aggregate wearing course on the completed and accepted subgrade or temporary road.

410.02 Materials. Furnish materials conforming to [703.18](#) for the type of material specified (Type A, Type B, or Type C).

410.03 Conditioning of the Subgrade. Eliminate wavy and irregular surfaces and maintain the subgrade in this condition until the application of material under this item. If the subgrade is soft due to rain, frost, or snow, place material only as permitted.

410.04 Spreading and Shaping. Uniformly spread the material using an approved spreader box or by other methods. Spread the amount of material shown on the plans or as directed by the Engineer. After spreading, blade and shape the materials to the specified cross-sections. Haul the material to its place on the road over the previously spread material. Conduct the hauling to obtain uniform compaction over the entire width of the surface material without rolling.

410.05 Maintaining. After shaping the material, blade it as directed by the Engineer. Open the road to traffic immediately after all the material has been spread and shaped.

Correct all holes, ruts, defects, or soft places that occur in the subgrade or surface by adding material and dragging. Maintain the surface, slopes, shoulders, ditches, and drainage structures until the work on this item has been completed and accepted.

410.06 Method of Measurement. The City will measure Traffic Compacted Surface, Type ___ by the number of cubic yards or tons of accepted material placed, shaped, and maintained as specified.

The City will measure the cubic yards of aggregate used loose in the vehicle at the point of delivery or calculate it by converting from weight using the following conversion factors:

TABLE 410.06-1

Material	Conversion Factor
Gravel, bank run or crusher run	2700 lb/yd ³
Limestone, crusher run	2500 lb/yd ³
Gravel, Size No. 4 and 57	2500 lb/yd ³
Limestone, Size No. 4 and 57	2400 lb/yd ³
Crushed slag ^[1]	
less than 80 lb/ft ³	2000 lb/yd ³
80 to 90 lb/ft ³	2100 lb/yd ³
90.1 to 100 lb/ft ³	2300 lb/yd ³
100.1 to 125 lb/ft ³	2700 lb/yd ³
more than 125 lb/ft ³	3000 lb/yd ³
Recycled Portland Cement Concrete	2250 lb/yd ³
Recycled Asphalt Pavement	2650 lb/yd ³
[1] Based on average dry rodded weight determined by the Laboratory. The conversion factors listed are the long gradation weights. These numbers are based on the dry rodded weights of Nos. 67, 57, or 8 gradation. The City will determine slag weights based on weights obtained from the original source.	

The City will classify salvaged or mixed materials according to the material that makes up the majority of the mixture.

Ensure that the moistures of the delivered material are less than 2 percent above saturated surface dry condition; if not, the City will base payment on the dry densities and dry weights.

Furnish freight bills, and weight and volume evidence according to [Item 109](#).

410.07 Basis of Payment. The City will pay for accepted quantities at the contract prices as follows:

Item	Unit	Description
410	Cubic Yard or Ton	Traffic Compacted Surface, Type A or B
410	Cubic Yard or Ton	Traffic Compacted Surface, Type C

ITEM 411 STABILIZED CRUSHED AGGREGATE

- [411.01 Description](#)
- [411.02 Materials](#)
- [411.03 Construction Methods](#)
- [411.04 Method of Measurement](#)
- [411.05 Basis of Payment](#)

411.01 Description. This work consists of placing a compacted course or courses of crushed aggregate.

411.02 Materials. Furnish materials conforming to [703.18](#).

411.03 Construction Methods. Construct the subgrade according to [Item 204](#). Use the spreading and compaction requirements of [Item 304](#), except as modified by the following:

- A. Use a maximum compacted lift thickness of 6 inches.
- B. Perform the initial compaction of the material by using crawler type tractors, tamping rollers, trench rollers, suitable pneumatic tire equipment, or other suitable equipment.
- C. Perform final compaction of the surface of the stabilized crushed aggregate by using approved pneumatic tire equipment.

Unless otherwise specified in the Contract Documents, the Engineer will perform all compaction tests according to [Supplemental Specification 1501](#).

411.04 Method of Measurement. The City will measure Stabilized Crushed Aggregate by the number of cubic yards, computed from the profile grade, cross-sections and typical sections, compacted in place.

When the plans provide for the use of material in variable width or depth of course and the quantity cannot be readily calculated from the profile grade, typical sections and cross-sections, the City will measure the cubic yards by converting from weight using the following conversion factors:

TABLE 411.04-1

Material	Conversion Factor
Crushed stone	3800 lb/yd ³
Crushed gravel	3900 lb/yd ³
Crushed slag ^[1]	
less than 90 lb/ft ³	3600 lb/yd ³
90 to 100 lb/ft ³	4000 lb/yd ³
more than 100 lb/ft ³	4500 lb/yd ³
Granulated slag	2800 lb/yd ³
Recycled Portland Cement Concrete	3400 lb/yd ³
Recycled Asphalt Pavement	4000 lb/yd ³
[1] Based on average dry rodded weight of standard size of slag aggregates on record at the Laboratory. The conversion factors listed are the long gradation weights. These numbers are based on the dry rodded weights of Nos. 67, 57, or 8 gradation. The City will determine slag weights based on weights obtained from the original source.	

The City will classify salvaged or mixed materials according to the material that makes up the majority of the mixture.

Ensure that the moistures of the delivered material are less than 2 percent above saturated surface dry condition; if not, the City will base payment on the dry densities and dry weights.

Furnish freight bills or certified weight bills according to [Item 109](#).

411.05 Basis of Payment. The City will pay for accepted quantities at the contract price as follows:

Item	Unit	Description
411	Cubic Yard	Stabilized Crushed Aggregate

ITEM 412 SEAL COAT

- [412.01](#) Description
- [412.02](#) Bituminous Material
- [412.03](#) Cover Aggregate Material
- [412.04](#) Weather Limitations
- [412.05](#) Equipment
- [412.06](#) Preparation of Surface
- [412.07](#) Protection of Curbs and Structures
- [412.08](#) Applying Bituminous Material
- [412.09](#) Cover Aggregate
- [412.10](#) Method of Measurement
- [412.11](#) Basis of Payment

412.01 Description. This work consists of constructing a wearing surface composed of 1 or more applications of bituminous material and cover aggregate, in place and compacted.

412.02 Bituminous Material. Furnish bituminous material, of the type and grade specified, conforming to [Item 702](#). When 2 or more grades of one type of bituminous material are specified in the contract, the Engineer will determine the grade to be used.

412.03 Cover Aggregate Material. Use cover aggregate conforming to [703.05](#). The sizes of aggregate shall be No. 6, No. 67, No. 8 or No. 9, as specified. The surface moisture of the cover aggregate shall not exceed that which will permit the proper coating and adhesion of the type of bituminous material specified, except that the Contractor may treat the bituminous material with an agent, conforming to AASHTO T 59, that will assist in obtaining sufficient coating to hold the aggregate in place, provided the Engineer approves such treatment.

412.04 Weather Limitations. Do not apply bituminous material when the temperature of the atmosphere is below 60° F nor when the air temperature within the preceding 24 hours has been below 40° F. Do not apply emulsified asphalt [401.09](#) between October 1 and May 15 of the succeeding year except by permission of the Engineer. Do not apply bituminous material while the surface is wet or when the humidity or impending weather conditions are such that proper curing may not be obtained. The Contractor may apply emulsified asphalt to a damp surface with the Engineer's approval.

412.05 Equipment. Use bituminous distributors conforming to [407.03](#). Use pneumatic tire roller conforming to [401.13](#). Inflate tires to a pressure producing a minimum average contact pressure of 55 psi.

When using pneumatic tire rollers on a seal coat with [Item 405](#), use in conjunction with three-wheeled rollers conforming to [401.13](#).

Use either self-propelled or truck mounted aggregate spreaders, equipped with hoppers, revolving cylinders and adjustments necessary to produce a uniform distribution of particles at the specified rate.

412.06 Preparation of Surface. Clean the pavement according to [407.05](#).

412.07 Protection of Curbs and Structures. When applying bituminous material, protect the exposed surfaces of curbs, curb and gutter or other structures from being marred or defaced.

412.08 Applying Bituminous Material. Use a pressure distributor to apply the bituminous material, heated to a temperature within the specified range. Apply the material with sufficient uniformity to prevent ridging or streaking in the completed surface. The Contractor may adjust the rate of application specified in the contract with the approval of the Engineer when necessary to result in satisfactory embodiment and retention of the cover aggregate.

At the beginning and at the end of a contract section, start and stop the application on paper or other suitable material sufficiently wide enough to permit full application on the surface being treated. Make transverse and longitudinal laps in such a manner that the texture of the finished surface will be uniform and continuous.

Prior to starting the application of bituminous material, ensure sufficient cover aggregate is available for immediate application.

412.09 Cover Aggregate. Immediately following the application of the bituminous material, apply cover aggregate uniformly without ridges or laps at the specified rate adjusted as directed by the Engineer to produce a minimum of excess loose particles. Spread aggregate in such manner that the tires of the truck or aggregate spreader at no time contact the uncovered and newly applied bituminous material. Prior to rolling, correct deficiencies in the application of cover aggregate in a manner satisfactory to the Engineer.

Begin rolling immediately behind the spreader and perform 4 complete coverages. When three-wheeled rollers are required, use them for at least the initial coverage. A roller coverage shall consist of 2 trips or passes over the same area. Do not operate rollers at speeds that cause pick up or dislodging of aggregate particles.

Following the completion of rolling, protect the surface from traffic damage during the period of time required for the bituminous material to cure sufficiently to prevent dislodging of the aggregate particles by normal traffic. During this period, correct deficiencies in cover aggregate by spreading additional aggregate or by light brooming as directed by the Engineer.

Sweep excess cover aggregate from the surface by means of rotary brooms soon after the bituminous material has cured sufficiently to prevent dislodging of the embedded aggregate particles.

412.10 Method of Measurement. The City will measure the number of tons of aggregate and the gallons of bituminous material in place, completed and accepted, according to [Item 109](#).

412.11 Basis of Payment. The City will pay for accepted quantities, complete in place, at the contract prices as follows:

Item	Unit	Description
412	Gallon	Seal Coat Bituminous Material
412	Ton	Seal Coat Cover Aggregate

ITEM 417 ASPHALT EMULSION SLURRY SEAL

[417.01](#) Description

[417.02](#) Materials

[417.03](#) Equipment

[417.04](#) Preparation of Surface

[417.05](#) Composition and Rate of Application of the Slurry Mix

- [417.06 Weather Limitations](#)
- [417.07 Traffic Control](#)
- [417.08 Application of the Slurry Surfaces](#)
- [417.09 Acceptance](#)
- [417.10 Documentation](#)
- [417.11 Method of Measurement](#)
- [417.12 Basis of Payment](#)

417.01 Description. This work consists of constructing a slurry seal composed of a mixture of emulsified asphalt, mineral aggregate, and water; properly proportioned, mixed, and spread evenly on the surface as specified herein and as directed by the Engineer. The cured slurry shall have a homogeneous appearance, fill all cracks, adhere firmly to the surface and have a skid resistant texture.

417.02 Materials.

- A. Asphalt Emulsion.** Furnish emulsified asphalt conforming to AASHTO specifications for dense mixing grade SS-1h except that they shall be of the QUICK SET SLURRY SEAL EMULSION TYPE, either anionic or cationic, whichever in the opinion of the Engineer and the Laboratory is best suited to the aggregates and job conditions to be encountered. The following specifications will apply:

TABLE 417.02-1

	Quick Set Anionic	Quick Set Cationic
Viscosity at 77° F, SSF, secs.	15-50	15-50
Residue from Distillation Weight, %	57% min.	57% min.
Sieve Test, Retained on 20 mesh, %	0.10 max.	0.10 max.
Particle Charge, Electroplate	Negative	Positive
Tests on Residue from Distillation:		
Penetration at 77° F, 100 G., 5 sec.	40-90	40-90
Solubility in CS2 or TCE	97.5 min.	97.5 min.
Ductility at 77° F, cm.	40 min.	40 min.
Tests on Job Design Slurry:		
Mixing Time Test Sec.	120 min.	120 min.
Set Time Blotter Test, 30 mins.	No brown stain or displacement	No brown stain or displacement
Water Resistance Test, 30 mins.	No - discoloration	No - discoloration
Coating Test (3 min. in boiling water), %	90 min.	90 min.
Wet Track Abrasion Test, Loss in gms. per sq. ft.	75 max.	75 max.
Loaded Wheel Test, Sand Adhesion gms. per sq. ft.	60 max.	60 max.

- B. Aggregate.** Furnish mineral aggregate consisting of 100 percent crushed gravel, or slag, or approved limestone and that is clean and free from vegetable matter and other deleterious substances. When tested by AASHTO T176, the aggregate blend shall have a sand equivalent of not less than 45. When tested according to AASHTO T104, the aggregate shall show a loss of not more than 35 percent.

Consider mineral fillers such as portland cement or limestone dust as part of the blended aggregate and use in minimum required amounts. Ensure mineral fillers meet the gradation requirements of ASTM D242 (Dry). Only use mineral fillers if needed to improve the workability of the mix or gradation of the aggregate.

Only use aggregates in the work that have a proven durability record for the conditions and traffic expected. The Engineer will approve the aggregate source before work proceeds. The combined mineral aggregate shall conform to the following gradation when tested by the previously mentioned test, ASTM D242 / D242M:

TABLE 417.02-2

Sieve Size	Type A (Slurry Seal) Percent Passing
3/8	100
No. 4	85-100
No. 8	50-80
No. 16	40-65
No. 30	25-45
No. 50	13-25
No. 100	--
No. 200	5-15
Theoretical Asphalt Content,	7.5-13.5
(% Dry Aggregate) % Extracted from dry sample	
Application Rate,	
Aggregate lbs./SY, Dry	16 (min.)

- C. **Water.** Only use potable water that is free from harmful soluble salts, with the slurry mixture.
- D. **Stockpiling of Aggregate.** Do not stockpile at areas other than the quarry site without the Engineer’s approval. Stockpile in a manner that prevents contamination and segregation of the aggregate.
- E. **Storage.** Provide suitable storage facilities for the asphalt emulsion. Equip the container to prevent water from entering the emulsion. Provide suitable heat if necessary to prevent freezing.
- F. **Sampling.** Provide samples of materials as directed by the Engineer during progress of the work. The Engineer may request test reports as additional materials arrive.
- G. **Design.** Submit to the Engineer a complete laboratory design made in a qualified laboratory at least 7 days prior to start of work. Perform a complete analysis of the materials and JMF proposed for use in the performance of the work in accordance with procedures outlined in the current issue of International Slurry Seal Association Technical Bulletin No. 111 as indicated by the Engineer. The Engineer will review and approve the selection of the optimum mix design from the material data presented.
- H. **Submittals.** Submit along with the required written materials analysis and proposed JMF the following physical specimens, if requested by the Laboratory:
 - 1. 11 lb of the proposed aggregate selected.
 - 2. 1 gal of the proposed emulsion selected.
 - 3. 1 lb of the filler selected, if applicable.
 - 4. 3 series of consistency tests at 100, 85 and 70 percent BR and at 2-3, 4-5, and 6-7 cm. consistencies.
 - 5. 2 each of abraded Wet Tract Abrasion Test specimens at 100, 85 and 70% BR.
 - 6. 2 each of sand adhered Loaded Wheel Test specimens at 100, 85 and 70% BR.
 Identify each specimen indelibly with the date and source.

The Engineer may waive the design submittals provided the Contractor has previously applied, in accordance with [417.02.H](#), a satisfactorily designed and applied slurry with substantially the same materials proposed for this work. In any case, the Contractor may not introduce untried materials into this work without complete analysis and design of a JMF for each new material and the approval of the Engineer.

417.03 Equipment. Maintain all equipment, tools, and machines used in the performance of this work in satisfactory working order at all times. Before mix production, calibrate the mixing equipment in the presence of the Engineer. Generate documentation for the Engineer, including individual calibrations of each material at various settings. Perform a new calibration if there is any change in the mix design. Supply all of the equipment, materials, and scales necessary to perform the calibration. Following calibration and adjustments for changes in the mix design, do not make any further calibration adjustments to the mixing equipment without the Engineer’s approval.

- A. **Slurry Mixing Equipment.** Use a continuous flow mixing unit, capable of delivering accurately a predetermined proportion of aggregate, water and asphalt emulsion to the mixing chamber and discharging the thoroughly mixed product on a continuous basis. Pre-wet the aggregate immediately prior to mixing with the emulsion. Ensure that the mixing unit of the mixing chamber is capable of thoroughly blending all ingredients together. Do not allow any violent mixing. Equip the mixing machine with an approved fines feeder that provides an accurate metering device or method to introduce a predetermined proportion of mineral filler into the mixer at the same time and location that the aggregate is fed. Use the fines feeder whenever added mineral filler is a part of the aggregate blend.

Equip the mixing machine with a water pressure system and fog type spray bar adequate for completing fogging the surface preceding spreading equipment with a maximum application of 0.05 gallons per square yard. Do not carry free water in front of the spreader. Equip the emulsion tanks with some type of measuring device that will provide a quick reference to determine application rate in gallons of emulsion per square yard. Use a minimum of two complete slurry machines of at least 10 tons aggregate capacity each to provide as nearly a continuous operation as possible.

B. Slurry Spreading Equipment. Attach to the mixing machine a mechanical type squeegee distributor box equipped with flexible material to contact with the surface to prevent loss of slurry from the spreader box. To prevent the loss of slurry on varying grades and crowns, adjust the spreader box to ensure a uniform spread.

Provide a steering device and a flexible strike-off. The spreader box shall have an adjustable width. Keep the box clean, and prevent build-up of asphalt and aggregate on the box. Use burlap drags or other drags with the Engineer's approval.

C. Cleaning Equipment. Use power brooms, power blowers, air compressors, water flushing equipment, and hand brooms to clean the surface and cracks of the old surface. Only use high pressure water (10 gal/m at 1,000 psi) to remove mud and adhesive clays.

D. Auxiliary Equipment. Provide hand squeegees, shovels, and other equipment as necessary to perform work.

417.04 Preparation of Surface. Perform sweeping, weed removal and final cleaning just before the machine. The Contractor may use any standard cleaning method to clean pavements, except water flushing will not be permitted in areas where considerable cracks are present in the pavement surface. The Engineer will give final approval of the surface.

If the slurry is being placed over a brick or concrete surface, highly absorbent asphalt surface, or over a surface where the aggregate has become exposed and is polished and slick, the Contractor may apply, with the asphalt distributor, a one part emulsion, three parts water, tack coat of the same asphalt emulsion type and grade as specified for the slurry. The normal application rate is 0.03 to 0.06 gallons of the diluted emulsion per square yard of surface. Do not proceed without the Engineer's final approval.

417.05 Composition and Rate of Application of the Slurry Mix. Translate the optimum JMF as set forth in the materials section of this specification into job control quantities in accordance with ISSA TB #107.

The slurry seal mixture shall be of proper consistency at all times so as to provide the application rate required by the surface condition. The average application rate, as measured, shall be in accordance with the following table.

Aggregate Type	Application	Application Rate
Type A	Urban and Residential Streets	16 lb/yd ² Minimum

The application rate is based upon the weight of dry aggregate in the mixture. The application rate is affected by the unit weight of the aggregate, the gradation of the aggregate and the demand of the surface to which the slurry seal is being applied. ISSA TB #112 gives a method to determine expected application rates.

Control the consistency of the mix to within 2.5 and 3.5 cm.

Maintain a complete daily record of the quantities and make available to the Engineer or City representative upon request. The City will not make final payment for the work until all load tickets and inventories are verified to ensure that specification quantities have been applied. In case of disputes, the Engineer's judgment will be final.

417.06 Weather Limitations. The Contractor may apply the mixture when both the air and pavement temperature are 45° F or above and rising.

417.07 Traffic Control. Use suitable methods such as pennants, barricades, flaggers, and pilot cars to protect the uncured slurry surface from all types of traffic. Any damage to the uncured slurry will be the responsibility of the Contractor. The Engineer will give final approval as to the method used. If damage occurs where suitable means have been made to protect the uncured slurry, the City will prosecute violators and reimburse the Contractor for the amount of the damages. Notify residents affected by the work in writing, 1 week before the work is to be done. Post "No Parking" signs 3 working days before the work is to be done. Tow parked vehicles after 3 days of notification, assuming responsibility and liability for the removal of these vehicles.

417.08 Application of the Slurry Surfaces.

A. General. Fog the surface with water directly preceding the spreader. Ensure that the slurry mixture is of the desired consistency when deposited on the surface; do not add additional elements. Total time of mixing shall not exceed 4 minutes. Ensure that a sufficient amount of slurry is carried in all parts of the spreader at all times so that complete coverage is obtained. Do not allow lumping, balling, or unmixed aggregate, or excessive breaking of the emulsion in the spreader box. Do not leave any streaks such as caused by oversized aggregate in the finished pavement.

B. Joints. Do not allow excessive build-up or unsightly appearance on longitudinal or transverse joints.

C. Hand Work. The Contractor may use approved squeegees to spread slurry in areas inaccessible to the slurry mixer. Take care to leave no unsightly appearance from hand work. In areas with adjacent concrete curb or curb and gutter which are not to be treated, use special care to avoid covering the concrete. If the Engineer determines that insufficient care is being taken to protect the concrete, the Engineer may require masking with suitable material at no additional cost to the City.

D. Curing. Before opening to traffic, allow treated areas to adequately cure until such time as the slurry seal will not be damaged by traffic.

E. Structures. Prior to the work, mask all structures that may become marred by the slurry, such as open gates, catch basins, manholes and valve boxes, with 0.006 inches plastic or equal and attached so as not to be displaced by the operations. Remove masking material after the slurry has cured. To achieve a clean straight line at intersections, use 15 pound roofing felt or equal as directed by the Engineer. Remove all masking materials at the completion of the work.

417.09 Acceptance. The Engineer will inspect the project with the Contractor for surface flushing and loss of material. If these deficiencies are found, corrective work is required. The Engineer will base acceptance of the slurry seal on the minimum required application rate.

Complete all corrective work within seven working days of the review, or by an agreed date. All costs associated with completing this corrective work, to the satisfaction of the Engineer, will be paid for by the Contractor.

417.10 Documentation. Provide a Summary of Slurry Seal Quantities - Yield Report for each worksheet to the Engineer, within one working day, with the following information:

- Control Section, Project Name, Street Name, County, Engineer
- Date, Time and Air Temperature
- Control Settings (From Calibration), Calibration Values (lbs/count)
- Unit weight of emulsion (lbs/gal), % residue in emulsion
- Beginning and ending stations of project
- Counter readings for Cement, Emulsion and Aggregate (beginning, ending and total)
- Length (Ft), width (Ft), area (Sq. Yd), weight of aggregate placed (lbs) and weight of emulsion placed (lbs)
- % of each material, percent of asphalt cement, application rate
- JMF (% portland cement, % emulsion, gradation and % A.C.)
- Contractor's authorized signature
- Contractor to calculate:
 - % Cement
 - % Emulsion
 - Aggregate Spread Rate
 - Gallons Emulsion/ Unit weight of emulsion (Lbs/gal)
 - Weight of emulsion placed (Lbs)/ % residue in emulsion
 - Asphalt Content

417.11 Method of Measurement. The City will measure slurry seal surface by the square yards of work completed and accepted as designated by the Engineer for each type applied.

417.12 Basis of Payment. The City will pay for accepted quantities complete in place at the contract unit price per square yard. Price and payment will be full compensation for furnishing and placing all materials. The City will not pay for any work that does not meet the specified application rate.

The City will pay for accepted quantities complete in place, at the contract price as follows:

Item	Unit	Description
417	Square Yard	Asphalt Emulsion Slurry Seal, Type A

ITEM 421 MICROSURFACING

- [421.01](#) Description
- [421.02](#) Materials
- [421.03](#) Proportioning
- [421.04](#) Weather Limitations
- [421.05](#) Mixing Equipment
- [421.06](#) Equipment Calibration
- [421.07](#) Spreading Equipment
- [421.08](#) Surface Preparation
- [421.09](#) Test Strip
- [421.10](#) Application
- [421.11](#) Acceptance
- [421.12](#) Not Used
- [421.13](#) Method of Measurement
- [421.14](#) Basis of Payment

421.01 Description. This work consists of constructing a cold laid polymer modified emulsified asphalt pavement course to fill ruts or provide a leveling and/or surface course for existing pavements.

421.02 Materials. Use a polymer modified emulsified asphalt binder (Binder) consisting of the following:

Use a quick-traffic CSS-1hM (as defined below). Use only emulsion certified per [City Supplement 1032](#).

Do not use port addition of the polymer to the emulsified asphalt. Provide to the Engineer certified test data and a statement from the Binder manufacturer with each load of Binder that the Binder is the same formulation as used in the mix design.

Ensure the Binder meets the following and specification limits will be producible for at least 30 days from sample date:

Tests on emulsion, AASHTO T 59, unless otherwise designated:	CSS-1hM [1]
Viscosity, Saybolt Furol, at 77°F (SFS)	20 to 100
Storage Stability Tests, 24-hr (% difference), max.	1
Particle Charge Tests	Positive
Sieve Tests (%) (Distilled Water), max.	0.10
Distillation to 177 °C, Residue % solids, min ^[2]	62
Tests on distillation residue:	
Penetration, 25 °C, 100 g, 5 sec (dmm) AASHTO T 49	40 to 90
Ductility, 25 °C 5 cm/min, AASHTO T 51	40
Solubility in trichloroethylene, (%), min. AASHTO T 44 ^[3]	97.5
Elastic Recovery, 10 °C, 20 cm (%), min. AASHTO T 301 ^[4]	45
Softening Point, Ring & Ball (°C), min. AASHTO T 53	60
<p>[1] Pre-blend only: Use a minimum of 3.0% SBR solids based on weight of the asphalt binder. Use Natural SBR latex modifier or synthetic SBR latex modifier conforming to 702.14. Use only one type of latex. Mill or blend the SBR Emulsion into the emulsified solution prior to the emulsification process.</p> <p>[2] See ODOT Supplement 1013. For natural latex, use the Oven Evaporation method in AASHTO T 59 in place of distillation and use this residue for further testing.</p> <p>[3] On the base asphalt only. Solubility in N-Propyl Bromide (ASTM D7553) can be used in place of trichloroethylene.</p> <p>[4] Straight molds. Hold at test temperature for 90 minutes. Place in ductilometer and elongate 20 cm at 5 cm/min. Hold for 5 minutes and cut. After 1 hour retract the broken ends to touch and measure the elongation (X) in centimeters to the nearest 0.01 cm. Use the following formula to calculate the elastic recovery:</p> $\text{Percent Recovery} = \left(\frac{20 - X}{20} \right) \times 100$ <p>Report Results to nearest 0.1%.</p>	

Conform to [703.01](#) and [703.05](#) for aggregate, except as follows:

Percent by weight of fractured pieces	100
Sand Equivalence (ASTM D 2419)	45 minimum

Conform to Gradation A for the aggregate for leveling and surface courses and to Gradation B for the aggregate for rut fill courses according to the following:

Sieve Size	Total Percent Passing	
	A	B
3/8 inch	100	100
No. 4	85 to 100	70 to 90
No. 8	50 to 80	45 to 70
No. 16	40 to 65	28 to 50
No. 30	25 to 45	19 to 34
No. 50	13 to 25	12 to 25
No. 100	–	7 to 18
No. 200	5 to 15	5 to 18

Screen the aggregate for oversize material prior to use. For mineral filler, use portland cement conforming to ASTM C 150, Type I. Use water conforming to [499.02](#). Use mix set additives as required.

421.03 Proportioning. Provide a mix design that has current ODOT approval. Where one does not exist, submit to the Laboratory a sample of the Binder to be used and a complete mix design prepared by an approved laboratory. Verify the compatibility of the aggregate, Binder, mineral filler, and other additives. Make the mix design with the same materials that will be used on the Project.

A. Ensure that the mix design:

1. Has aggregate meeting the gradation specified.
2. Has residual asphalt by dry weight of aggregate of 7.0 to 8.5 percent for leveling and surface courses or 6.5 to 8.0 percent for rut fill courses.
3. Has a mineral filler content of 0.3 to 3.5 percent by dry weight of aggregate.
4. Meets the specified properties of the following International Slurry Seal Association (ISSA) tests:

ISSA Test No.	Description	Specification
TB-139 (1-90)	Wet Cohesion	
	30 minutes min. (set time)	12 kg-cm min.
	60 minutes min. (traffic)	20 kg-cm min or near spin
TB-114 (1-90)	Wet Stripping	90 percent min.
TB-100 (90)	Wet Track Abrasion Loss	
	1-hour soak 6 day soak	450 g/m ² max. 650 g/m ² max.
TB-144 (2-89)	Saturated Abrasion Compatibility	3 g loss max.
TB-113 (1-90)	Mix Time @ 25 °C	Controllable to 120 seconds
	Mix Time @ 40 °C	Controllable to 35 seconds

Check the ISSA TB-139 (set time) and ISSA TB-113 (mix time) tests at the highest temperature expected during construction. For the ISSA TB-113 test at 104 °F, preheat all ingredients and containers.

B. The JMF should report the following (all percentages are based on the dry weight of the aggregate):

1. Source of each individual material.
2. Aggregate gradation.
3. Percentage of aggregate.
4. Sand equivalence of the aggregate.
5. Percentage of mineral filler (minimum and maximum).
6. Percentage of water (minimum and maximum).
7. Percentage of mix set additives (if required).
8. Percentage of Binder and type.
9. Quantitative effects of moisture content on the unit weight of the aggregate.

421.04 Weather Limitations. Apply the mixture only when it is not raining and the existing pavement surface and atmospheric temperature is a minimum of 45 °F and rising and there is no forecast of an atmospheric temperature below 32 °F within 24 hours from the time the mixture is applied. Between September 30 and May 1, do not apply the mixture if the existing pavement surface temperature is less than 50 °F.

421.05 Mixing Equipment. Produce the mixture in a self-propelled, front feed, continuous loading mixing machine equipped with a conveyer belt aggregate delivery system and an interconnected positive displacement, water jacketed gear pump to accurately proportion aggregate and asphalt emulsion. Locate the mineral filler feed so the proper amount of mineral filler is dropped on the aggregate before discharge into the pugmill. Provide a spray bar to completely pre-wet the aggregate dropping down to the pugmill with additive and water before introduction of asphalt emulsion. Ensure that the twin-shaft, multi-blade pugmill is a continuous flow type and minimum of 49 inches long. Ensure that the blade size and side clearances meet the equipment manufacturer's recommendations. Introduce the emulsion within the first one-third of the mixer length to ensure proper mixing of all materials before exit from the pugmill.

Equip the machine with opposite side driving stations to allow full control of the machine from either side. Equip the mixer with a remote forward speed control at the back mixing platform so the back operator can control forward speed and level of mixture in the paving or rut box. Provide material control devices that are readily accessible and positioned so the amount of each material used can be determined at any time.

Equip the mixing machine with a water pressure system and nozzle type spray bar to provide a water spray ahead of and outside the spreader box when required. Apply water at a rate that will dampen the surface, but will not create free flowing water ahead of the spreader box.

The Contractor may use truck-mounted machines with a conveyer belt aggregate delivery system and without the front feed, continuous loading feature on project segments of less than 15,500 square yards on spot repairs.

421.06 Equipment Calibration. Before mix production, calibrate the mixing equipment in the presence of the Engineer. Generate documentation for the Engineer, including individual calibrations of each material at various settings. Perform a new calibration if there is any change in the mix design. Supply all of the equipment, materials, and scales necessary to perform the calibration. Following calibration and adjustments for changes in the mix design do not make any further calibration adjustments to the mixing equipment without the Engineer's approval.

421.07 Spreading Equipment. If a leveling or surface course is specified, apply the mixture uniformly by means of a conventional spreader box attached to the mixer.

If a rut fill course is specified, apply the mixture with a V-shaped rut filling spreader box attached to the mixer. Equip the rut filling spreader box with a steel strike-off.

Equip the spreader box with augers mounted on an adjustable shaft to continually agitate and distribute the materials throughout the box. Ensure that the equipment provides sufficient turbulence to prevent the mix from setting in the box or causing excessive side build-up or lumps. To prevent loss of the mixture from the box, attach flexible seals, front and rear, in contact with the road. Operate the spreading equipment in such a manner as to prevent the loss of the mixture on super-elevated curves.

For surface courses, attach a secondary strike-off to the spreader.

The Contractor may use burlap drags or other drags, if necessary, to obtain the desired finish. Replace drags having excessive build-up.

421.08 Surface Preparation. Before applying the mixture, thoroughly clean the surface.

Remove all existing pavement markings, except [740.02](#) (traffic paint), using an abrasion method conforming to [641.09](#).

If the microsurfacing is being placed over a brick or concrete surface, highly absorbent asphalt surface, or over a surface where the aggregate has become exposed and is polished and slick, the Contractor may apply a tack coat conforming to [Item 407](#), consisting of one part asphalt emulsion and three parts water. Apply the tack coat at a rate of 0.03 to 0.06 gallon per square yard.

Remove raised pavement markers according to [621.08](#), when specified. The Contractor may fill the depression caused by the removal of the casting with material meeting this specification.

Remove any existing longitudinal pavement markings [740.04](#) (thermoplastic) and [740.07](#) (epoxy) using an abrasion method conforming to [641.09](#). Protect drainage structures, monument boxes, water valves, and similar structures during material application.

421.09 Test Strip. Construct a continuous 1000-foot long by lane width test strip consisting of the application course specified. Construct the test strip at the same time of day or night the full production will be applied.

The Engineer will evaluate the completed test strip 1 hour after application to determine if the mix design is acceptable. The Contractor may begin full production after the Engineer accepts the test strip.

If the microsurfacing is being applied between May 1 and September 30, the City will waive the test strip if the Contractor has constructed a City accepted test strip during the same timeframe with the same materials and mix design.

421.10 Application. Apply the paving mixture in a manner to fill cracks, shallow potholes, and minor surface irregularities and achieve a uniform surface without causing skips, lumps, or tears. Carry a sufficient amount of material at all times in all parts of the spreader box to ensure complete coverage. Avoid overloading of the spreader box. Do not allow lumping, balling, or unmixed aggregate in the spreader box.

If a rut fill course is specified, apply enough material to fill the wheel paths without excess crowning (overfilling). An excess crown is defined as 1/8 inch after 24 hours of traffic compaction. Apply rut fill courses in widths from 5 to 6 feet for each wheel path. Provide a smooth, neat seam where two rut fill passes meet. Take care to restore the designed profile of the pavement cross-section. Feather the edges of the rut fill course to minimize the use of excess material.

If a leveling course and a surface course are specified, apply the paving mixture at 14 ± 2 pounds per square yard for the leveling course and 16 ± 1 pounds per square yard for the surface course. Apply the two courses at a minimum combined rate of 30 pounds per square yard, regardless of the above tolerances.

If a surface course is specified and it is not placed on a Microsurfacing Leveling Course, apply the dry aggregate at a minimum of 20 pounds per square yard.

For surface courses, provide a smooth, neat seam of 1 to 3 inches where two passes meet. Leveling courses should not overlap. Immediately remove excess material from the ends of each run.

Construct surface courses wide enough to cover the outside edges of rut fill and leveling courses. Maintain straight edge lines along curbs and shoulders. Do not allow runoff in these areas. Ensure that lines at intersections are straight.

Use squeegees and lutes to spread the mixture in areas inaccessible to the spreader box and areas requiring hand spreading. The Contractor may adjust the mix set additive to provide a slower setting time if hand spreading is needed. Do not adjust the water content to adjust the setting time. If hand spreading, pour the mixture in a small windrow along one edge of the surface to be covered and spread it uniformly by a hand squeegee or lute. Provide uniform appearance of the entire surface area regardless of the means used to spread material.

Ensure that the microsurfacing cures at a rate that will permit traffic on the pavement within 1 hour after application without damaging the pavement surface. However, should the Contractor have concerns about adequate cure, work out an arrangement agreeable to the Engineer before releasing traffic on the pavement.

If there is an excessive streaking problem created by high amounts of oversize material in the mix, stop applying the mixture and take steps to correct the streaking problem. Do not resume work until the Engineer is satisfied the problem has been corrected.

421.11 Acceptance. Maintain continuous control of the binder to dry aggregate proportioning to conform to the approved mix design within a tolerance of ±2 gallons per ton. Control the spread rate to not less than the specified quantity of aggregate per square yard on a dry weight basis.

If requested by the Engineer, within one hour of start of production, obtain and label a binder and diluted tack coat sample from the distributor trucks and give the samples to the Engineer the same day. Provide and sample the binder and diluted tack coat in one quart plastic containers with plastic screw tops. Label and retain one sample of each per each additional day for the City. Take more samples when requested by the Engineer.

The Engineer will base acceptance of the binder-to-dry aggregate proportion and spread rate on the Engineer's summary of quantities used each day. The Engineer will approve and accept a day's application of microsurfacing provided:

- A. The Engineer's summary indicates conformance with the above control requirements for proportioning and spread rate and
- B. The pavement is free from excessive scratch marks, tears, rippling and other surface irregularities, longitudinal joints and lane edges coincide with any lane lines, and edge lines and transverse joints are uniform, neat and provide a smooth transition.

The spread rate requirement does not apply to rut fill courses if the Contractor filled the wheel paths according to this specification.

421.12 Not Used.

421.13 Method of Measurement. The City will measure Microsurfacing, Surface Course and Microsurfacing, Leveling Course by the number of square yards, complete and accepted in place. The City will base the width of the pavement course on the width shown on the plans, specified in this specification, or directed by the Engineer. The City will measure the length along the centerline of each roadway or ramp.

The City will measure the number of raised pavement markers removed.

The City will measure Microsurfacing, Rut Fill Course by the number of tons of dry aggregate used, complete and accepted in place. The City will base the weight of the dry aggregate used on the ticket net weight of individual loads from an approved scale.

421.14 Basis of Payment. The cost of [Item 407](#) Tack Coat and [Item 423](#) Crack Sealing shall be separate pay items to Microsurfacing.

The City will pay for removal of existing pavement markings according to [421.08](#) under [Items 644, 645, 646, 647, and 648](#) as specified. The City will pay for removal of existing raised pavement markers according to [Item 621](#) Raised Pavement Markers Removed.

The City will pay for the construction of accepted test strips at the individual bid prices for the courses constructed.

The City will pay for accepted quantities at the contract prices as follows:

Item	Unit	Description
421	Square Yard	Microsurfacing, Surface Course
421	Square Yard	Microsurfacing, Leveling Course
421	Ton	Microsurfacing, Rut Fill Course

ITEM 423 CRACK SEALING, HOT APPLIED

- [423.01](#) Description
- [423.02](#) Materials
- [423.03](#) Equipment
- [423.04](#) Weather Limitations
- [423.05](#) Preparation
- [423.06](#) Mixing Type II and III
- [423.07](#) Application of Sealant
- [423.08](#) Opening to Traffic
- [423.09](#) Method of Measurement
- [423.10](#) Basis of Payment

423.01 Description. This work consists of preparing and sealing pavement cracks with a hot applied crack sealant.

423.02 Materials. Furnish hot applied crack sealant, of the type specified, conforming to:

- Type I..... [705.04](#)
- Type II..... [702.17.B](#)
- Type III..... [702.17.C](#)
- Type IV..... [702.17.D](#)

Obtain the Laboratory's approval of Type I crack sealant before shipping to the project. Obtain approval of other crack sealants according to [702.17](#).

423.03 Equipment. Equipment used in the performance of this work is subject to the Engineer's approval and to the requirements of [108.05](#).

For Type I crack sealant, heat the sealant in a kettle or melter constructed as a double boiler, with the space between the inner and outer shells filled with oil or other heat-transfer fluid. Use a kettle or melter with positive temperature control of the oil bath, and provide a mixing vat, mechanical agitation, and recirculating pumps. Do not apply direct heat to the sealant.

For Types II, III, and IV crack sealants, heat the sealant in a kettle or melter constructed as a double boiler, with the space between the inner and outer shells filled with oil or other heat-transfer fluid. Use a kettle or melter with separate thermometers for the oil bath and mixing vat. Equip the

kettle with a full sweep type agitator. Also, equip the kettle with a 2-inch minimum recirculating pump to provide circulation of the materials when not applying the crack sealant. Do not apply direct heat to the sealant.

For Types I and IV crack sealants, use a mechanical applicator wand capable of continuously feeding the sealant through nozzles shaped to penetrate the cracks. A positive sealant flow shutoff mechanism is required. Ensure that the wand produces a band according to the tolerances of [423.07](#).

For Types II and III crack sealants, use a mechanical applicator wand head capable of placing the crack sealant according to the tolerances of [423.07](#) while filling the cracks. A positive sealant flow shutoff mechanism is required.

Use portable air compressors capable of furnishing at least 100 pounds per square inch of air pressure at the nozzle. Use compressors equipped with traps that maintain the compressed air free of oil and water.

Use water cleaning equipment capable of delivering water at 2000 pounds per square inch of pressure from a nozzle to the crack being cleaned.

Use a propane lance unit capable of producing a blast of hot air that operates at 1000 °F and a gas velocity of 2000 feet per second.

Use mechanical and power driven routing and sawing equipment capable of following close to the path of cracks and of widening the cracks to the required dimension without causing excessive spalling or damage to the adjacent pavement. For sawing equipment, use diamond saw blades with a diameter of 8 inches or less.

423.04 Weather Limitations. Do not seal cracks if the surface is visibly damp or the temperature is below 45 °F.

423.05 Preparation. Fill all cracks according to [423.07](#) or as directed by the Engineer.

If routing is specified, rout cracks with an opening less than 3/4 inch to provide a sealant reservoir with a nominal size of 3/4 inch wide by 1 inch deep.

If sawing is specified, saw all cracks to 3/4 to 7/8 inch wide and 7/8 to 1 inch deep. Use hand tools or a lightweight chipping hammer to remove all slivers of asphalt concrete less than 1 inch wide remaining along the crack after sawing. Immediately before sealing, sandblast both faces of the sawed crack to remove all contamination and to texture the faces. If the crack below the sealant reservoir is greater than 3/8 inch wide, insert a backer rod into the crack to form the bottom of the reservoir at the proper depth.

Before applying the hot sealant, clean cracks by an approved method or methods to remove dust, dirt, moisture, vegetation, and other foreign material. Keep the cracks clean and dry until all sealing operations are completed.

423.06 Mixing Type II and III. Use weigh tickets in determining the specified proportion of fiber to blend into the binder. Add fibers to the binder, and mix thoroughly in the kettle. Do not allow the temperature of the sealant in the field application to exceed the safe heating temperature recommended by the manufacturer. Do not heat Type III crack sealant to greater than 295 °F.

423.07 Application of Sealant. Perform the crack sealing operation within 250 feet of the cleaning operation.

Seal only cracks that are wide enough to permit entry of sealant. Seal tightly closed cracks (less than 1/4-inch wide) only if they show signs of raveling or spalling. Do not seal cracks greater than 1-inch wide, and do not seal spalls or cavities greater than 4 inches wide, unless otherwise directed.

For Types I and IV crack sealants, fill the entire crack reservoir with the sealant from the bottom up to approximately 1/16 inch above the pavement surface. Immediately scrape the filled cracks with a V-shaped or U-shaped squeegee, or similar hand tool, to smooth the overfill. This may require more than one application of sealant. The Engineer will not accept the work if the band of sealant on the pavement surface is greater than 2 inches wide.

For Types II and III crack sealants, place the sealant such that it fills the cracks with a band of sealant within 2 to 4 inches wide. The Engineer will not accept the work if the thickness on the pavement is greater than 3/16 inches.

423.08 Opening to Traffic. Do not allow traffic on the sealant until it has cured and the possibility of tracking no longer exists. However, if the Engineer determines it is necessary to allow traffic to pass over the sealant before adequate curing, dust portland cement or other approved material over sealed cracks to eliminate pickup or tracking.

423.09 Method of Measurement. The City will measure Crack Sealing, of the type specified, either by the number of pounds, the number of square yards, or the number of linear feet, of hot applied sealant in place, completed, and accepted.

423.10 Basis of Payment. The City will pay for accepted quantities at the contract prices as follows:

Item	Unit	Description
423	Pound, Square Yard, or Linear Foot	Crack Sealing, Type I
423	Pound, Square Yard, or Linear Foot	Crack Sealing with Routing, Type I
423	Pound, Square Yard, or Linear Foot	Crack Sealing with Sawing, Type I
423	Pound, Square Yard,	Crack Sealing, Type II

423	or Linear Foot Pound, Square Yard, or Linear Foot	Crack Sealing, Type III
423	Pound, Square Yard, or Linear Foot	Crack Sealing, Type II or III
423	Pound, Square Yard, or Linear Foot	Crack Sealing, Type IV

ITEM 424 FINE GRADED POLYMER ASPHALT CONCRETE

- [424.01](#) Description
- [424.02](#) Composition
- [424.03](#) Materials
- [424.04](#) Mixing
- [424.05](#) Weather Limitations
- [424.06](#) Spreading, Compacting and Finishing
- [424.07](#) Surface Tolerances
- [424.08](#) Acceptance
- [424.09](#) Method of Measurement
- [424.10](#) Basis of Payment

424.01 Description. This work consists of constructing a surface course of aggregate and polymer modified asphalt binder mixed in a central plant and spread and compacted on a prepared surface. The requirements of [Item 401](#) apply, except as modified by this specification.

424.02 Composition. For Type A mixes use 8.5 percent modified asphalt binder by total mix weight.

For Type B mixes, submit a proposed JMF according to [441.02](#) to the Laboratory that meets the requirements of a Type I surface course, except as follows:

- A. Minimum VMA, 15.0 percent
- B. Minimum total binder content, 6.4 percent
- C. Design air voids, 4.0 percent
- D. For projects with less than 1500 trucks use 50 blows, for projects with greater than or equal to 1500 trucks use 75 blows. If multiple traffic segments occur on a project use 75 blows for the project.

424.03 Materials. Furnish clean, uncoated aggregate conforming to the applicable requirements of [Table 424.03-1](#) and quality requirements of [703.05](#).

Use a PG 76-22M asphalt binder; or a PG 64-22 asphalt binder modified by adding 5.0 ±0.3 percent by weight Styrene Butadiene Rubber (SBR) solids and meeting the requirements of PG 76-22. Provide SBR conforming to [702.14](#). Provide mineral filler conforming to [703.07](#). Provide binders conforming to [702.01](#).

Ten percent RAP may be used in a Type B mix if all requirements of footnote [3] are met by the RAP. Do not use RAP in a Type A mix.

TABLE 424.03-1 - MIX GRADATION

Sieve Size	Total Percent Passing	
	Type A ^{[1][2]}	Type B ^{[1][3][4]}
1/2 inch		100
3/8 inch	100	95 to 100
No. 4	95 to 100	85 to 95
No. 8	90 to 100	53 to 63
No. 16	80 to 100	37 to 47
No. 30	60 to 90	25 to 35
No. 50	30 to 65	9 to 19
No. 100	10 to 30	--
No. 200	3 to 10	3 to 8

[1] Gradation includes any mineral filler and is specified in percent passing.

[2] Use natural sand with at least 50 percent silicon dioxide by weight according to ASTM C 146. Include with a JMF submittal certified test data from an AASHTO accredited laboratory showing conformance to the 50 percent silicon dioxide requirement. Ensure data is no more than one year old at time of submittal.

[3] Fine Aggregate - Use natural sand with at least 50 percent silicon dioxide by weight according to ASTM C 146. Include with a JMF submittal certified test data from an AASHTO accredited laboratory showing conformance to the 50 percent silicon dioxide requirement. Ensure data is no more than one year old at time of submittal. For 50 blow mixes, use no more than 20 percent limestone sand, No. 10

limestone, or combination of both by weight of total aggregate. For 75 blow mixes, use 20 percent limestone sand, No. 10 limestone, air cooled slag sand or combination thereof by weight of total aggregate. If 10 percent RAP is used the silicon dioxide content of the total natural sand blend must be at least 50 percent. Contact the Laboratory for guidance on submitting RAP aggregate silicon dioxide data.
 [4] Coarse Aggregate - For 50 blow mixes, for the final blend of all coarse aggregate use a minimum 10 percent two or more fractured faces aggregate. For 75 blow mixes, use 100 percent two or more fractured faces aggregate. Meet the two or more fractured faces aggregate criteria of ASTM D5821-13.

424.04 Mixing. Ensure the mixing plant conforms to [Item 402](#). Discharge the mix from the plant at temperatures from 335 °F to 370 °F for hot mix asphalt or 300 °F to 340 °F for warm mix asphalt.

424.05 Weather Limitations. Do not place the asphalt concrete when the surface of the existing pavement is less than 60 °F or the air temperature is less than 60 °F.

424.06 Spreading, Compacting and Finishing. Compact Type A or B mixes conforming to [401.13](#) and [401.16](#). If compacting a mixture 1 inch thick or less, do not use a spreading rate that exceeds twice the total capacity of the rollers in use. Use a minimum of two rollers. Do not allow traffic on the compacted mixture until it has cooled sufficiently to prevent damage.

424.07 Surface Tolerances. Ensure the completed surface course conforms to [401.19](#).

Remove raised pavement markers according to [621.08](#). The Contractor may fill the depression caused by the removal of the casting with material meeting this specification.

424.08 Acceptance. For Type A mixes, comply with acceptance requirements of [Item 301](#). For Type B mixes, comply with all requirements of [Item 448](#).

424.09 Method of Measurement. For Type A mixes, use a unit weight conversion of 1.75 tons/cubic yard.

The City will measure the number of raised pavement markers removed.

424.10 Basis of Payment. The City will pay for removal of existing raised pavement markers according to [Item 621](#) Raised Pavement Markers Removed.

The City will make payment for accepted quantities, completed in place, at the contract price as follows:

Item	Unit	Description
424	Cubic Yard	Fine Graded Polymer Asphalt Concrete, Type A
424	Cubic Yard	Fine Graded Polymer Asphalt Concrete, Type B

ITEM 441 ASPHALT CONCRETE - MIX DESIGN AND QUALITY CONTROL

- [441.01](#) Description
- [441.02](#) Composition
- [441.03](#) Use of Reclaimed Pavement
- [441.04](#) Antistrip Additive
- [441.05](#) JMF Field Adjustment
- [441.06](#) Monitoring
- [441.07](#) Quality Control Program
- [441.08](#) Testing Facilities
- [441.09](#) Quality Control Tests
- [441.10](#) Control Charts
- [441.11](#) Quality Control Reports
- [441.12](#) Mixture Deficiencies
- [441.13](#) Acceptance
- [441.14](#) Basis of Payment

441.01 Description. This work consists of constructing a surface course or an intermediate course of aggregate and asphalt binder mixed in a central plant and compacted on a prepared surface. This specification includes general requirements applicable to all types of asphalt concrete pavements where the Contractor is responsible for performing the mix design and quality control. Deviations from these general requirements will be covered in the specific requirements for each type. The requirements of [Item 401](#) apply, except as follows.

Control all production processes to assure the Engineer that the mixture delivered to the paving site is uniform in composition, conforms to the specification requirements and that the placed mixture is free of any defect (e.g. segregation, tenderness, lack of mixture and texture uniformity, raveling, flushing, rutting, holes, debris etc.) within the Contractor’s control at project completion.

441.02 Composition. Compose the asphalt concrete of approved aggregates, asphalt binder and, if required, other modifiers. Develop a JMF to comply with the mix design criteria and submit it to the Laboratory on approved forms at least two weeks prior to the start of production for preliminary approval. The Laboratory may require additional time prior to preliminary approval to perform tests on lab or plant produced mixtures to ensure adequate mix performance. The Laboratory will notify the Contractor if additional time for testing is required. Based on the results of this testing, the Laboratory may require the Contractor to design a new JMF.

Perform the mix design and supply all required data in a manner taught in Level 2 Asphalt Technician School, Level 3 Asphalt Mix Design School and in the Asphalt Institute Manual Series No. 2. The Laboratory may visit the Level 3 mix design lab for review. Use a 2-hour cure for all mix samples. Ensure the cure temperature and specimen compaction temperature are the same. Select the JMF asphalt binder content using the Design Air Voids and ensure the JMF meets the other requirements of [Table 441.02-1](#). Determine Air Voids from specimens prepared and tested according to [City Supplement 1036](#). Provide a mix design with at least four asphalt binder content points, including a minimum of two points above and two points below the JMF asphalt binder content. Additional submittals are at the discretion of the Laboratory. Unless otherwise directed, submit a 5-pound minimum uncompacted sample (all mixes) representing the JMF. Provide City testing laboratory with six laboratory conditioned gyratory compacted samples according to the ODOT Supplement 1033. Submit additional samples as requested by the Laboratory.

Do not start mix production without a preliminary JMF approval and 48 hour notification of the Laboratory. Final approval of a JMF will be based upon field verification. According to [441.12](#), the JMF can be rejected for failure to verify in the plant or at the project.

Do not apply the gradation requirements of [703.05](#) for fine aggregate.

If the F/A ratio using total asphalt binder content is greater than 1.0, recalculate it using the effective asphalt binder content. Calculate the effective asphalt binder content according to the Asphalt Institute Manual Series No. 2. The value (calculated to the nearest percentage point) of the Fifty to Thirty (F-T) value, is the percent of total aggregate retained between the No. 50 and No. 30 sieves, minus the percent of total aggregate retained between the No. 30 and No. 16 sieves.

Use a PG 64-22 asphalt binder for a Type 1 Intermediate course unless RAP used according to [401.04](#) require a virgin binder grade change. Use a PG 64-22 asphalt binder for a Type 2 intermediate course unless RAP used according to [401.04](#) require a virgin binder grade change. Use a PG 64-22 asphalt binder and Type 1 surface gradation for asphalt concrete for driveways and under guardrails.

Identify the PG Binder supplier, as well as the polymer type if applicable, on the JMF submittal. A change in polymer asphalt binder or polymer source will require a redesign. Provide on one page neatly summarized, dated test results for the requirements of [Table 702.01-1](#). Ensure data is no more than two months old. If SBR polymer is added at the asphalt concrete mixing plant, provide in the JMF data from the SBR polymer supplier for total solids (percent) and ash (percent) according to the [702.14](#). As well, provide the target amount of SBR polymer greater than or equal to 3.5 percent to achieve the properties specified. Include a letter of certification from the polymer supplier verifying percent butadiene in the SBS or SBR polymer. Report in the JMF submittal results of temperature-viscosity testing for mixing and compaction temperatures. For polymer asphalt binders, supplier recommended temperatures may be used in lieu of the temperature-viscosity results, but the temperature-viscosity results must still be reported.

TABLE 441.02-1

Asphalt Mixture Composition			
Property	Type 1 Surface	Type 1 Intermediate	Type 2 Intermediate
1 1/2 inch ^[1]			100
1 inch ^[1]			95-100
3/4 inch ^[1]			85-100
1/2 inch ^[1]	100	100	65-85
3/8 inch ^[1]	90-100	90 to 100	
No. 4 ^[1]	45-57	50-72	35-60
No. 8 ^[1]	30-45	30 to 55	25-48
No. 16 ^[1]	17-35	17 to 40	16-36
No. 30 ^[1]	12-25	12 to 30	12-30
No. 50 ^[1]	5-18	5 to 20	5 to 18
No. 100 ^[1]	2-10	2 to 12	2 to 10
No. 200 ^[1]			
Asphalt Binder ^[2]	5.8-10.0	5.0 to 10.0	4.0 to 9.0
F/A Ratio, max ^[3]	1.2	1.2	1.2
F-T Value ^[4]	+2	+2	
Blows ^[5]	50	50	50
Stability, min., pounds ^[5]	1200	1200	1200
Flow, 0.25 mm ^[5]	8 to 16	8 to 16	8 to 16
Design Air Voids ^[6]	3.5	3.5	4.0
VMA, min. ^[7]	16	16	13
[1] Sieve, percent passing [2] Percent of total mix [3] Using effective asphalt binder content [4] Percentage points maximum [5] T 245 [6] Percent, City Supplement 1036 [7] Percent, City Supplement 1037			

441.03 Use of Reclaimed Pavement. Comply with the requirements of [401.04](#).

441.04 Antistrip Additive. If the proposed JMF contains any gravel coarse aggregate, or contains more than 25 percent natural sand, or contains more than 20 percent reclaimed asphalt concrete pavement containing gravel coarse aggregate, or is designed according to [Item 442](#) conduct the following tests:

- A. Moisture damage potential test according to [City Supplement 1051](#).
- B. Washed gradation according to AASHTO T 11 as modified by [City Supplement 1004](#).
- C. Adherent fines test for each component according to ASTM D 5711.

Modify the mix with one of the following antistrip additives if the results of the moisture damage potential test show the Tensile Strength Ratio (TSR) of the asphalt concrete mix to be less than 0.80 for [442](#) mixes or 0.70 for all other mix types:

Liquid Antistrip Material. Include liquid antistrip material at a rate of 0.5 to 1.0 percent by weight of the asphalt binder. However, if [442](#) is specified, include liquid antistrip material at a rate of 0.50 to 1.25 percent by weight of the asphalt binder. Ensure the TSR of the asphalt concrete mix is greater than or equal to 0.80 after the addition of the liquid antistrip material.

Hydrated Lime. Include hydrated lime in the dry form at a rate of 1.0 percent by the dry weight of aggregate for asphalt concrete. Conform to AASHTO M 303, Type 1 for hydrated lime. Ensure the TSR of the asphalt concrete mix is greater than or equal to 0.80 after the addition of the hydrated lime. Provide the Engineer the following information for each shipment of hydrated lime: Letter of certification, Production date, Shipment date, Shipment destination, Batch or lot number and Net weight. The Laboratory may obtain samples of the hydrated lime at any time to verify quality. If the quality of the hydrated lime is in question, the Laboratory may require independent laboratory testing.

Include the antistrip additive in the mix design. Submit the following to the Laboratory with the proposed JMF:

- A. All TSR data (before and after the addition of the antistrip additive).

- B. Rate of addition of the liquid antistripping material, if used.
- C. If using liquid antistripping material submit product information, information on use by other State DOTs using the liquid antistripping material, and a letter of certification. If using hydrated lime submit certified test data showing the hydrated lime conforms to AASHTO M 303, Type 1.
- D. Results of the washed gradation test of the individual components of the mix used in determining the combined gradation.
- E. Results of the adherent fines testing for each component.

The Laboratory may perform additional tests on lab or plant produced mix according to City Supplements [1004](#) and [1051](#). If a change in the aggregate production is suspected, the City may require the Contractor to perform washed gradations on components and calculate adherent fines to determine the need for additional TSR review. Store and introduce antistripping additives into the plant according to [City Supplement 1053](#). Obtain Laboratory approval of the antistripping additive storage and feed systems prior to the start of production.

Provide delivery tickets to the Engineer at the end of the project and at the end of each construction year on a multiple year project. The Engineer will verify the number of pounds of antistripping additive used is within 10 percent of the calculated amount of antistripping additive required for the total weight of asphalt binder, based on the JMF, used in the asphalt concrete.

441.05 JMF Field Adjustments. During the first three days of production, the Contractor may adjust the JMF gradation within the below limits without a redesign of the mixture. For projects with less than 3 days of production, give the Laboratory written notice of any JMF gradation adjustments within 1 workday following the last day of production. Limit adjustments of the JMF to conform to actual production, without a redesign of the mixture, to ± 3 percent passing each of the 1/2 inch, No. 4, and No. 8 sieves and ± 1 percent passing the No. 200 sieve. Do not exceed the limits in [Table 441.02-1](#) and [Table 442.02-2](#) in the adjusted JMF. The adjustment on the 1/2 inch sieve applies only to the Type 2 mixes. Determine the need for any JMF gradation adjustments in the time specified. Should no adjustments be made, the City will base acceptance on conformance to the original JMF. After the time period specified, the City will allow no further adjustment of the JMF.

Should a redesign of the mixture become necessary, submit a new JMF according to the requirements for the initial JMF. Acceptance quantities will be based on each JMF production shift. Make any adjustment of this new JMF as provided for the original JMF. Record both the design JMF and the adjusted JMF in effect during production on the Quality Control Report. In the event that a new JMF is proposed and approved, also make a notation on the ticket for the first load produced under the new JMF.

441.06 Monitoring. The City will establish a Monitoring Team for the purpose of verifying all Contractor mixture production processes. Verification may be accomplished by obtaining split samples from Contractor QC or independent samples from the plant or roadway. If independent samples are taken split them for Contractor testing. If the mixture quality verifies then production may continue. If mixture quality does not verify then the Monitoring Team and Contractor will cooperatively investigate and resolve the problem. Whenever results are disputed, the City will investigate and conduct additional testing to resolve. Based on the Monitoring Team’s review, the Engineer may at any time disallow production to continue.

441.07 Quality Control Program. Submit a Quality Control Program (QCP) according to [403.03](#). Include an example control chart per [441.10](#) with the QCP. Use quality control technicians working in the plant lab during all mixture production and that are approved by the City. Technician approval will be according to [City Supplement 1041](#).

441.08 Testing Facilities. Provide testing facilities at the plant site conforming to [City Supplement 1041](#).

441.09 Quality Control Tests. Perform quality control tests to control the asphalt concrete mix within the specifications. As required by mix type, ensure that these quality control tests measure the asphalt binder content, gradation, air voids, and Maximum Specific Gravity (MSG) according to the Contractor’s approved QCP. Perform quality control testing according to the following schedule of testing based on material loaded for delivery during each shift:

0 to 100 tons	No testing required
101 to 200 tons	One “Basic” test per Item 403.05
201 to 500 tons	Complete set of QC tests per this section
501 to 1000 tons	Complete set of QC tests per this section
1001 to 1500 tons	Complete set of QC tests per this section

All QC testing requirements will be based on delivery ticket load times for material delivered to City of Columbus projects during a shift. No QC testing is required for shift quantities of less than 100 tons unless visual observations indicate a potential issue may exist with the mix. A shift is defined as one twelve-hour period starting at either 6:00 am or 6:00 pm. The basic test and first complete set of tests may be combined to account for the first 500 tons produced and loaded for the shift.

Perform more sampling and testing than the minimum specified at the start of production. Additionally perform more sampling and testing than the minimum during production when the quality control tests show the asphalt concrete being produced is outside the warning bands as shown in the Contractor’s approved QCP. Immediately resolve problems indicated by any test result exceeding the warning bands and immediately retest to validate corrections have returned the materials to within the warning band limits. The Contractor may determine the method of testing of the asphalt concrete beyond the minimum specified, and will detail the methods technicians will follow in the Contractor’s approved QCP.

Should additional testing as required above not be performed, the Engineer, after consultation with the Laboratory, will require the testing frequency be increased to all tests every two hours of production for the remainder of the project. If this occurs, the Engineer will request an opinion from the City Engineer for action(s) against the technician and/or Contractor including but not limited to warning, removal and/or a change of the facility to Unconditional Acceptance.

Record the results of every test performed.

Perform the required quality control tests as follows:

- A. Asphalt Binder Content.** Determine the asphalt binder content of a sample of asphalt concrete by performing an Asphalt Content (AC) Gauge test according to [City Supplement 1043](#). Make all printouts available for review by the Laboratory at any time. Offset the AC Gauge for each JMF on each project at the project's start. Perform the offset using the solvent extraction method for every QC sample according to [City Supplement 1038](#) and the AC Gauge Verification and Offset Record until the offset is established. Use solvent extraction according to [City Supplement 1038](#) when an AC Gauge problem exists and for testing cooled samples that cannot adequately be tested in an AC Gauge test.

Total, for each day's production, the flow meter printouts for SBR polymer added at the asphalt concrete mixing plant. Calculate the percent of polymer versus neat asphalt binder in the mix each day and record on the TE-199. Hold calculation worksheets and printouts in the plant laboratory for review by the Laboratory. A +/- 0.2 percent tolerance from the target amount of SBR polymer will be used as a guide for an acceptable amount of SBR polymer, but consistently low will not be acceptable. Only take SBR PG-Modified Binder samples using a five gallon bucket. Take 1 gallon to clean the valve port and discard. Take 2 gallons again, stir its contents and transfer to the required sample containers.

Determine the moisture content of the asphalt concrete for each AC Gauge test. Maintain the moisture content at 0.8 percent or less.

- B. Gradation.** Perform at least one gradation test each production day on aggregate remaining after removing the asphalt binder with a solvent from an asphalt concrete sample used in an AC Gauge test (solvent sample) or on aggregate remaining after removing the asphalt binder with a preapproved asphalt ignition oven according to [City Supplement 1054](#) and from an asphalt concrete sample used in an AC Gauge test (ignition oven sample). Use only an asphalt ignition oven to obtain an aggregate sample from an asphalt concrete sample having a polymer modified PG Binder. The Engineer may make an exception to this for SBS polymer as long as no issues arise. Correct each solvent sample for ash. Perform all other gradations on solvent samples, ignition oven samples, or on samples obtained according to the Contractor's approved QCP.

The gradation results of all the sieves must be representative of the JMF. If the Contractor fails to control the entire gradation, the Laboratory may require a redesign according to [441.02](#).

When the F-T value is specified for a mix in [441.02](#) calculate it for each gradation analysis. Maintain the F-T value at +4 percentage points or less for these mixes.

Calculate the F/A ratio for every solvent sample or ignition oven sample analysis. Maintain the F/A ratio so no F/A ratio is greater than 1.2 for all mixes. Use the asphalt binder content determined by the AC Gauge for calculating the F/A ratio. If the F/A ratio is greater than 1.0, recalculate the F/A ratio using the effective asphalt binder content. Calculate the effective asphalt binder content on the calculation sheet using the asphalt binder content determined by the AC Gauge and attach it to the Quality Control Report. Use bulk and effective aggregate specific gravities and remaining values needed in the calculation from the approved JMF. Do not deviate from these values without the Laboratory's approval. If the F/A ratio is greater than 1.0 for ignition oven samples, calculate the F/A ratio using the percent passing the No. 200 sieve from a washed gradation of the ignition oven sample according to AASHTO T 30.

- C. Air Voids and MSG.** Determine the air voids of the asphalt concrete by analyzing a set of compacted specimens and a corresponding MSG determination according to [City Supplement 1036](#). Ensure that the cure temperature and specimen compaction temperature are the same. Use a 1-hour cure for all mix samples used in voids analysis. The Contractor may use a 2-hour cure time if voids are consistently near the low void warning band. In this case, use the 2-hour cure for all voids testing through the remainder of the project. For hot mix asphalt use the JMF lab compaction temperature. For warm mix asphalt according to [402.04](#) use a lab compaction temperature 30.0 °F less than the JMF lab compaction temperature for hot mix asphalt. Use a compaction temperature tolerance of +/- 5.0 °F. Record on the TE-199 if the mixture produced was ran at the asphalt plant as a hot mix asphalt (HMA) or as a warm mix asphalt (WMA) produced according to [402.04](#) or another approved method.

Calculate the Voids in Mineral Aggregate (VMA) value for every set of compacted specimens according to [City Supplement 1037](#).

Calculate the average of all the MSG determinations performed each production day and report this average on the Quality Control Report. When the range of three consecutive daily average MSG determinations is equal to or less than 0.020 average these three average MSG determinations to determine the Maximum Theoretical Density (MTD). After the MTD is established, compare all individual MSG determinations to the MTD.

Whenever compacted specimens are to be made and an MSG determination is to be run, take a sample of sufficient size to run a corresponding AC Gauge test. When the air void and MSG test results are recorded reference them to the AC Gauge test of the sample.

- D. Other Requirements.** Supply proper containers and take two 1 quart asphalt binder samples from the first transport truck load of each different asphalt binder grade of the project before incorporation into the storage tank. Label the samples with binder grade, supplier, project number and date and retain them in the plant laboratory for future reference by the City. Discard the samples at the Project's Final Acceptance if not taken by the Laboratory.

Retain a split sample for each AC Gauge test and MSG test and all compacted specimens for monitoring by the City. Maintain MSG samples in the state described in ASTM D 2041, Section 9.2. The Contractor may dispose of the AC Gauge test samples after two days and all other split samples after seven days if the City does not process the split samples.

Measure the temperature of the mixture and record. Validate the results on the load tickets at least once during each hour of production.

The Contractor may conduct additional testing of any type. Record such additional testing along with all other quality control records and have these records readily available for the Laboratory’s review. The Laboratory may observe, review, and approve the procedures at any time.

441.10 Control Charts. Maintain up to date control charts showing each individual test result and also the moving accumulative range as follows:

- A. Plot tests showing the percent passing for the 1/2 inch, No. 4, No. 8, and No. 200 sieves the percent asphalt binder content, the MSG and the percent air voids. Round all percentages to the nearest whole percent; except, round asphalt binder content, the No. 200 sieve, and air voids to the nearest 0.1 percent.
- B. Show the out of specification limits specified in [Table 441.10-1](#) and QCP Warning Band Limits on the control charts.
- C. Label each control chart to identify the project, mix type and producer.
- D. Record the moving accumulative range for three tests under each test point on the chart for air voids and asphalt binder content. Accumulative range is defined as the positive total of the individual ranges of two consecutive tests in three consecutive tests regardless of the up or down direction tests take. If more than the minimum required testing (i.e. two tests per production day or night, [441.09](#) first paragraph) is performed do not include the result in accumulative range calculations.

Stop production and immediately notify the Laboratory when either E or F occurs:

- E. Any two tests in a row or any two tests in two days are outside of the specification limits of [Table 441.10-1](#).
- F. Any four consecutive moving accumulative ranges greater than specification limits of 2.50 percent for air voids or 0.60 percent for asphalt binder content occur.

Any mixture sent to the paving site without stopping production and notifying the Laboratory when required by this specification will be considered non-specification material.

Do not restart production until an adequate correction to remedy problems is in place and the Laboratory is satisfied. Following a shutdown restart production in a manner acceptable to the Engineer. When production problems cannot be solved within one day after a plant shut down, a Contractor’s representative holding Level 3 Asphalt City approval is required to be at the asphalt plant until a full production day is achieved with results satisfactory to the Laboratory.

TABLE 441.10-1

Mix Characteristic	Out of Specification Limits ^[5]
Asphalt Binder Content ^[1]	-0.3% to 0.3%
1/2 inch sieve ^[1]	-6.0% to 6.0%
No. 4 sieve ^[1]	-5.0% to 5.0%
No. 8 sieve ^[1]	-4.0% to 4.0%
No. 200 sieve ^[1]	-2.0% to 2.0%
Air Voids ^[2]	2.5% to 4.5%
Air Voids ^[3]	3.0% to 5.0%
MSG ^[4]	-0.012 to 0.012
^[1] deviation from the JMF ^[2] for Design Air Voids of 3.5% ^[3] for Design Air Voids of 4.0% ^[4] deviation from the MTD ^[5] unless otherwise restricted by mix type specification	

441.11 Quality Control Reports. Use Form TE-199 for the Quality Control Report. Record all test results on the Quality Control Report. Document all decisions regarding responses to test results on the Quality Control Report (referring to the particular test), including reasons why a particular problem may exist what action was taken to correct the problem (plant operation or testing), and what communication with City personnel took place. Submit one Quality Control Report to the Engineer no later than specified. Retain copies of all records documenting the quality control inspections and tests throughout the life of the Contract and furnish them to the Engineer on request.

441.12 Mixture Deficiencies. Control all production processes to assure the Engineer that the mixture delivered to the paving site is uniform in composition; within the specification requirements and limits; conforms to the JMF; and that the placed mixture is free of any defect (ex. segregation, tenderness, lack of mixture and/or texture uniformity, raveling, flushing, rutting, holes, debris etc.) within the Contractor’s control. Correct obvious pavement problems according to [401.15](#). If the City has any suspicion that other mixture composition or pavement problems exist, the Laboratory will conduct an initial investigation through review of data and sampling of the asphalt pavement. Should a City investigation determine that the Contractor’s QCP is not controlling the mixture in a manner to achieve mixture quality as described above the Contractor quality control data may be rejected. In that case the City will conduct a thorough investigation by testing samples from the roadway and use those test results in determining disposition of the non-specification material.

A mixture is not uniform in composition if multiple random non-specification individual tests or any four consecutive non-specification moving accumulative ranges exist. The mixture can be rejected, production can be stopped and/or a redesign can be called for by the City. The Laboratory

will not approve any redesign it determines is unsatisfactory to provide acceptable mix performance. Submit this new design for approval according to [441.02](#) and at no additional cost to the City.

When any out of specification material, based on quality control tests not within the limits of [Table 441.10-1](#), is sent to the paving site, the Engineer will determine disposition of the material according to [105.03](#).

441.13 Acceptance. The City will base acceptance of the asphalt concrete mix on the item specified in the Contract item description. (i.e. [Item 446, 448](#)).

441.14 Basis of Payment. The City will pay for accepted quantities at the contract prices as follows:

Item	Unit	Description
441	Cubic Yard	Asphalt Concrete Surface Course, Type 1, (), PG64-22
441	Cubic Yard	Asphalt Concrete Surface Course, Type 1, (), PG70-22M
441	Cubic Yard	Asphalt Concrete Intermediate Course, Type 1, ()
441	Cubic Yard	Asphalt Concrete Intermediate Course, Type 2, ()

ITEM 442 SUPERPAVE ASPHALT CONCRETE

- [442.01](#) Description
- [442.02](#) Type A Mix Design
- [442.03](#) Type B Mix Design
- [442.04](#) Asphalt Binder
- [442.05](#) Quality Control
- [442.06](#) Acceptance
- [442.07](#) Basis of Payment

442.01 Description. This work consists of gyratory mix design, material, and quality control requirements for constructing a Superpave asphalt concrete pavement surface or intermediate course. The asphalt concrete pavement course consists of aggregate, and asphalt binder mixed in a central plant and spread and compacted on a prepared surface.

The requirements of [Item 441](#) apply, except as modified by this specification.

442.02 Type A Mix Design. Design the mixture composition for a Type A mix according to [441.02](#) and the most recent Asphalt Institute Manual Series No. 2 (MS-2) for design procedures and material properties except as modified by this subsection. Include in the JMF submittal the standard City cover and summary page; all printouts from the gyratory compactor (all gyratory points not necessary); and analysis covering the required mix properties.

The Contractor may use the Marshall flow test in design as an indicator of potential for excess tenderness.

Supply aggregate according to the lane current average daily truck traffic (Lane ADTT) as follows unless otherwise shown on the plans:

$$\text{Lane ADTT} = \text{Current ADT} \times T_{24} \times 0.45$$

Where:

- Current ADT = current average daily traffic count from the plans
- T₂₄ = percent trucks per day from the plans

TABLE 442.02-1 GYRATION LEVEL AND MATERIAL REQUIREMENTS

Lane ADTT	Nini	Ndes	Nmax	Coarse Aggregate Angularity	Fine Aggregate Angularity	Flat and Elongated Particles	Sand Equivalent
<4000	7	65	105	95 ^[1] / 90 ^[2]	44	10	45
>4000	7	65	105	100 ^[1] / 100 ^[2]	44	10	50
[1] Percent fractured (one or more faces) according to ASTM D5821							
[2] Percent fractured (two or more faces) according to ASTM D5821							

If fine aggregate is from crushed carbonate stone or air-cooled blast furnace slag, the City will not require the fine aggregate angularity (FAA) test. The City will allow a blend of a material not meeting the FAA with a material that meets the FAA, but calculate the FAA result based on the individual City FAA results and actual blend percentages. Obtain City approval of any blends.

The restricted zone does not apply. Use control points according to MS-2, except as specified in [Table 442.02-2](#).

TABLE 442.02-2 AGGREGATE GRADATION REQUIREMENTS

Sieve Size		9.5 mm mix	12.5 mm	12.5 mm	19 mm mix
			Surface Course mix	Intermediate Course Mix	
Total Percent Passing					
1 1/2 inch	(3.75 mm)	–	–	100	100
3/4 inch	(19 mm)	–	100	95 to 100	85 to 100
1/2 inch	(12.5 mm)	100	95 to 100	90 to 100	90 max
3/8 inch	(9.5 mm)	90 to 100	96 max	89 max	–
No. 4	(4.75 mm)	70 max	52 to 60 ^[1]	60 max	–
No. 8	(2.36 mm)	34 to 52	34 to 45	34 to 45	28 to 45
No. 200	(75 µm)	2 to 8	2 to 8	2 to 8	2 to 6

[1] For the No. 4 sieve, do not exceed 63 in production.

Ensure that the F/A ratio is a maximum of 1.2. Use a 2-hour cure for the mix design.

If more than 15 percent fine aggregate not meeting FAA is used, perform a loaded wheel test (LWT) according to [City Supplement 1057](#). To estimate a LWT sample mix volume, use the bulk density from gyratory specimens at N_{des}. Deformation less than 0.20 inch (5.0 mm) at 120 °F (49 °C) are considered passing for PG 58-28 and PG 64-22 mixes. Deformation less than 0.12 inch (3.0 mm) at 120 °F (49 °C) are considered passing for all other mixes.

The Contractor may use reclaimed asphalt concrete pavement according to [401.04](#). Test design volumetric properties at N_{des}. Test N_{max} for the required criteria. Ensure that the VMA is not less than the minimum values of [Table 442.02-3](#).

TABLE 442.02-3 VMA CRITERIA

Mix	VMA (percent minimum)
9.5 mm	15.0
12.5 mm Surface	14.0
12.5 mm Intermediate	14.0
19.0 mm	13.0

442.03 Type B Mix Design. Apply the mix design specified in [442.02](#) for a Type A mix except as modified by this subsection:

Modify the Coarse Aggregate Angularity of [Table 442.02-1](#) according to [Table 442.03-1](#).

TABLE 442.03-1

Lane ADTT	Coarse Aggregate Angularity
<4000	65 ^[1] /65 ^[2]
>4000	75 ^[1] /70 ^[2]

[1] Percent fractured (one or more faces) according to ASTM D5821
 [2] Percent fractured (two or more faces) according to ASTM D5821

Ensure that at least 50 percent by weight of virgin fine aggregate is aggregate meeting FAA or is crushed carbonate stone or air-cooled blast furnace slag. Modify the No. 8 sieve requirement for a 12.5 mm surface course mix in [Table 442.02-2](#) to 34 to 40 percent. Apply an F-T value of +2 according to [441.02](#) and [441.09](#).

442.04 Asphalt Binder. Use a PG 70-22M asphalt binder for surface courses and a PG 64-28 asphalt binder for 19.0 mm intermediate courses. For 12.5 mm intermediate courses use a PG 64-22 asphalt binder for 25 percent or less RAP, and a PG 64-28 asphalt binder for more than 25 percent RAP.

The minimum total asphalt binder content for a surface course is 5.8 percent. For 12.5 mm intermediate courses, the minimum total asphalt binder content is 5.4 percent and the minimum total virgin asphalt binder content is 3.5 percent. The minimum total asphalt binder content for a 19.0 mm is 4.6 percent.

442.05 Quality Control. Conform to [441.09](#), except as specified in this subsection. Ensure that plant operation and quality control testing conform to the Contractor’s Quality Control Program (QCP).

For 12.5mm mixes, ensure the percent passing the No. 4 sieve does not exceed 63 in production. If two tests in a row or any two tests in two days (QC and/or [448](#) day’s production) exceed 63, stop production and notify Laboratory.

Use a gyratory compactor conforming to the requirements of Superpave. If the gyratory compactor was moved to the plant before production, calibrate it and present the results to the Laboratory.

Determine bulk gravity for air voids determination on specimens compacted to N_{des}.

If the design gradation requires an LWT test, take a sample sufficient to run a LWT test once each day for the first 3 days and test it according to [City Supplement 1057](#). The Contractor may perform the LWT test in the Contractor’s Level 2 laboratory, but must compact the sample the same

day the sample was taken, cure it overnight, and test it the following day. Give the test result and sample density to the Engineer the day of the LWT test. Report the LWT data on the Quality Control Report.

442.06 Acceptance. The City will base acceptance of the asphalt concrete mix on the method specified in the Contract line item description (i.e. [Item 446, 448](#)).

442.07 Basis of Payment. The City will pay for accepted quantities at the contract prices as follows:

Item	Unit	Description
442	Cubic Yard	Asphalt Concrete Surface Course, (____ mm), Type __ (____)
442	Cubic Yard	Asphalt Concrete Intermediate Course, (____ mm), Type __ (____)

ITEM 446 ASPHALT CONCRETE CORE DENSITY ACCEPTANCE

[446.01](#) Description

[446.02](#) Monitoring

[446.03](#) Reports

[446.04](#) Density Acceptance

[446.05](#) Joints

446.01 Description. This specification describes the acceptance criteria for asphalt concrete surface and intermediate courses. The City will base acceptance of the compacted mixture in place on the level of density attained as sampled by the Contractor and analyzed by the City.

446.02 Monitoring. If there is poor comparison between the City's comparison samples and the Contractor's quality control tests, the Monitoring Team may at any time disallow acceptance to continue under [Item 446](#). In this case, accept per [Item 448](#) and [Item 446](#). The City will notify the Contractor in writing to stop production.

446.03 Reports. Submit the Quality Control Report according to [441.11](#) on the workday following the production day of the material represented by the report.

446.04 Density Acceptance. The requirements of [401.13](#) do not apply. However, rollers must fully and satisfactorily provide the required compaction, be mechanically sound, and meet Asphalt industry standards. The City retains the right to reject the use of rollers which are not in good repair, or are not designed to do the work required. A three-wheel roller according to [401.17](#) is not required.

Obtain ten, 4-inch cores for the City to test to determine the in-place density of the compacted mixture as a percentage of the average QC Maximum Specific Gravity (MSG) for the production day the material was placed. If City MSG VA tests show poor comparison to the average QC MSG according to [403.06](#), use City determined MSG results in the density calculation for each production day. Compact shoulders using the same equipment and procedures as used on the mainline pavement. The requirements of [401.16](#), except for the last four paragraphs, are waived.

Payment for compaction of all asphalt placed is by daily production, based upon the degree to which density is attained. Payment for shoulders depends on the degree to which the density is obtained on the adjacent mainline pavement lane or ramp. However, when a cold longitudinal joint is made between a mainline pavement lane and an adjoining shoulder, payment for the shoulder will be based on the degree to which the density is obtained on the shoulder.

A day's production consists of an area of pavement placed during a production day, including the shoulders. If less than 300 tons is produced in a production day, then that production day is combined with the next production day into a day's production. If less than 300 tons is produced on the last production day for the project, it is part of the previous day's production for acceptance.

Within 48 hours after the pavement is placed or prior to opening to traffic, obtain ten cores for each day's production at random locations the Engineer determines. Only obtain core samples in the presence of the Engineer and immediately surrender each core sample to the Engineer for testing. The Engineer will divide a day's production into ten equal sections and designate one random core location in each section. Both mainline pavement and ramps will be included in the day's production determinations. The Engineer will not give the Contractor random core locations early in the placement. Cores will be taken as follows. Three cores will be taken from cold longitudinal joints (joint cores) and seven cores will be taken from the mat (mat cores). Do not take joint cores from ramp joints. Take joint cores from the first, last and randomly from one of the remaining sections. Except where notched wedge joints are used, take joint cores such that the core's closest edge is 4 inches from the edge of the mat. Obtain the mat cores from at least twelve inches away from the longitudinal joint. Locate cores obtained for Contractor quality control (QC sister core) longitudinally from and within four inches of the random core. In addition to the QC sister cores, three/five extra cores may be taken from the first day's production of a JMF for testing to correlate density gauges. Do not take additional cores beyond what is noted above unless clearly identified in the Contractor's QCP. Clearly label all cores with mat locations so that they may be readily identified. Any unlabeled cores may be destroyed by the City. Notify the Laboratory if any questions arise. Do not store additional cores anywhere (project, in vehicles or at the plant) beyond those required to be taken for testing. Test all Contractor QC cores and maintain records of all tests (core tests and correlated gauge tests) per the QCP. Destroy all cores immediately after testing is complete.

Notched Wedge Joints: When notched wedge joint construction is used, do not take cores on the sloped face of the wedge before the adjoining lane (matching pass) is placed. Take cores such that the core's closest edge is six inches from the edge of the joint upper notch. When a nine inch or wider wedge joint is used, take the core three inches from the upper wedge joint notch.

The City will determine the pay factor for each day's production cored by the pay schedule in [Table 446.04-1](#) for daily production with three cold longitudinal joint cores and [Table 446.04-2](#) for daily production with less than three cold longitudinal joint cores. The City will verify the

Maximum Theoretical Density (MTD) if the MSG determination has a deviation from the MTD of less than or equal to 0.020. If the MTD is not verified, establish a new MTD according to the procedures established in [441.09](#). If less than 10 cores are available for determining the mean, the City will determine disposition of the day's production.

Fill core holes by the next workday with hot-mix asphalt concrete. Before filling, ensure the holes are dry and tack them with asphalt material conforming to [407.02](#). Properly compact the asphalt concrete used for filling the hole and leave it flush with the pavement.

TABLE 446.04-1 FOR DAY'S PRODUCTION WITH 3 COLD JOINT CORES

Mean of Cores ^[1]	Pay Factor	
	Surface Course	Intermediate Course
98.0% or greater	[2]	[2]
97.0 to 97.9%	0.94	[2]
96.0 to 96.9%	1.00	0.94
93.4 to 95.9%	1.04 ^[4]	1.00
92.4 to 93.3%	1.00	1.00
91.4 to 92.3%	0.98	1.00
90.4 to 91.3%	0.90	0.94
89.4 to 90.3%	0.80	0.88
88.4 to 89.3%	[3]	[3]
Less than 88.4%	[2]	[2]

[1] Mean of cores as percent of average MSG for the production day.
 [2] For surface courses, remove and replace. For other courses, the City will determine whether the material may remain in place. If the City determines the course should be removed and replaced, the Contractor will remove and replace this course and all courses paved on this course. The pay factor for material allowed to remain in place is 0.60.
 [3] The City will determine whether the material may remain in place. If the City determines the course should be removed and replaced, the Contractor will remove and replace this course and all courses paved on this course. The pay factor for such material allowed to remain in place is 0.70.
 [4] No incentive will be paid if any single cold joint core is less than 91.0%.

TABLE 446.04-2 FOR DAY'S PRODUCTION WITH LESS THAN 3 COLD JOINT CORES

Mean of Cores ^[1]	Pay Factor	
	Surface Course	Intermediate Course
98.0% or greater	[2]	[2]
97.0 to 97.9%	0.94	[2]
96.0 to 96.9%	1.00	0.94
94.0 to 95.9%	1.04 ^[4]	1.00
93.0 to 93.9%	1.00	1.00
92.0 to 92.9%	0.98	1.00
91.0 to 91.9%	0.90	0.94
90.0 to 90.9%	0.80	0.88
89.0 to 89.9%	[3]	[3]
Less than 89.0%	[2]	[2]

[1] Mean of cores as percent of average MSG for the production day.
 [2] For surface courses, remove and replace. For other courses, the City will determine whether the material may remain in place. If the City determines the course should be removed and replaced, the Contractor will remove and replace this course and all courses paved on this course. The pay factor for material allowed to remain in place is 0.60.
 [3] The City will determine whether the material may remain in place. If the City determines the course should be removed and replaced, the Contractor will remove and replace this course and all courses paved on this course. The pay factor for such material allowed to remain in place is 0.70.
 [4] No incentive will be paid for a day's production where 3 joint cores are required to be taken but less than 3 cores are taken.

446.05 Joints. Construct joints according to [401.17](#). Make a hot longitudinal joint between the mainline pavement lane and the adjoining shoulder and all ramps and the adjoining shoulders. If a hot longitudinal joint is specified between the mainline pavement lanes, the Contractor may construct a cold longitudinal joint between the mainline pavement lanes and the adjoining shoulders. Cold longitudinal joints in mainline pavement will be tested according to [446.04](#).

ITEM 448 ASPHALT CONCRETE ACCEPTANCE

[448.01](#) Description

[448.02](#) Density

[448.03](#) Reports

[448.04](#) Acceptance

448.01 Description. This specification describes the acceptance criteria for asphalt concrete surface and intermediate courses. The City will determine acceptance of the mixture by daily production, based on the composition of random samples taken and tested by the Contractor and verified by the City.

448.02 Density. Conduct density gauge quality control testing on the asphalt mat according to [City Supplement 1055](#). Conduct density gauge testing on uniform courses of 1.0 in or more plan thickness. Conduct density gauge testing on projects with a daily minimum of 200 tons of paving (excepting bridges, intersections, etc.). Do NOT enter a density gauge offset of any kind into the gauge. If an offset is already in the gauge remove it. Verify to the Engineer daily that no offset is present in the gauge. All values used in controlling mat density according to [City Supplement 1055](#) will be as calculated and written on forms supplied in [City Supplement 1055](#).

When [City Supplement 1055](#) density gauge testing is required, the requirements of [401.16](#), except the last four paragraphs, are waived. The requirements of [401.13](#) do not apply. However, rollers must fully and satisfactorily provide the required compaction, be mechanically sound, and meet Asphalt industry standards. The City retains the right to reject the use of rollers which are not in good repair, or are not designed to do the work required. A three-wheel roller per [401.17](#) is not required.

448.03 Reports. Refer to [Item 403](#) for reporting requirements of asphalt mixtures tested at the asphalt plant. Report density gauge QC testing results according to [City Supplement 1055](#).

448.04 Acceptance. Refer to [Item 403](#) for acceptance requirements. If a project includes [448.02](#) Density, acceptance will include any density deductions according to [City Supplement 1055](#).

450 RIGID PAVEMENT

ITEM 451 REINFORCED PORTLAND CEMENT CONCRETE PAVEMENT

- [451.01](#) Description
- [451.02](#) Materials
- [451.03](#) Not Used
- [451.04](#) Equipment
- [451.05](#) Setting Forms
- [451.06](#) Fine Grading of Subgrade or Subbase
- [451.07](#) Placing Concrete
- [451.071](#) Depositing and Curing Concrete during Cold Weather
- [451.08](#) Placing Reinforcement
- [451.09](#) Joints
- [451.10](#) Finishing
- [451.11](#) Curing
- [451.12](#) Removing Forms
- [451.13](#) Surface Smoothness
- [451.14](#) Profile Grinding
- [451.15](#) Pavement Grooving Corrections
- [451.16](#) Sealing Expansion Joints
- [451.17](#) Opening to Traffic
- [451.18](#) Pavement Thickness and Concrete Strength
- [451.19](#) Price Adjustments
- [451.20](#) Method of Measurement
- [451.21](#) Basis of Payment

451.01 Description. This work consists of constructing a pavement composed of reinforced portland cement concrete on a prepared surface.

451.02 Materials. Furnish materials conforming to:

Concrete, either Class COC 1, or COC MS	499
Joint sealer.....	705.04
Preformed filler	705.03
Curing materials	705.05 , 705.06 , 705.07 Type 2
Tiebar steel, epoxy coated.....	709.00
Reinforcing steel.....	709.09 , 709.10 , 709.12
Dowel bars and basket assemblies	709.13

451.03 Not Used.

451.04 Equipment. Furnish self-propelled spreading and finishing machines capable of consolidating and finishing the concrete and producing a finished surface meeting the requirements specified. Ensure that all paving equipment is operated in a manner that does not result in segregation of the mixture or loss of air entrainment in the mixture.

Construct pavement using either fixed forms or slip form paving equipment that conforms to the following:

- A. Fixed Form Construction.** Spread, screed, and consolidate concrete using one or more machines between previously set side forms. Furnish an adequate number and capacity of machines to perform the work at a rate equal to the concrete delivery rate. Furnish machines capable of uniformly distributing and consolidating the concrete without segregation.

Provide machines capable of operating on two side forms, on adjacent lanes of pavement and one side form, or on two adjacent lanes as necessary. When placing concrete adjacent to an existing pavement lane, take measures to protect the adjacent pavement from damage. Remove from the work any machine that causes displacement of the side forms from the line or grade or causes undue delay, as determined by the Engineer, due to mechanical difficulties.

Finish small areas, irregular areas, and areas that are inaccessible to finishing equipment using other methods as approved by the Engineer. Accomplish vibration of these areas using hand held or machine mounted internal vibrators. Continue vibration to achieve adequate consolidation, without segregation, for the full depth and width of the area placed.

Use straight edge side forms made of steel and of a depth equal to the specified pavement thickness. Do not use bent or damaged side forms or forms with damaged joint locks or pin pockets. Clean and oil all forms each time they are used. Provide forms in sections of not less than 10 ft in length without horizontal joints in the height of the form. Utilize forms with a nominal base width of at least 3 inches. Ensure forms are capable of supporting the paving equipment without shifting or deforming during paving. If the radius of the circular pavement edge is 100 feet or less, use flexible or curved forms of a design acceptable to the Engineer. Provide adequate devices to securely set forms and withstand operation of the paving equipment. Do not use built-up forms except to construct pavement of a specified thickness whose total area for the project is less than 2000 square yards. Provide forms with adequate joint locks to tightly join ends of abutting form sections together.

- B. Slip Form Construction.** Place concrete using an industry-standard slip form paver designed to spread, consolidate, screed, and finish the freshly placed concrete in one complete pass of the machine and with a minimum of hand finishing providing a dense and homogeneous pavement.

Consolidate the full width and depth of concrete pavement placed by a single pass of approved internal vibrators. Operate the vibrators at a frequency range of 7000 to 11,000 impulses per minute. Attach vibrators to either the spreading or finishing equipment in such a manner that they do not come in contact with preset dowel basket assemblies, the subgrade, reinforcing mesh, or side forms. Do not operate vibrators in a manner to cause a separation of the mix ingredients (segregation); i.e., either a downward displacement of large aggregate particles or an accumulation of laitance on the surface of the concrete. Avoidance of segregation may require reduction in the vibration frequency within the range specified when forward motion of the paver is reduced. Connect the power to all vibrators so they stop when the machine motion is stopped. Stop paving operations if any vibrator fails to operate within the above specified range.

Provide an electronic monitoring device that displays the operating frequency of each internal vibrator when paving mainline, ramps, acceleration/deceleration lanes, and collector/distributor lanes. Ensure the monitoring device has a readout display near the paver operator's controls visible to the operator and the Engineer. Operate the monitoring device continuously while paving and display all vibrator frequencies with manual or automatic sequencing among individual vibrators. Using the monitoring system, record the following minimum information: time of day, station location, paver track speed, and the frequency of each individual vibrator. Make recordings after each 25 feet of paving or after 5-minute intervals of time. If not using a monitoring system with a recorder, make and record readings every 30 minutes. Provide vibration data, in electronic format, to the Engineer prior to the next concrete placement.

Electronic vibration monitoring devices are not required for paving machines used to construct shoulders, gores, or for any construction project with a total of less than 10,000 square yards of pavement. When electronic monitoring devices are not required, use a tachometer or similar device to demonstrate to the Engineer the paving equipment vibration meets specification.

Operate the slip form paver with as nearly a continuous forward movement as possible. Coordinate all operations of mixing, delivering, and spreading concrete to provide uniform progress with minimal stopping and starting of the paver. If for any reason it is necessary to stop the forward movement of the paver, immediately stop the consolidation devices. Unless controlled from the machine, do not apply any other tractive force to the machine.

Accurately control the finish grade of the pavement from a pre-set grade line parallel to the finish grade. Use equipment with controls that will trace the grade line and automatically adjust the grade of the screed.

In areas where adjoining concrete pavement is to be constructed, ensure that the surface at the edge of the pavement on either side of the longitudinal joint does not vary more than 1/4 inch below the typical section. Ensure that the outside edges of the pavement does not vary more than 1/2 inch below the typical section. Ensure that all pavement edges are nearly vertical with no projections or keyways exceeding 1/2 inch.

In the area of construction joints placed at the end of the days run, the Engineer will allow a reduction of approximately 2 inches in overall width.

451.05 Setting Forms. Set all forms in conformance to the required grade and alignment. Ensure the entire length of the forms is supported on thoroughly compacted material for the entire operation of placing and finishing the concrete. Set side forms with the top face of the form varying not more than 1/8 inch in 10 feet from true plane, and the vertical face varying not more than 1/4 inch in 10 feet from true plane. Test the forms for variations from the above requirements and reset as necessary. Do not use loose earth, pebbles, etc., to shim the forms. Immediately before placing concrete, the Engineer will approve the alignment and grade of all forms set.

451.06 Fine Grading of Subgrade or Subbase.

- A. Fixed Form Construction.** After side forms have been set to line and grade and securely fastened, use a subgrade or subbase planer to remove a slight amount of material and bring the surface to final grade and a smooth dense condition. Check the subgrade or subbase using a multiple pin template operated on the forms or other methods approved by the Engineer. Correct and retest all high or low spots.

Instead of the above operation, the Contractor may place forms on subgrade or subbase prepared according to [451.06.B](#).

- B. Slip Form Construction.** After the subgrade or subbase is placed and compacted to the required density, use an automatic subgrading machine to cut the areas for pavement and the areas that will support the paving machine to the plan elevation. Construct the grade sufficiently in advance of placing the concrete to permit the Engineer to check the grade.

451.07 Placing Concrete. When constructing on subgrade or subbase, immediately before placing concrete, bring the surface to a thoroughly moistened condition by sprinkling with water as directed by the Engineer.

When constructing on asphalt concrete, coat the surface with curing membrane at least one day prior to placing concrete. Apply the curing membrane at a minimum rate of 1 gallon for each 150 square feet of surface treated using an approved self-propelled mechanical sprayer. Provide an adequate shield to protect the fog spray from the wind. Thoroughly agitate the curing material before use.

Deposit concrete on the grade in a manner that requires as little rehandling as possible. Do not allow workers to walk in the freshly mixed concrete unless wearing clean boots or shoes, free of earth or any foreign material.

When using dowel basket assemblies, place concrete in such a manner that the assemblies are not disturbed. Do not allow concrete to discharge onto any dowel basket assembly unless the hopper is well centered on the assembly. Use a separate internal vibrator to consolidate concrete around dowel basket assemblies.

Provided the curing compound damage caused by sawing is repaired according to [451.11](#) and to the Engineer's satisfaction, the Contractor may operate the sawing equipment necessary to saw joints on the newly constructed pavement. Do not operate mechanical equipment other than saws on newly placed concrete pavement prior to opening to traffic according to [451.17](#). If only finishing equipment is carried on an existing lane, paving adjacent lanes may be permitted after that lane has been in place for at least 3 days and after test cylinders have attained a split tensile strength of 350 pounds per square inch, as tested per ASTM C496.

When the width of pavement being placed in one operation is 12 feet or more and the total area of any given width of pavement on the project exceeds 10,000 square yards and at the direction of the Engineer, use a separate standard manufacture, self-propelled concrete placer/spreader that receives concrete into a hopper adjacent to the area to be paved, delivers the concrete in front of the slipform paver, and uniformly spreads the concrete at the proper thickness for the full width being paved. When a slipform paver is equipped with a dowel bar inserter, the separate placer/spreader requirement may be waived provided the concrete is delivered in front of the slipform paver at a consistent and uniform thickness for the full width being paved and the slipform paver is capable of spreading, consolidating, screeding, and float finishing the freshly placed concrete. Provide the Engineer documentation that the slipform paver will meet this specification.

Do not mix, place, or finish concrete after dark without operating an adequate and approved lighting system.

When the air temperature is 35 °F or below, ensure the concrete has a temperature of between 50 and 80 °F at the point of placement.

When the air temperature is greater than 35 °F before placing, maintain a concrete temperature of not more than 95 °F.

Do not place concrete on any surface that is frozen or has frost.

Make one set of 4 test cylinders for each 100 cubic yards for miscellaneous concrete including but not limited to walls, curbs, and steps, and 250 cubic yards for residential and arterial bases and pavements.

451.071 Depositing and Curing Concrete during Cold Weather. When an atmospheric temperature of 35° F or less exists at the time concrete is placed, or is predicted by weather forecasts to occur during the curing period, the following procedures shall apply:

1. Heat the water or aggregate or both as necessary to make the temperature of the concrete not less than 50° F nor more than 80° F when placed.
2. Once placed, cover the entire surface of the top and the sides of the newly placed concrete and protect from freezing for seven days, unless split tensile specimens have attained the required minimum strength specified. Accomplish protection as directed in [511.12](#) with insulated blankets or with a combination of loose straw 12 inches thick covered with a securely fastened exterior cover of waterproof material.
3. During the initial 24 hours of protection for base concrete only ([Items 305](#) and [306](#)), the Contractor may use a layer of waterproof material provided the atmospheric temperature is not expected to fall below 25° F and is expected to rise above 35° F during that period. If the temperature falls below 25° F in the initial 24 hours, use full protection as described above.
4. Cure the concrete by maintaining the surface temperature between 50° F and 100° F for a period of not less than 5 days, except as modified below for concrete flooded with water. At the end of this curing period, reduce the temperature at a rate not to exceed 20° F in 24 hours until it is within 20° F at atmospheric temperatures.
5. If High-Early Strength concrete is desired and approved for the placement, the Contractor may use, at no expense to the City, additional cement in combination with calcium chloride in lieu of High-Early Strength Cement, Type III.
6. Furnish and install sufficient thermometers in such a manner that the surface temperature of the concrete may be readily determined. The Engineer will read and record the thermometers.

451.08 Placing Reinforcement. Place pavement mesh of the size and at the locations within the concrete slab shown on [ODOT's Standard Drawing BP-1.1](#). When placing reinforced concrete pavement in two layers, strike off the entire width of the bottom layer to a length and depth that allows laying the mat of reinforcement on the concrete and in its final position without further manipulation. After installing reinforcement directly upon the concrete, place, strike off, and screed the top layer of concrete. When reinforced concrete pavement is placed in one layer and in advance of placing concrete, position and securely anchor the reinforcement to the underlying base or pavement. As an alternative, after spreading the concrete and while it is in a plastic condition, use mechanical or vibratory means to place reinforcement in the concrete.

Where reinforcement is overlapped, securely fasten mats of reinforcement together at the edges of the sheets and at two additional points along the lap. Use reinforcing steel free from dirt, oil, paint, and grease.

451.09 Joints. Unless otherwise directed, construct all transverse joints normal to the centerline of the pavement lane and of the type, dimensions, and at locations specified.

Determine contraction and longitudinal joint sawing time limits to protect the concrete from early cracking. Provided the curing compound damage caused by sawing is repaired according to [451.11](#) and to the Engineer's satisfaction, the Contractor may operate the sawing equipment necessary to saw joints on the newly constructed pavement.

Accurately mark both edges of the pavement with the correct locations of all joints to be saw cut. Ensure the method of marking remains clearly visible after the paver passes and until the joint saw cut is completed.

A. Longitudinal Joint. Construct longitudinal joints between simultaneously placed lanes by sawing.

When a standard (water cooled diamond bladed) concrete saw is used to make the longitudinal joint between simultaneously placed lanes, saw the joint within three (3) days of placing pavement. For pavement less than or equal to 10 inches, saw the joint to a minimum

depth of one-fourth the specified pavement thickness. For pavements greater than 10 inches thick, saw the joint to a minimum depth of one-third the specified pavement thickness. Saw joints $1/4 \pm 1/16$ inch wide measured at the time of sawing.

When using early-entry (dry cut, light weight) saws to make the longitudinal joint between simultaneously placed lanes, only use saw blades and skid plates as recommended by the saw manufacturer for the coarse aggregate type being used in the concrete. Perform the early-entry sawing after initial set and before final set. Saw the joint $1/8$ inch wide and $2 \ 1/4$ to $2 \ 1/2$ inches deep.

Place deformed epoxy coated steel tiebars, epoxy coated hook bolt with epoxy coated coupling, or epoxy coated hook bolt alternate (wiggle bolt) with epoxy coated coupling, in longitudinal joints during consolidation of the concrete. Install them at mid-depth in the slab by approved mechanical equipment. As an alternate procedure, rigidly secure them on chairs or other approved supports to prevent displacement. Provide tie bars, hook bolts, or wiggle bolts of the size and spaced as shown on the standard drawings. If used, securely fasten hook bolts or wiggle bolts with couplings to the form at the longitudinal construction joint as shown on the Standard Drawings.

B. Transverse Joints. Unless otherwise directed, construct all transverse joints normal to the centerline of the pavement lane and of the type, dimensions, and at locations specified.

For all transverse joints, install round, straight, smooth, steel dowel bars of the size shown in [Table 451.09-1](#).

TABLE 451.09-1 DOWEL SIZE

Thickness of Pavement (T)	Diameter of Solid Dowel
Less than 8 1/2 inches	1 inch
8 1/2 to 10 inches	1 1/4 inches
Over 10 inches	1 1/2 inches

Within 2 hours prior to placing concrete around the dowels, coat the full length of all preset dowels with a thin uniform coat of new light form oil as a bond-breaking material.

1. Load Transfer Assemblies.

Use load transfer (dowel basket) assemblies in transverse contraction joints conforming to and placed according to the standard drawings to hold the dowels in a position parallel to the surface and centerline of the slab at mid-depth of the slab thickness.

Preset all dowel basket assemblies before the day’s paving unless the Engineer determines complete presetting is impractical.

Completely install dowel basket assemblies before shipping and spacer wires are removed. Immediately before paving, remove all shipping and spacer wires from the dowel basket assemblies, check that the assemblies are held firmly in place, and check that the dowels are parallel to the grade and parallel to centerline of pavement.

For each load transfer assembly, provide a continuous assembly between longitudinal joints or between the longitudinal joint and pavement edge. Drive at least eight 1/2-inch diameter steel pins a minimum of 18 inches long at an angle to brace the assembly from lateral and vertical displacements during the placing of concrete. Drive two of these pins opposite each other at each end of the assembly, and drive the remaining pins in staggered positions on each side of the assembly. Where it is impractical to use the 18-inch length pins, such as where hardpan or rock is encountered, and provided the assembly is held firmly, the Engineer may authorize use of shorter pins. Where the dowel basket assembly is placed on material that may allow settlement or distortion, anchor the assembly with a combination of pins and steel plates, or by some other means satisfactory to the Engineer to prevent settlement.

When concrete pavement is placed on an existing concrete pavement or on a stabilized base, secure dowel basket assemblies from lateral and vertical displacement during concrete placement using power-driven fasteners and appropriate clips or pins driven in predrilled holes of a diameter slightly less than the pin diameter. Use either of the above methods or a combination of the two in sufficient numbers to adequately secure the basket assemblies.

Where widths other than 12 feet are specified, the Contractor may use standard dowel basket assemblies with dowel spacings adjusted as follows. Maintain 6-inch dowel spacing at the longitudinal joint and increase the spacing at the outer edge of the lane up to 12 inches. Where an odd width of lane occurs and if the standard dowel basket assembly would provide for a space exceeding 12 inches, place a dowel 6 inches from the outer edge of the lane. Hold such a dowel rigidly in proper position by a method satisfactory to the Engineer or cut and splice a dowel basket assembly of greater length than required to attain the required length.

C. Expansion Joints. Where a pressure relief joint is not provided adjacent to a bridge structure, construct expansion joints at the first two regularly spaced joint locations adjacent to the bridge approach slab on each side of the bridge. If the pavement is constructed in two or more separately placed lanes, construct the transverse expansion joints in a continuous line for the full width of the pavement and shoulders.

Construct expansion joints according to the Standard Drawings. Install the face of the expansion joint perpendicular to the centerline except when expansion joint is installed at a skewed bridge approach slab.

Use round, straight, smooth, steel dowels, and within 2 hours of placing concrete, coat the dowels with a thin uniform coat of new light form oil as a bond-breaking material to provide free movement. After coating the dowel, install a sleeve of metal or other approved material approximately 3 inches long, with crimped end, overlapping seams fitting closely around the dowel, and a depression or interior projection to stop the dowel a sufficient distance from the crimped end to allow 1 inch for longitudinal dowel movement with pavement expansion on one free end of each dowel. If approved by the Engineer, use other means to allow for 1 inch of expansion.

Punch or drill proper size dowel holes into the preformed expansion joint filler to assure a tight fit around each dowel.

Form a 1-inch wide and 1-inch deep opening on top of the expansion joint filler and seal this opening with [705.04](#) joint sealers.

- D. Contraction Joint.** For pavement less than or equal to 10 inches thick, saw contraction joints with a standard (water cooled diamond bladed) concrete saw to a minimum depth of one-fourth of the specified pavement thickness. For pavement greater than 10-inches thick, saw contraction joints to a minimum depth of one-third the specified pavement thickness. When cutting joints using a standard (water cooled diamond blade) saw ensure the joint is $1/4 \pm 1/16$ inch wide when measured at the time of sawing.

When using the option of early-entry (dry cut, light weight) saws, only use saw blades and skid plates as recommended by the saw manufacturer for the coarse aggregate type being used in the concrete. Perform the early entry contraction joint sawing after initial set and before final set. Saw the contraction joint 2-1/4 to 2-1/2-inches deep. Ensure any early entry saw joints are approximately 1/8-inch wide at the time of sawing.

If the pavement is constructed in two or more separately placed lanes, install the joints continuous for the full width of the pavement. Saw the pavement with sawing equipment approved by the Engineer as soon as the saw can be operated without damaging the concrete. Provide saws with adequate guides, blade guards, and a method of controlling the depth of cut. After wet sawing, clean the joint using a jet of water. After dry sawing clean the joint using air under pressure. During sawing of contraction joints, maintain a standby saw in working condition with an adequate supply of blades.

- E. Construction Joints.** Install dowelled construction joints at the end of each day's work and when work is suspended for a period of more than 30 minutes.

Use dowels in transverse construction joints. Within 2 hours prior to placing concrete, coat the free half of all dowels with a thin uniform coat of new light form oil. Use an adequate bulkhead, with openings provided for dowel bars spaced as specified and shaped to fit the typical section of the pavement, to form a straight joint. During placing of concrete, hold dowels rigidly in position.

Locate construction joints at or between contraction joints. If located between contraction joints, construct the construction joint no closer than 10 feet to the last contraction joint.

451.10 Finishing. Use 10-foot straightedges to continually check the finished concrete surface for trueness. If the pavement surface is dragged with a diagonal pipe float machine, occasionally check the surface while the concrete is plastic. Do not add water or finishing agent to aid finishing.

Before the concrete initially sets, round the edges of the pavement along each side of each slab and on each side of transverse expansion joints to the radius specified using an approved edging tool. Before texturing the surface, eliminate tool marks left by the edging tool.

The surface shall be textured by use of a broom or artificial turf drag in the longitudinal direction so as to produce a uniform, gritty, longitudinal texture. In addition to and immediately following the above specified longitudinal drag texture, the pavement shall be textured in the transverse direction by an approved device that will produce a relatively uniform pattern of grooves. The grooves shall be spaced at approximately 3/4 inch centers and shall be approximately 1/8 inch deep and 1/8 inch wide. Variation from the texturing requirements will be permitted only with the written permission of the Engineer.

451.11 Curing. Immediately after the finishing operations have been completed and after all free water has dissipated, spray and seal all exposed concrete surfaces with a uniform application of curing membrane in such a manner as to provide a continuous uniform film without marring the surface of the concrete. Apply a minimum of 1 gallon of material for each 150 square feet of surface treated using an approved mechanical sprayer. Provide an adequate shield to protect the fog spray from the wind. Before each use, thoroughly agitate the curing material.

On pavement with integral curb or small and irregular areas that are inaccessible to the mechanical spray machine, apply the curing material by a hand-held sprayer.

As soon as the forms have been removed, immediately correct all honey-comb areas and coat the edges of the pavement with the curing material.

Respray all areas of curing material film damaged during the sawing of joints.

The Contractor may water cure concrete with wet burlap cloth, waterproof paper, or polyethylene sheeting. Apply curing as soon as possible and without marring the concrete surface. Unless the test cylinders have attained a split tensile strength of 450 pounds per square inch, as tested per ASTM C496, keep the entire surface of the top and sides of the newly placed concrete covered for seven days. Protect concrete from freezing until cylinders attain a split tensile strength of 450 pounds per square inch, as tested per ASTM C496.

The above requirements for curing are minimum requirements only. Repair or replace all concrete showing injury or damage due to insufficient curing at no additional cost to the City.

451.12 Removing Forms. Remove forms in a manner that does not damage the pavement.

451.13 Surface Smoothness. After final concrete curing and cleaning the pavement surface, test the pavement surface for smoothness using a 10-foot rolling straightedge. Provide a two or four-wheeled device with an indicator wheel at the center that detects high and low areas in the pavement surface. Provide equipment that actuates a pointer scale, issues an audio alert, or marks the pavement with paint or dye when encountering any high or low areas in excess of a preset tolerance. Tow or walk the rolling straightedge over the completed pavement. Test all wheel paths in the presence of the Engineer. Locate wheel paths parallel to the pavement centerline and approximately 3 feet measured transversely from the center of the lane. Maintain alignment of the rolling straightedge with reference to the pavement edge at all times.

Correct all surface variations so indicated to within the specified tolerance and in a manner that provides a surface texture conforming to [451.10](#). For corrective grinding provide equipment conforming to [451.14](#). Ensure pavement surface variations do not exceed 1/8 inch in a 10-foot length of pavement. For ramp pavements and for those pavements with curvature greater than 8 degrees, or with grades exceeding 6 percent, ensure the surface variations do not exceed 1/4 inch in 10 feet.

Repair or replace sections of pavement containing depressions that cannot be corrected by grinding as directed by the Engineer.

451.14 Profile Grinding. To correct surface variations exceeding tolerances specified in [451.13](#) use grinding equipment conforming to [Item 257](#).

451.15 Pavement Grooving Corrections. When pavement tining locations are found out of conformance with [451.10](#) correct the tining using power driven, self-propelled machines specifically designed to groove concrete pavement with diamond impregnated blades or diamond impregnated cylinder rings. Furnish blades or cylinder rings mounted on an arbor head so that the resulting grooves comply with [451.10](#). Furnish grooving equipment with a depth control device that will detect variations in the pavement surface and enable adjustment of the cutting head to maintain the specified groove depth.

If a pavement area was diamond ground to bring the pavement's surface smoothness within the tolerances of [451.13](#), that pavement area does not require tining restoration conforming to [451.10](#).

Vary from these requirements only for small areas and only with written permission from the Engineer.

451.16 Sealing Expansion Joints. As soon as feasible after completing sawing, but before the pavement is open to construction equipment and traffic, seal expansion joints with material conforming to [705.04](#). Just before sealing, thoroughly clean each joint of all foreign material, using approved equipment. Ensure the joint faces are clean and dry when the seal is installed.

451.17 Opening to Traffic. When 7 days have elapsed, the Contractor may use the completed pavement for traffic, including construction traffic. If a split tensile strength of 450 pounds per square inch, as tested per ASTM C496, has been attained, the Contractor may open the pavement to traffic when 5 days have elapsed. If necessary to open a portion of the pavement in less than 5 days, with the proviso that the pavement will be cured for a minimum of 3 days, use high early strength concrete according to [499.03.C](#) and obtain a split tensile strength of 450 pounds per square inch, as tested per ASTM C496 in 3 days or less.

Pavement Repairs before City Acceptance. Remove and replace or repair diagonal cracks; longitudinal cracks; transverse cracks; spalled pavement surfaces, and any pavement panels with cement balls or mud balls; as approved by and at no cost to the City. Do not repair single hairline transverse cracks in the middle third of panels with reinforcing conforming to BP-1.1. Submit a repair plan with the location, type of repair, materials to be used and procedures to the City for approval. Do not perform any repairs without City approval.

Repair transverse or diagonal cracks with a full depth repair according to [Item 255](#) and applicable Standard Drawings. Repair cracks by replacing the pavement the full width between longitudinal joints, perpendicular to the centerline and at least 6 feet longitudinally. At the direction of the Engineer, install smooth dowel bars at the interface between the original pavement and the replaced pavement section. Locate and size the repairs to ensure that the repair limits are at least 7 feet away from any transverse joint.

Repair longitudinal cracks within 15 inches of a tied longitudinal joint by routing and sealing the crack according to [Item 423](#). For other longitudinal cracks, repair the same as for transverse or diagonal cracks stated above.

Repair spalled pavement with [Item 256](#) Bonded Patching of Portland Cement Concrete Pavement.

Repair all cement balls or mud balls by coring out the area, 1 inch beyond the outside limits of the defective area, with a diamond core bit and replacing the removed concrete with the same concrete as in the pavement. Remove and replace any pavement panel with 5 or more cement balls or mud balls. Locate the limits of the repair along the longitudinal joints and at least 1-foot past the transverse joints to remove any existing dowel bars. Install smooth dowel bars at the transverse limits of the repairs. Install Type D (Drilled Tied Longitudinal) Joint along the longitudinal limits.

451.18 Pavement Thickness and Concrete Strength.

A. Thickness. As determined by measurement of cores cut as specified in this section, construct the concrete not more than 0.2 inch less than the specified thickness. Use cores or cylinders for strength determination as directed by the Engineer. Core pavement at the direction of the Engineer and at locations the Engineer determines according to [City Supplement 1064](#). The Engineer will measure core length according to AASHTO T 148.

For the purpose of coring, the City will consider the entire pavement area of a specified thickness a unit. To determine the number of cores, each pavement unit will be divided into Lots. A Lot consists of 2000 square yards of a pavement unit or major fraction thereof.

Take one random core for each Lot but not less than 3 cores for any pavement unit cored. If a core shows a deficiency in thickness of more than 1/2 inch from the specified thickness, take additional cores to determine the limits of the deficiency. Follow the procedures below:

1. Take a core 5 feet longitudinally on both sides of the deficient core. If both the cores are less than 1/2-inch deficient in thickness, the zone of deficiency has been determined.
2. If either or both [451.18.A.1](#) cores are more than 1/2 inch deficient in thickness, cut a core 50 feet longitudinally from the deficient core(s). If the 50 foot core(s) is more than 1/2 inch deficient, cut additional cores at 100 foot longitudinal intervals until a core is less than 1/2 inch deficient; until the pavement ends; or until overlapping an adjacent pavement Lot's core in the same lane.
3. If a pavement Lot has cores more than 1/2 inch deficient in thickness and the Lot's constructed width is greater than 12 feet obtain cores transverse to the location of the more than 1/2 inch deficient cores. Obtain transverse cores at a location 1/2 the distance from the deficient core to the furthest edge of pavement. Obtain a transverse core for each core more than 1/2 inch deficient.
4. The Engineer will use the cores that measure less than 1/2 inch deficient in thickness to define the limits of the deficiency.

If any deficient core is greater than 1 inch deficient in thickness determine the limits of over 1 inch deficiency by following [451.18.A.1](#) through 4 to determine the limits. Remove and replace those areas greater than 1 inch deficient in thickness.

The Engineer will calculate average thickness of concrete pavement placed as follows:

When zones of deficient thickness greater than 1/2 inch to 1 inch are allowed to remain in place, the Engineer will calculate two average thicknesses. A Project Average Thickness (PAT) including all cores not more than 1/2 inch deficient. Cores that exceed the specified thickness by more than 1/2 inch will be considered as the specified thickness plus 1/2 inch when calculating the PAT. A second Deficient Zone Average (DZA) will include all cores with thickness deficiency greater than 1/2 inch to 1 inch. The pavement represented by each of the two averages, PAT or DZA, will be calculated and paid separately.

The City will determine and apply deductions to each separately placed width of pavement.

For any pavement areas removed and replaced, re-core those areas following this section of the specifications. Include those core values into the calculations for average pavement thickness.

Unless the Engineer requests, do not core any widening less than 5 feet in width or any pavement area less than 2000 square yards.

Fill all core holes with concrete of the same proportions and materials used in the pavement.

B. Strength.

The Engineer will calculate average compressive strength of concrete pavement placed as follows:

When zones of deficient strength between 90% to 85% of specified strength are allowed to remain in place, the Engineer will calculate two average strengths. A Project Average Strength (PAS) will include all cores/cylinders exceeding 90% of the specified strength. Cores that exceed the specified strength by more than 10% will be considered as the specified strength plus 10% when calculating the PAS. A second Deficient Strength Zone Average (DSZA) will include all cores/cylinders with strengths between 90% and 85% of the specified strength. The pavement represented by each of the two averages, PAS or DSZA, will be calculated and paid separately.

Any area represented by cores/cylinders with a strength of less than 85% of the specified strength shall be removed and replaced.

451.19 Price Adjustments. Based on the Pavement Average Thickness and Pavement Average Strength, the City will make payment as specified in [Tables 451.19-1](#) and/or [451.19-2](#).

A. Pavement Thickness. Price adjustments for thickness deficiencies will be calculated according to [Table 451.19-1](#).

**TABLE 451.19-1
CONCRETE PAVEMENT THICKNESS PAY FACTOR (PF_T)**

Deficiency in Thickness as Determined by Cores	Proportional Part of Contract Price
0.0 to 0.2 inch	100 percent
0.3 to 0.5 inch	Ratio $\left[\frac{PAT}{PST}\right]^6$
0.6 to 1.0 inch*	Ratio $\left[\frac{DZA}{PST}\right]^6$
Greater than 1.0 inch	Remove and replace

* The Engineer will determine whether pavement areas from 0.6 inch to 1 inch deficient in thickness will be allowed to remain in place at the reduced price or must be removed and replaced.
 PAT = Project Average Thickness
 PST = Plan Specified Thickness
 DZA = Deficient Zone Average

B. Pavement Strength. Price adjustments for strength deficiencies will be calculated according to [Table 451.19-2](#).

**TABLE 451.19-2
CONCRETE PAVEMENT STRENGTH PAY FACTOR (PF_S)**

Percent of Compressive Strength as Determined by Cores/Cylinders	Proportional Part of Contract Price
100% to 95%	100 percent
94.9% to 90.0%	Ratio $\left[\frac{PAS}{PSS}\right]^6$
89.9% to 85.0%*	Ratio $\left[\frac{DSZA}{PSS}\right]^6$
Less than 85%	Remove and replace

* The Engineer will determine whether pavement areas with strengths from 85% to 90% of the specified strength will be allowed to remain in place at the reduced price or must be removed and replaced.
 PAS = Project Average Strength
 PSS = Plan Specified Strength
 DSZA = Deficient Strength Zone Average

C. **Multiple Deficiencies.** When a pavement exhibits multiple deficiencies for thickness and strength, the reduced unit price will be calculated for each deficiency and the lowest reduced unit price will be used.

451.20 Method of Measurement. The City will measure Reinforced Concrete Pavement by the number of square yards completed and accepted in place. The width equals the pavement width shown on the typical cross-section of the plans plus additional widening as the Engineer directs in writing. The City will field measure the length along the centerline of each roadway or ramp. The City will determine the area based on the above width and length.

451.21 Basis of Payment. Payment is full compensation for furnishing and placing all materials including reinforcing steel, dowels, and joint materials; for furnishing the 10-foot rolling straightedge; and for coring and testing the pavement. For pavement found deficient in thickness or compressive strength, the City will pay a reduced price according to [451.19](#).

The City will not pay extra for pavement with an average thickness in excess of that shown on the plans.

The City will pay for accepted quantities at the contract price as follows:

Item	Unit	Description
451	Square Yard	Reinforced Concrete Pavement Class ____

ITEM 452 NON-REINFORCED PORTLAND CEMENT CONCRETE PAVEMENT

- [452.01](#) Description
- [452.02](#) Construction
- [452.03](#) Method of Measurement
- [452.04](#) Basis of Payment

452.01 Description. This work consists of constructing a non-reinforced portland cement concrete pavement on a prepared surface.

452.02 Construction. The requirements of [Item 451](#) apply, except as follows.

Do not comply with the requirements of [451.08](#).

Provide dowels at transverse contraction joints in mainline pavement, ramps, acceleration/deceleration lanes, or collector/distributor lanes. Dowels for contraction joints in concrete shoulders on mainline pavement, ramps, acceleration/deceleration lanes, or collector/distributor lanes are not required unless the contraction joint is located within 500 feet of a pressure relief joint.

Space contraction joints according to the Standard Drawings. If [Item 452](#) pavement is specified for shoulders and is tied longitudinally to [Item 451](#) or [Item 305](#) pavement, match the joints in the shoulder pavement to the spacing and alignment of the adjacent pavement.

Do not place construction joints within 6 feet of another parallel joint.

If making pavement repairs before City acceptance under [451.17](#), repair all cracks exclusive of size or location.

452.03 Method of Measurement. The City will measure Non-Reinforced Concrete Pavement by the number of square yards completed and accepted in place. The width equals the pavement width shown on the typical cross-sections of the plans plus additional widening as the Engineer directs in writing. The City will field measure the length along the centerline of each roadway or ramp.

452.04 Basis of Payment. Payment is full compensation for furnishing and placing all materials, for surface testing, and for coring the pavement. For pavement found deficient in thickness or compressive strength, the City will pay a reduced price according to [451.19](#).

The City will not make additional payment over the contract unit price for any pavement with an average thickness in excess of that shown on the plans.

The City will pay for accepted quantities at the contract price as follows:

Item	Unit	Description
452	Square Yard	Non-Reinforced Concrete Pavement, Class ____

ITEM 454 PAVEMENT RELIEF JOINTS

- [454.01](#) Description
- [454.02](#) Materials
- [454.03](#) General
- [454.04](#) Placement
- [454.05](#) Method of Measurement
- [454.06](#) Basis of Payment

454.01 Description. This work consists of constructing pavement relief joints composed of asphalt concrete on a prepared subgrade.

454.02 Materials. Furnish asphalt concrete conforming to [Item 441](#) Asphalt Concrete, Intermediate Course, Type 2.

454.03 General. Construct pavement relief joints with all portland cement type pavements or bases, in accordance with [Standard Drawing 2175](#) and this specification. Each pavement relief joint shall be 4 feet long and extend between pavement edges, curbs or gutters. Place 2 inches of expansion joint material in the curb or curb and gutter at and centered on the relief joint. Place the [Item 441](#) Asphalt Concrete, Intermediate Course, Type 2 in lifts no greater than the thickness of the pavement or base divided by 3; however, do not exceed 3 inches in any lift. Construct the pavement relief joint flush to the top of the portland cement concrete pavement or base.

454.04 Placement. Construct pavement relief joints as follows:

1. At the P.C. and P.T. for all pavement sections with a centerline radii less than or equal to 500 feet and deltas greater than 50 degrees.
2. At least one between intersections, including T type. Construct additional pavement relief joints when the distance within any one block exceeds 800 feet; space these additional pavement relief joints a minimum of 400 feet apart and not to exceed 800 feet.
3. Whenever a new roadway adjoins an existing roadway, begin this work with a pavement relief joint.
4. Plan pours of pavements or bases in such a manner so as to end a day's work at a pavement relief joint.

454.05 Method of Measurement. The City will measure the actual linear feet of Pavement Relief Joint accepted in place as measured between curbs and perpendicular to the centerline of the pavement.

454.06 Basis of Pavement. The City will pay for accepted quantities complete in place, at the contract price as follows:

Item	Unit	Description
454	Linear Feet	Pavement Relief Joint

ITEM 499 CONCRETE—GENERAL

[499.01](#) Description

[499.02](#) Materials

[499.03](#) Concrete Mix Designs

[499.04](#) Adjustments and Controls

[499.05](#) Equipment

[499.06](#) Handling, Measuring, and Batching Materials

[499.07](#) Batch Plant Tickets

[499.08](#) Mixing Concrete

499.01 Description. This specification consists of proportioning requirements for Portland concrete mix designs, mixing, and controls of Portland cement concrete.

499.02 Materials. Furnish materials conforming to:

Portland cement.....	701.01 , 701.02 , 701.04
.....	701.05 and 701.09 or blended cement ^[1]
Microsilica	701.10
Ground granulated blast furnace slag (GGBFS) ^[6]	701.11
Fly ash.....	701.13
Fine aggregate ^[2] ^[3]	703.02
Coarse aggregate ^[3]	703.02 , 703.13 ^[4]
Air-entraining admixture	705.10
Chemical admixture for concrete ^[5]	705.12
Carbonate Micro-Fines	701.14

[1] If blended cement is used, provide mill certification of all the cement and pozzolanic components and final product for approval by the Laboratory.

[2] [703.02](#) natural sand or sand manufactured from stone as specified in [703.02.A.3](#) is required in [Item 255](#), [256](#), [451](#), [452](#), [526](#), and [511](#) deck slabs.

[3] Aggregates may be standard gradation sizes from [703.02](#) and [Table 703.01-1](#) or they may be a modified gradation defined with the mix design submittal and certified by the Laboratory under [City Supplement 1069](#).

[4] Applies only to [305](#), [306](#), [451](#) and [452](#) concrete.

[5] Admixtures shall contain no more than 50 parts per million chloride ions by weight of cement except for Type C accelerating admixtures or calcium chloride for COC FS only.

[6] To be used only for [305](#), [306](#), [307](#), [451](#), [452](#) concrete.

Use water for concrete mixing free from sewage, oil, acid, strong alkalis, vegetable matter, clay, and loam. Potable water is satisfactory for use in concrete. Non-potable water will meet the requirements of ASTM C1602. Water from a reclaiming system will contain no more than 0.06% chlorides. Test the non-potable water monthly and maintain data verifying that the water meets the requirements. Provide the data at the Engineer's request.

499.03 Concrete Mix Designs. Develop concrete mix designs according to ACI 301, Section 4 meeting the requirements of [Table 499.03-1](#). Limit the pozzolan content of any mix design according to [Table 499.03-2](#). The design air for concrete with 1" nominal maximum size aggregate is 7%. Develop concrete mix designs per this specification and [ODOT Supplement 1126](#).

Only use mix designs accepted by the City and issued a JMF number.

TABLE 499.03-1 CONCRETE MIX DESIGN REQUIREMENTS Quantities Per Cubic Yard Provide Concrete with 7±2% Air Content					
Class	Previous Class ^[8]	Design Strength psi	Permeability ^[1] Maximum (Coulombs)	Cementitious Content ^[2] Minimum. lbs	Aggregate Requirements
COC 1	New	4,000 at 28 days	2,000	520	Well-Graded
COC 2	New	4,500 at 28 days	1,500	520	Well-Graded
COC 3 Special	New	As per plan	1,500 or as per plan	520 or as per plan	Well-Graded or as per plan
COC 4 Mass Concrete	New	4,000 or as per plan ^[3]	2,000 or as per plan	470 ^[4] ^[5] or as per plan	Well-Graded or as per plan
COC 5 ^[7]	Class S	4,500 at 28 days	N/A	520	1 inch or 3/8 inch nominal maximum size
COC 6	Class C	4,000 at 28 days	N/A	550 ^[6]	1 inch nominal maximum size
COC 7	Class F	3,000 at 28 days	N/A	420 ^[6]	1 inch nominal maximum size
COC 8	Class A	Unspecified	N/A	280	1 inch nominal maximum size
COC MS	MS	See ODOT Supplement 1126	N/A	800	1 inch nominal maximum size
COC FS	FS	See ODOT Supplement 1126	N/A	900	1 inch nominal maximum size
<p>[1] AASHTO T277 Modified.</p> <p>[2] Cementitious Content includes cement, pozzolan, and carbonate micro-fines materials, denoted as Cm.</p> <p>[3] Strength for Mass Concrete (COC 4) may be tested at either 28 or 56 days.</p> <p>[4] Do not use Type III cement or accelerating admixtures in mass concrete.</p> <p>[5] The maximum fly ash or GGBFS content may be increased up to 50%.</p> <p>[6] Cement or a combination of cement and up to 15% fly ash or up to 30% GGBFS.</p> <p>[7] For COC 5 mixes with 3/8 inch nominal size, provide an air content of 8±2%.</p> <p>[8] Class designation from 2012 CMSC book.</p>					

Determine the permeability by testing according to AASHTO T277 except moist cure the permeability samples for 7 days at 73 °F followed by 21 days of moist curing at 100 °F. Perform permeability testing at 28 days.

Limit pozzolan materials as a percent of total cementitious content according to [Table 499.03-2](#):

TABLE 499.03-2 POZZOLAN MATERIALS

MATERIAL	MAXIMUM CONTENT (%)
Fly Ash	25
GGBFS	30
Micro-Silica	10
Carbonate Micro-Fines ^[1]	20
When using multiple pozzolan materials, do not exceed the individual maximum contents above for each material. A combination of pozzolan materials may not exceed 50% of the total cementitious content by weight.	
[1] Not for use in COC 2 or COC 3 concrete.	

A. **Slump.** Maintain slump within the nominal slump range in [Table 499.03-3](#). If below the maximum water-cementitious ratio of the Job Mix Formula (JMF), adjust the quantity of water to meet slump requirements. Do not use concrete with a slump greater than the maximum shown in [Table 499.03-3](#).

TABLE 499.03-3 CONCRETE SLUMP

Type of Work	Nominal Slump Inch ^[1]	Maximum Slump Inch ^[2]
Concrete pavement (305 , 306 , 451 , 452 , 615)	1 to 3	4
Structural Concrete (511 , 610 , 622)	1 to 4	5
Superstructure concrete (511 , 526)	2 to 4	4
Non-reinforced concrete (601 , 602 , 603 , 604 , 608 , 609 , 622)	1 to 4	5
[1] This nominal slump may be increased to 6 inches, provided the increase in slump is achieved by adding a chemical admixture conforming to the requirements of 705.12 , Type F or G.		
[2] This maximum slump may be increased to 7 inches, provided the increase in slump is achieved by adding a chemical admixture conforming to the requirements of 705.12 , Type F or G.		

B. Air Content. Ensure that the air content in all concrete at the point of placement is within the percentage range specified in [Table 499.03-1](#).

499.04 Adjustments and Controls. Provide the following adjustments and controls during batching and placement of the concrete:

- A.** Batch the concrete to the proportions of the accepted JMF. Provide a workable and finishable mix. Adjustments to the JMF’s aggregate proportions up to 100 lbs for workability may be made. Adjustments greater than 100 lbs may be made if approved by the Engineer. Maintain an absolute volume of 27.0 cubic feet/cubic yard for the adjusted concrete mix. For Well Graded JMF adjustments, maintain the combined aggregate gradation within the optimal zone II requirements for well-graded mixes as defined in [ODOT Supplement 1126](#). If outside the optimal zone II of the Coarseness Factor Chart adjust the JMF’s proportions to maintain the combined gradation within Zone II and report the JMF changes to the Engineer.
- B.** Handle, haul and store aggregates to minimize segregation, avoid contamination, and assure a uniform grading within the specified gradation. Do not combine aggregates from different sources or of different gradings in the same stockpile. Do not use segregated or contaminated aggregates.
- C.** Remove all wash water by reversing each truck drum at the plant immediately prior to reloading.
- D.** Adjust the SSD aggregate design weights in the JMF to compensate for the moisture contained in the aggregates and moisture the aggregates will absorb during batching. Adjust the mix water to compensate for the aggregate moistures.
- E.** Use only compatible admixtures in the concrete. Dispense all admixtures according to the manufacturer’s recommendations. Furnish a volumetric dispenser for the Type F or G admixture or ensure that there is a gage on each truck-mounted Type F or G admixture dispensing tank. If any admixture is added at the job site, mix the load for a minimum of 5 minutes.
- F.** Do not exceed the maximum water/cementitious ratio of the accepted JMF. Use a water-reducing admixture conforming to [705.12](#); proportionately increase the cementitious content; or develop and submit for acceptance a new JMF. Adjust the absolute volume of the aggregates if the cement content is increased.
- G.** If during placement of concrete, cement or microsilica balling is observed, take corrective action with further mixing. If after corrective action, balling continues, reject the load. Revise the mixing process and/or loading sequence to prevent further balling.
- H.** If slump loss occurs before placement of the concrete, the concrete may be “replasticized” with an admixture to restore plasticity. The Engineer will recheck the slump range and air content to ensure conformance to the specifications. If after “replasticizing” the components of the load are segregated, the City will reject the load.
- I.** Completely discharge the concrete from each delivery truck within the time requirements of [499.08](#).
- J.** Provide sufficient quality control at the plant to assure conformance with this specification and project requirements.
- K.** Use an approved set-retarding admixture conforming to [705.12](#), Type B or D when the concrete temperature exceeds a nominal temperature of 75° F.

499.05 Equipment. Use a City approved batch plant and trucks. Provide batching and mixing equipment meeting the following requirements:

- A. Batching Plants.** Operate each plant so that aggregate materials are not segregated and there is no intermingling of the materials before batching. Use weighing mechanisms that allow a visible means of checking weights and produce a printed record. Use dispensing mechanisms for water and admixtures that allow a visible means of checking quantities and produce a printed record.

Use cement and aggregate weighing mechanisms that are accurate to within ±0.5 percent of the correct weight. Ensure that devices for weighing or metering water are accurate to ±1.0 percent throughout the range used.

Maintain a certification from a Sealer of Weights and Measures or a scale servicing company attesting to the accuracy of the weighing and metering devices. A Certificate of Performance issued by the National Ready Mixed Concrete Association may be used instead of the Sealer of Weights and Measures or a scale servicing company. Do not use plants with a certification or certificate older than 12 months.

Maintain the services of a scale servicing company or ten standard test weights to reach a capacity of 500 pounds for testing the weighing devices at the batch plant. Ensure all device-testing weights are sealed by the Ohio Department of Agriculture every 3 years.

The Engineer may test weighing and dispensing devices as often as necessary to ensure continued accuracy.

- B. Mixers.** Provide mixers and agitators conforming to AASHTO M 157, Sections 10, 11.2, 11.5, and 11.6, except that the City will allow mechanical counters.

For bodies of non-agitating concrete hauling equipment, provide smooth, mortar-tight, metal containers capable of discharging the concrete at a satisfactory controlled rate without segregation. Provide covers when required by the Engineer. The Engineer will allow trucks having dump bodies with rounded corners and no internal ribs or projections for non-agitating hauling.

- C. Concrete Pumping and Conveying Equipment.** Provide concrete pumping and conveying equipment in accordance with ACI 304.2R and ACI 304.4R. Conduct a pre-placement meeting to discuss concrete pumping and conveying procedures to maintain air content within specified limits per [Table 499.03-1](#).

- D. Volumetric Truck Mixers.** Provide mixers conforming to ASTM C685, Sections 7, 8, 9, 10, 11, 13, and 14. Mixers must have rating plates indicating that the performance of the mixer is in accordance with the Volumetric Mixer Manufacturer Bureau or equivalent. Mix concrete in accordance with the manufacturer's recommended procedures. The volumetric mixer must be capable of carrying sufficient unmixed dry bulk cement, supplementary cementitious materials, coarse and fine aggregate, admixtures and water, in separate compartments and accurately proportion the approved JMF. Each volumetric mixer shall be equipped with an onboard ticketing system that will electronically produce a record of all material used and their respective weights and the total volume of concrete placed. Place no more than 30 cubic yards (23 m³) per unit per day. Limit the use of volumetric truck mixers to Item 604, Item 606, Item 608, Item 609, concrete collars or encasements, and Item 623.

499.06 Handling, Measuring, and Batching Materials. Do not stockpile aggregates from different sources or different gradations together. Do not use aggregates that have become segregated or mixed with foreign material. The Engineer may direct reworking or cleaning, or may reject aggregates that have become segregated or mixed with earth or foreign material.

Prior to and during batching, maintain all coarse aggregates at a uniform moisture content.

For all slag aggregates or other aggregates with a reported absorption above 3.0 percent, maintain the moisture contents at or above the ODOT-reported SSD for that aggregate as follows:

- A.** Use appropriate stockpile watering systems capable of raising and maintaining aggregate moisture at or above SSD. Test the moisture content of the watered aggregate stockpiles in at least five (5) locations to assure the stockpile is at or above SSD.
- B.** Have processes to maintain the aggregate stockpile at SSD until stockpile draining for SSD consistency has begun. Twenty-four (24) hours before batching concrete with the aggregate, shut down the stockpile watering process to allow drainage and to establish a uniform moisture content.
- C.** Test aggregate moisture content at least once per half day, but not less than twice per day, during concrete production. If the moisture content varies between tests by more than 1 percent increase the moisture testing frequency to assure correct batching information.
- D.** Provide the moisture content test results as part of all quality control plant ticket information.

Separately weigh the amounts of fine aggregate and coarse aggregate. Use a separate weighing device for cementitious materials.

Batch each material to ensure weights are within the tolerance specified in [Table 499.06-1](#), based on the amount specified in the approved JMF.

TABLE 499.06-1 CONCRETE BATCHING TOLERANCES

Material	Batching Tolerance (%)
Cement	±1.0
Pozzolan	±1.0
Carbonate Micro-Fines	±1.0
Aggregates	±2.0
Water[1]	±1.0
Chemical Admixtures	±3.0

[1] Measured by weight or volume

499.07 Batch Plant Tickets. Furnish a concrete batch plant ticket to the Engineer for each load of concrete incorporated into the project. Provide computer generated batch tickets. At a minimum, include the information listed in [Table 499.07-1](#) on each ticket:

TABLE 499.07-1 EVERY BATCH TICKET

Name of ready-mix batch plant	
Batch plant No.	
Batch plant location	
Serial number of ticket	
Date	
Truck number	
Class of concrete	
JMF Number	
Batch time	
Batch size	yd ³
Actual weights of cementitious material:	
Cement	lb
Fly ash	lb
GGBFS	lb
Microsilica	lb
Carbonate Micro-Fines	lb
Other	lb
Actual weights of aggregates:	
Coarse	lb
Intermediate	lb
Fine	lb
Other	lb
Actual weight of water	lb
Actual volume of admixtures:	
Air-entrainer	fl oz
Superplasticizer	fl oz
Water-reducer	fl oz
Retarder	fl oz
Other	fl oz
Aggregate moisture contents:	
Coarse aggregate	%
Intermediate aggregate	%
Fine aggregate	%
Water-cementitious ratio, leaving the plant	

Provide the information in [Table 499.07-2](#) with batch tickets for each day’s first load of concrete and for each JMF. Include [Table 499.07-2](#) information on the batch ticket or furnish the information on a separate computer-generated or handwritten form attached to the batch ticket.

If during the concrete manufacturing process any of the information listed in [Table 499.07-2](#) changes, resubmit [Table 499.07-2](#) information with the first batch ticket supplied with the changed concrete.

TABLE 499.07-2 FIRST TICKET EACH DAY, EACH JMF

Cementitious Materials:	Source:	Grade or Type:
Cement		
Fly ash		
GGBFS		
Microsilica		
Carbonate Micro-Fines		
Other		
Admixtures	Brand:	Type:
Air-entrainer		
Retarder		
Superplasticizer		
Water-reducer		
Other		

Provide concrete batch ticket information according to ASTM C 94/C 94M, Section 13.

The Engineer may require supporting data to validate the basis for furnished aggregate moisture contents.

499.08 Mixing Concrete. Use a central mix plant or in truck mixers to mix the concrete.

When using a central mix plant, mix the concrete not less than 60 seconds. Begin the mixing time when all materials are in the drum and end the mixing time when discharge begins. Include transfer time in multiple drum mixers in the mixing time. Remove the contents of an individual mixer drum before a succeeding batch is emptied into the drum.

When concrete is mixed using a truck mixer for complete mixing, mix each batch of concrete at the rotation rate designated on the mixer as mixing speed for not less than 70 revolutions of the drum. Transport mixed concrete from the central mixers in truck mixers, truck agitators, or trucks having non-agitating bodies. Within 90 minutes after cement and water are combined, deliver and completely discharge concrete.

When concrete is delivered in transit mixers and before discharging any of a batch, the Engineer may allow adding water within the specified water-cement ratio limits. Perform sufficient mixing, a minimum of 30 revolutions at mixing speed, to adjust the slump and to regenerate the specified air content throughout the batch.

When approved by the Engineer, the Contractor may use approved admixtures ([705.12](#), Type F or G) for retempering the load to adjust the slump after the start of discharge. Mix for a minimum of 30 revolutions at mixing speed after addition of the admixture.

Use admixtures containing no more than 50 parts per million chloride by weight of cement only when specified in the Contract Documents, the accepted JMF, or with the Engineer's written permission.

Ensure that the temperature of all concrete does not exceed 90°F until incorporated into the work.

The City will pay for accepted quantities at the contract price as follows:

Item	Unit	Description
610	Square Foot	Cellular Retaining Wall

ITEM 613 LOW STRENGTH MORTAR BACKFILL

- [613.01](#) Description
- [613.02](#) Materials
- [613.03](#) Mix Proportioning
- [613.04](#) Mix Adjustment
- [613.05](#) Alternate Mixes
- [613.06](#) Mixing Equipment
- [613.07](#) Discharging the Materials
- [613.08](#) Placing Mortar
- [613.09](#) Method of Measurement
- [613.10](#) Basis of Payment

613.01 Description. This work consists of placing a low strength mortar backfill around conduits and at other locations. Perform the work for this item according to [Item 499](#), except as modified below.

613.02 Materials. Furnish materials conforming to:

- Cement [701.01](#) or [701.04](#)
- Fly Ash..... [701.13](#)

Furnish fine aggregate consisting of foundry sand, natural sand, sand manufactured from stone, gravel, or air-cooled blast furnace slag. Conform to the fine aggregate gradation requirements of [703.05](#). Use fine aggregate that is fine enough to stay in suspension in the mixture to ensure proper flow.

Furnish an air-entraining admixture that is designed for use in low strength mortar mixtures (also called controlled density fill or flowable fill).

613.03 Mix Proportioning. Furnish a low strength mortar mixture listed below or provide an alternate mix conforming to [613.05](#).

TABLE 613.03-1

	Type 1 ^[1]	Type 2	Type 3	Type 4
	lb/yd ³	lb/yd ³	lb/yd ³	lb/yd ³
Cement	50	100	0	0
Fly Ash, Class F	250	^[2]	0	1500
Fly Ash, Class C ^[4]	0	0	400	500
Fine Aggregate ^[3]	2910	2850	2900	0
Water (Target)	500	500	425	850

[1] The Contractor may add an air-entraining agent specifically designed for the use in the low strength mortar mixture.
 [2] Entrained air is substituted for fly ash in this mix. (Approximately 25 percent)
 [3] Saturated Surface Dry
 [4] Class C Fly Ash may be substituted for Class F Fly ash in Type 1 mixes with an approved mix design meeting the alternate mix design criteria of this specification.

These mixtures of materials are expected to yield approximately 1 cubic yard of material of a flowable consistency. Make small adjustments, as necessary, in the amounts of the materials in a mix to achieve the final product.

613.04 Mix Adjustment. Make one or more 1 cubic yard trial batches at different water contents to ensure a flowable material. The mixture is too dry if cracks develop in the mixture as it flows into place.

Adjust the proportions to maintain the total absolute volume. For large adjustments, see [613.05](#).

In order to expedite the settlement of a Type 1 mixture without entrained air, bleed water may appear on the surface immediately after the material is struck off. A delay in bleeding indicates there are too many fines in the mixture. The Contractor may reduce the fly ash quantity in increments of 50 pounds until the mixture is bleeding freely. Add approximately 60 pounds of sand to replace each 50 pounds increment of fly ash to maintain the original yield.

613.05 Alternate Mixes. The Contractor may submit alternate mixes for approval. Furnish the mix design and test data from an independent test laboratory 30 days before the intended usage for approval.

Submit an alternate mix design for all mixes that:

- A. Vary more than 300 pounds in fine aggregate, 100 pounds in water, 20 pounds in cement, or 200 pounds in fly ash from the [613.03](#) mixes. These are considered large adjustments.
- B. Have less than 50 pounds of cement in the Type 1 mixes or less than 100 pounds of cement in the Type 2 mixes.

- C. Use alternate materials.
- D. Contain foundry sand.
- E. Contain fly ash not conforming to [701.13](#).
- F. Use fine aggregate gradations other than [703.05](#).

The Contractor may use foundry sand if it meets the requirements of the Division of Surface Water Policy 400.007 “Beneficial Use of Non-Toxic Bottom Ash, Fly Ash and Spent Foundry Sand and Other Exempt Wastes,” and all other regulations. Ten days before using a mixture containing foundry sand on the project, submit written permission from the Ohio EPA to the Engineer. The Contractor may elect to have an independent ODOT consultant pre-qualified in remedial design environmental site assessment review the proposed usage. The consultant will provide all documentation utilized to ensure that the proposed usage obeys all Ohio EPA regulations. The consultant shall coordinate all EPA required meetings, documentation, and testing requirements. The consultant shall certify the report or reports to the City.

Provide alternate mixes with an unconfined compressive strength between 50 and 100 pounds per square inch at 28 days when tested according to ASTM D 4832. Ensure that the long term (12-month) unconfined compressive strength is less than 100 pounds per square inch.

Ensure that the final mix has the required strength, fills the voids of the intended usages and sets up within 12 hours (4 hours for Type 3, Type 3 alternate mixes, Type 4, and Type 4 alternate mixes). The proportioning, yield, consistency, workability, compressive strength, and all other requirements are the sole responsibility of the Contractor.

613.06 Mixing Equipment. Provide the mixing capacity and delivery equipment to place the material without interruption as much as practical. Deliver and place Type 1 and 2 mixes or Type 1 and 2 alternate mixes from ready mixed concrete trucks, or deliver them from a batch plant.

Deliver and place Type 3 and 4 mixes or Type 3 and 4 alternate mixes using volumetric mobile mixers. Calibrate volumetric mixers properly and sufficiently mix the materials in the mixer to produce a uniform material.

613.07 Discharging the Materials. Discharge the mixture within 2.5 hours after adding water.

613.08 Placing Mortar. Unless specifically shown on the plans, do not place the mortar within 3 feet of the subgrade elevation. Discharge the flowable material from the mixer by any reasonable means into the space of the plan intended usage. Bring the fill material up uniformly to the fill line shown on the plans. The Contractor may begin placing the other fill material over low strength mortar backfill material as soon as the surface water is gone. The Engineer reserves the right to reject the mix if a flowable mixture is not produced.

Before placing the low strength mortar backfill as backfill for [Item 603](#) Conduit, secure the conduit to prevent it from floating during placement of the flowable material.

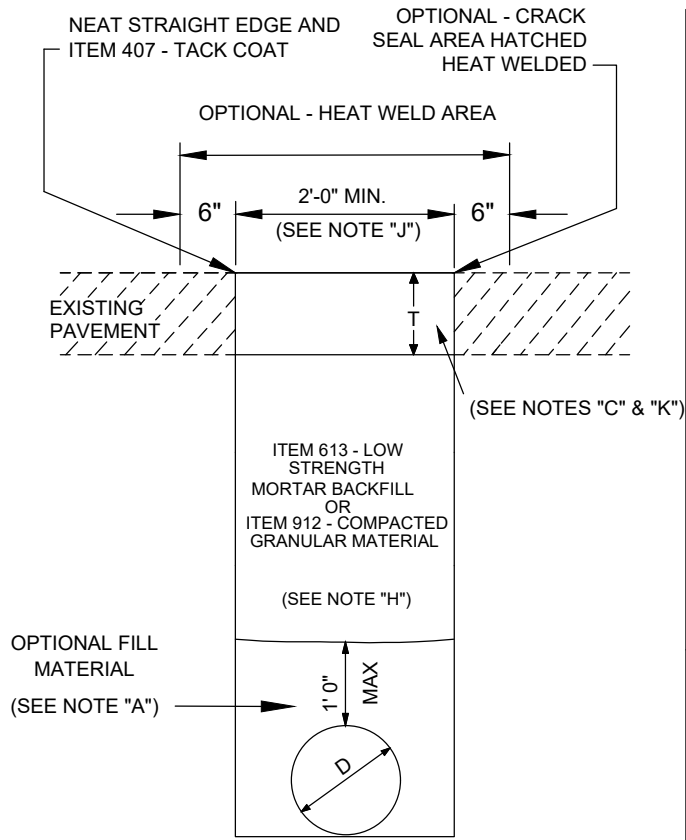
613.09 Method of Measurement. The City will measure Low Strength Mortar Backfill by the number of cubic yards completed and accepted in place, computed from the plan lines. The City will not pay additional compensation for over excavated areas or for a change in the material blends.

613.10 Basis of Payment. The City will pay for accepted quantities at the contract prices as follows:

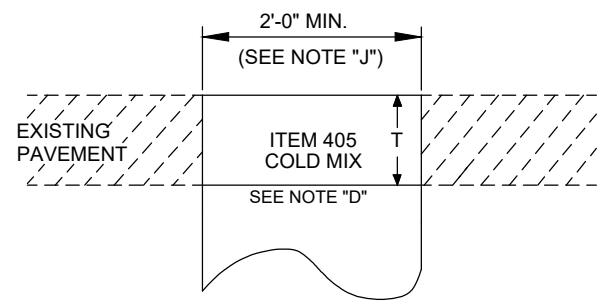
Item	Unit	Description
613	Cubic Yard	Low Strength Mortar Backfill
613	Cubic Yard	Low Strength Mortar Backfill (Type ___)

ITEM 614 MAINTAINING TRAFFIC

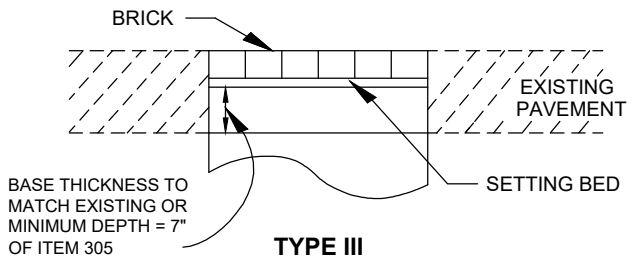
- [614.01](#) Description
- [614.02](#) Traffic Facilities
- [614.03](#) Traffic Control - General
- [614.031](#) Permit
- [614.032](#) Notification
- [614.035](#) Storage of Equipment, Vehicle and Material on Highway Rights of Way
- [614.04](#) Work Zone Marking Signs
- [614.05](#) Road Closed
- [614.055](#) Surface Condition Signs
- [614.06](#) Detour Signing
- [614.07](#) Traffic Maintained
- [614.071](#) Existing Parking Meters
- [614.08](#) Flaggers
- [614.09](#) Law Enforcement Officer
- [614.10](#) Work Zone Traffic Signals
- [614.11](#) Work Zone Pavement Markings
- [614.115](#) Work Zone Raised Pavement Markers
- [614.12](#) Pavement Marking Operations
- [614.13](#) Asphalt Concrete for Maintaining Traffic
- [614.14](#) Performance
- [614.15](#) Method of Measurement



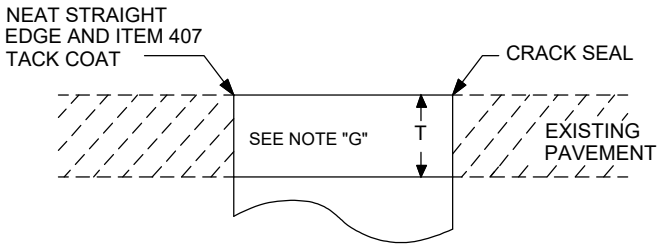
TYPE I
STANDARD FLEXIBLE ASPHALT REPAIR
 (SEE NOTES "B" & "C")



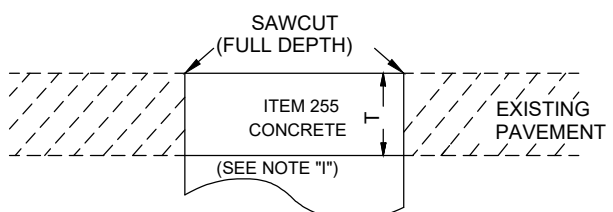
TYPE II
WINTER OPERATIONS FLEXIBLE ASPHALT REPAIR
 (SEE NOTE "E")



TYPE III
BRICK STREET REPAIR
 (SEE NOTE "F")



TYPE IV
ALLEY REPAIR
 (SEE NOTE "G")



TYPE V
CONCRETE STREET REPAIR, CONCRETE BASE, CONCRETE BUS PAD OR CONCRETE PANEL REPLACEMENT
 (SEE NOTE "I")

BACKFILL FOR ALL TYPES SHALL MEET THE REQUIREMENTS SHOWN IN TYPE I ABOVE.

T: MATCH EXISTING PAVEMENT THICKNESS, HOWEVER, MINIMUM OF 10" ON ALL STREET CUTS AND 6" ON ALL ALLEYS.

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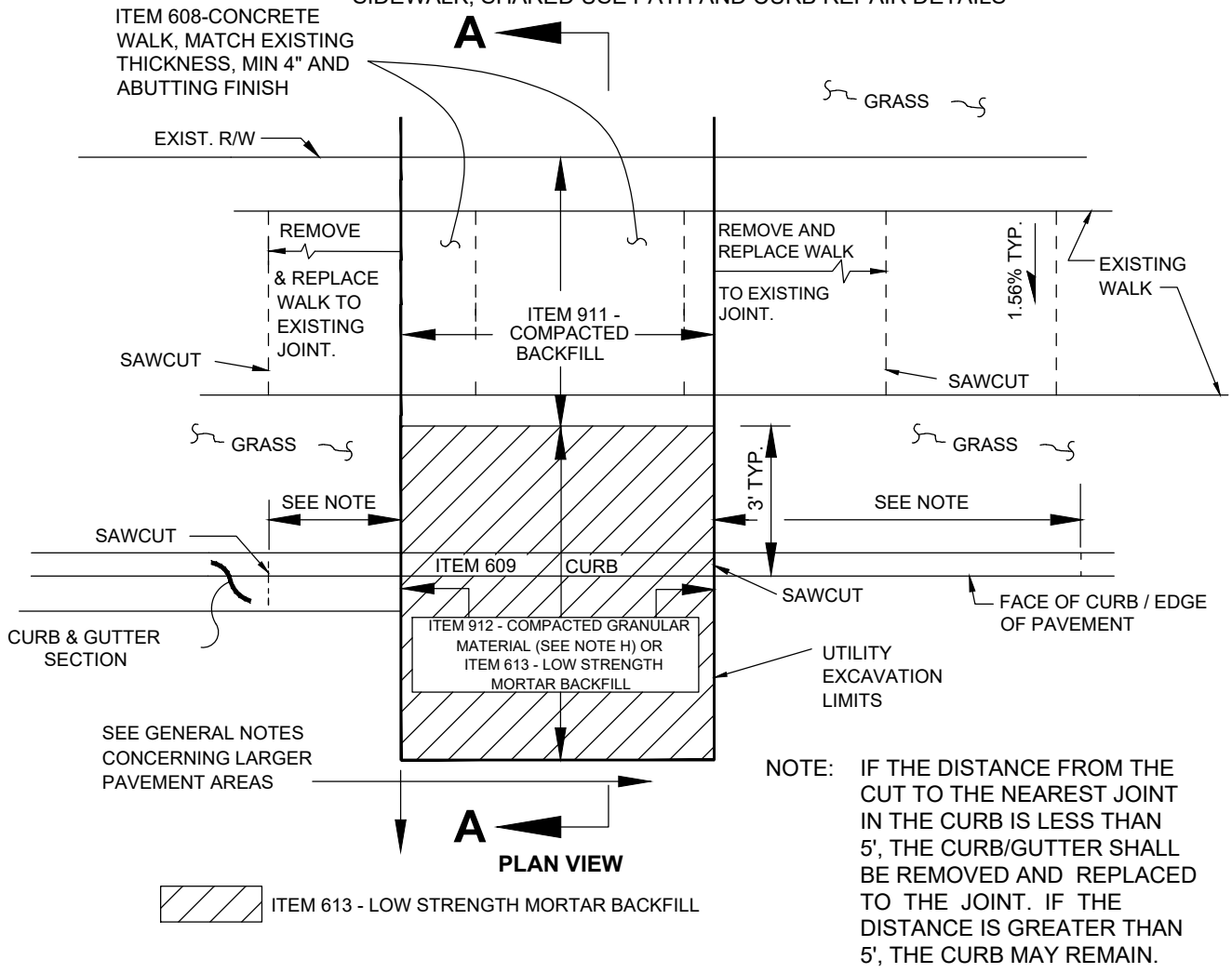
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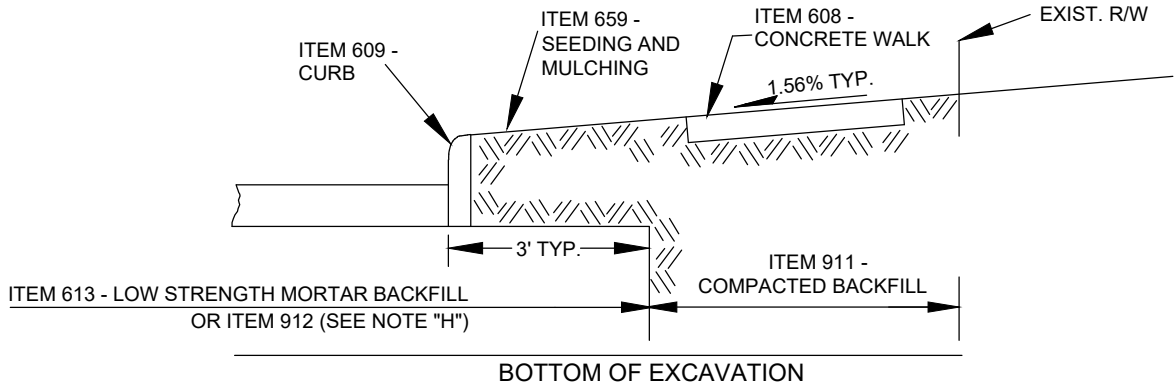
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SIDEWALK, SHARED USE PATH AND CURB REPAIR DETAILS



NOTE: IF THE DISTANCE FROM THE CUT TO THE NEAREST JOINT IN THE CURB IS LESS THAN 5', THE CURB/GUTTER SHALL BE REMOVED AND REPLACED TO THE JOINT. IF THE DISTANCE IS GREATER THAN 5', THE CURB MAY REMAIN.

SECTION A-A



ALL GRASS AREAS SHALL BE SEEDED IN ACCORDANCE WITH ITEM 659, SEEDING AND MULCHING

SEE NOTE M, FOR RESTORATION REQUIREMENTS FOR BRICK SIDEWALK OR SPECIAL NON-STANDARD SIDEWALK MATERIAL.

SEE NOTE N, FOR RESTORATION REQUIREMENTS FOR A SHARED-USE PATH (SUP).

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GENERAL NOTES

EXCAVATION PERMIT REQUIRED: A CITY OF COLUMBUS STREET EXCAVATION PERMIT IS REQUIRED FOR ALL EXCAVATIONS WITHIN THE PUBLIC RIGHT-OF-WAY, AS SET FORTH BY COLUMBUS CITY CODE, CHAPTER 903 AND ISSUED IN ACCORDANCE WITH PROVISIONS IN THE GENERAL RULES AND REGULATIONS OF THE DEPARTMENT OF PUBLIC SERVICE (DPS).

SCOPE OF WORK

THE CONTRACTOR SHALL FULLY COMPLY WITH THE CITY OF COLUMBUS ADA RULES AND REGULATIONS AND THE CITY OF COLUMBUS CONSTRUCTION AND MATERIAL SPECIFICATIONS, CURRENT EDITION.

THIS WORK SHALL CONSIST OF PAVEMENT REMOVAL, NECESSARY EXCAVATION, AND PAVEMENT REPLACEMENT IN ACCORDANCE WITH THE DETAILS SHOWN HEREIN. ALL WORK AND MATERIALS SHALL CONFORM TO THE REQUIREMENTS OF THE CURRENT CITY OF COLUMBUS CONSTRUCTION AND MATERIALS SPECIFICATION (CMSC).

PROCEDURES USED FOR THE PAVEMENT REMOVAL AND REPLACEMENT SHALL NOT CAUSE SPALLING OR CRACKING OF ADJACENT PAVEMENT.

WHEN THE PAVEMENT IS REMOVED AND THE CONTRACTOR IS UNABLE TO COMPLETE THE REQUIRED REPLACEMENT IN TIME FOR IT TO BE OPENED TO TRAFFIC AS INDICATED ON THE PERMIT, THE EXCAVATION SHALL BE FILLED WITH THOROUGHLY COMPACTED ITEM 405 BITUMINOUS COLD MIX WITH A DURABLE SURFACE (OR APPROVED BITUMINOUS MATERIAL) OR PROPERLY PLATED PER CHAPTER 903 AND SHEETS 12 AND 13 OF THIS STANDARD DRAWING. THE CONTRACTOR WILL BE REQUIRED TO MAINTAIN THESE TEMPORARY MEASURES WHILE THEY ARE IN SERVICE. THE COST OF PLACING, MAINTAINING, REMOVING AND DISPOSING OF THE TEMPORARY PATCHES OR PLATES WILL BE AT THE CONTRACTOR'S EXPENSE.

WHEN ITEM 613 LOW STRENGTH MORTAR BACKFILL (LSMB) IS USED AS A BACKFILL, NO PAVEMENT, SIDEWALK OR SUP, SHALL BE PLACED UNTIL BLEED WATER HAS BEEN EVAPORATED FROM THE LSMB SURFACE OR HAS BEEN DRAINED OR REMOVED FROM THE SURFACE. ITEM 613 LSMB IS NOT PERMITTED AS A TEMPORARY DRIVING SURFACE OR WITHIN THE DEPTH OF THE PAVEMENT REPAIR. LSMB SHALL NOT BE PLACED HIGHER THAN THE SUBGRADE ELEVATION AND NOT EXTEND INTO THE PAVEMENT BUILD-UP.

THE PAVEMENT REPAIR SHALL BE PERFORMED BY THE CONTRACTOR OR PERMITTEE IN ACCORDANCE WITH CITY SPECIFICATIONS. IF DESIRED, ANY OR ALL OF THIS WORK CAN BE PERFORMED BY THE CITY OF COLUMBUS. THE CITY SHALL COLLECT APPROPRIATE FEES AT THE TIME THE PERMIT IS ISSUED FOR SAID WORK. PAVEMENT RESTORATION MAY TRIGGER REQUIRED ADA IMPROVEMENTS PER CITY OF COLUMBUS ADA RULES AND REGULATIONS.

RESTORATION OF ANY SIDEWALK, CURB, STREET PAVEMENT (INCLUDING CRACK SEAL OR HEAT WELDING) ECT., AND INCLUDING BUT NOT LIMITED TO IN-STREET TRAFFIC CONTROL DEVICES SUCH AS REBOUNDABLE PYLONS, LONGITUDINAL CHANNELIZERS, RAISED PAVEMENT MARKERS, TRAFFIC CONTROL DEVICES SUCH AS SPEED HUMPS, RUMBLE STRIPS OR OTHER RAISED PAVEMENT TRAFFIC CALMING DEVICES SHALL OCCUR NO LATER THAN 30 DAYS AFTER CONCLUSION OF ANY UTILITY REPAIR OR INSTALLATION ACTIVITY. CONSTRUCTION ACTIVITY COMPLETED DECEMBER THROUGH APRIL SHALL BE RESOLVED NO LATER THAN MAY 31ST. ADDITIONAL PERMITS SHALL NOT BE ISSUED UNTIL THE VIOLATIONS ARE CORRECTED TO THE SATISFACTION OF THE DEPARTMENT OF PUBLIC SERVICE. IN ADDITION, EACH VIOLATION MAY BE ENFORCED IN ACCORDANCE WITH SECTION 903.99 OF THE COLUMBUS CITY CODE.

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SCOPE OF WORK (CONTINUED FROM PREVIOUS SHEET)

CITY CHAPTER 903 - SECTION 9 - NEW PAVEMENT OR REPAVEMENT

A THREE (3) YEAR MORATORIUM SHALL BE ENFORCED FOR ALL NEW PAVEMENT OR REPAVEMENT/RESURFACING. **NO PERMIT SHALL BE GRANTED FOR THE PURPOSE OF OPENING SUCH PAVEMENT FOR A PERIOD OF NO LESS THAN THREE (3) YEARS AFTER COMPLETION**, EXCEPT FOR THE PURPOSE OF REPAIRING LEAKING PIPES OR WORK DEEMED NECESSARY BY THE DIRECTOR OF PUBLIC SERVICE, CITY ENGINEER OR DESIGNEE. EMERGENCY REPAIRS OR OPENINGS WITHIN THE THREE (3) YEAR MORATORIUM SHALL HAVE ADDITIONAL AND SPECIFIC REQUIREMENTS BEYOND THE MINIMUM REQUIREMENT OF STD DWG 1441.

SPECIAL IMPROVED STREETS

SPECIAL IMPROVED STREETS, AS APPROVED BY THE DIRECTOR OF PUBLIC SERVICE, CITY ENGINEER OR DESIGNEE SHALL HAVE FIVE (5) YEAR MORATORIUM. NO PERMIT SHALL BE GRANTED FOR THE PURPOSE TO MAKE ANY OPENING ON ANY HARD SURFACE AREAS SUCH AS PAVEMENT, SIDEWALK, CURB, ETC., WITHIN THE RIGHT OF WAY OF SPECIAL IMPROVED STREET FOR A PERIOD OF NO LESS THAN FIVE (5) YEARS AFTER COMPLETION OF SUCH HARD SURFACE AREA. EMERGENCY REPAIRS OR PAVEMENT OPENINGS WITHIN THE FIVE (5) MORATORIUM SHALL HAVE ADDITIONAL AND SPECIFIC REQUIREMENTS BEYOND THE MINIMUM REQUIREMENTS OF STD DWG 1441 AND APPROVED ONLY BY THE DIRECTOR OF THE PUBLIC SERVICE AND CITY ENGINEER OR DESIGNEE.

CURB RAMP INSTALLATION

ALL CURB RAMPS SHALL BE INSTALLED PER STANDARD DRAWINGS 2300, 2319 AND DPS ADA RULES AND REGULATIONS.

SPECIAL PAVEMENT, BASE, AND STORMWATER CONTROL PRACTICES (SCP)

WHEN PAVEMENT CUTS OR REPAIRS IMPACT NON-CONVENTIONAL PAVEMENT BUILDUPS, THE CITY ENGINEER OR DESIGNEE WILL PROVIDE DIRECTION ON THE REQUIRED RESTORATION. IF THE NON-CONVENTIONAL PAVEMENT IS NOT IDENTIFIED IN THE DESIGN STAGE, IT IS THE PERMIT HOLDER'S RESPONSIBILITY TO BRING THIS TO THE ATTENTION OF THE DEPARTMENT OF PUBLIC SERVICE. SOME EXAMPLES OF NON-CONVENTIONAL PAVEMENT INCLUDE, FABRICS AND GRIDS USED TO STABILIZE SUBGRADE AND PAVEMENT, SPECIALITY BACKFILL AND SOIL SUPPORT STRUCTURES, PERMEABLE PAVEMENT AND STORMWATER CONTROL PRACTICES (SCP).

TRAFFIC CONTROL

WHEN PAVEMENT CUTS OR REPAIRS REMOVE EXISTING STRIPING OR OTHERWISE RENDER STRIPING UNSERVICEABLE AS DETERMINED BY THE ENGINEER, TEMPORARY PAVEMENT MARKINGS PER CMSC 614 SHALL APPLY. TEMPORARY CLASS II MARKINGS SHALL BE PLACED IMMEDIATELY. CLASS II MARKINGS ARE ONLY FOR LANE LINES, CENTERLINES AND GORE MARKINGS AND PLACED FOR A MAXIMUM OF 14 DAYS. ALL TEMPORARY MARKINGS PLACED FOR A PERIOD LONGER THAN 14 DAYS BUT LESS THAN 30 DAYS SHALL BE ITEM 642 CLASS III MARKINGS. PERMANENT THERMOPLASTIC OR SPRAY THERMOPLASTIC SHALL BE PLACED WITHIN 30 DAYS ON A SURFACE COURSE. WHEN THERMOPLASTIC OR SPRAY THERMOPLASTIC IS TO BE INSTALLED, TEMPORARY MARKINGS SHALL BE CLASS III. ALL OVER WINTER TEMPORARY MARKINGS SHALL BE TYPE 1. ALL TEMPORARY PAVEMENT MARKINGS ON CONCRETE SHALL BE AS PER 740.06, TYPE I. PERMANENT PAVEMENT MARKINGS ON CONCRETE SHALL MATCH THE EXISTING PAVEMENT MARKINGS DIRECTED BY THE ENGINEER.

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SPECIAL NOTES

NOTE 'A' : LOW STRENGTH MORTAR BACKFILL (LSMB)

WHEN USING LOW STRENGTH MORTAR BACKFILL (LSMB), THE OPTIONAL FILL AREA OVER THE CONDUIT MAY BE BACKFILLED WITH SAND, GRANULAR MATERIAL, OR OTHER SUITABLE 912 MATERIAL, FOR A DISTANCE NOT TO EXCEED 1 FT. A PROTECTIVE BARRIER OF VISQUEEN OR SIMILAR MATERIAL IS PERMITTED.

NOTE 'B' : TYPE 1 PAVEMENT REPAIR SEALING

FOR TYPE I PAVEMENT REPAIR SEALING OPTIONS - THE FOLLOWING METHODS ARE PERMITTED:

1. CRACK SEALING METHOD: SEAL THE PERIMETER SURFACE OF THE REPAIRED AREA BY APPLYING A NOMINAL 4 INCH STRIP OF APPROVED ITEM 423 - CRACK SEALING, TYPE II OR III.
2. HEAT WELD METHOD: FOR PAVEMENT REPAIR LOCATIONS, THE AREA TO BE HEAT WELDED IS TO INCLUDE THE CUT AND EXTEND FOR 6 INCHES BEYOND EACH SIDE OF THE CUT FOR A NOMINAL DEPTH OF 2 INCHES.

NOTE 'C' : TYPE 1 PAVEMENT REPAIR RESURFACING (SEE SHEETS 9-11)

FOR TYPE I PAVEMENT REPAIR APPLICATIONS, THE FOLLOWING METHODS ARE PERMITTED:

1. IF LANE WIDTH TO BE RESURFACED: USE ITEM 441 ASPHALT CONCRETE, INTERMEDIATE COURSE, TYPE 2, (BINDER MATCHING SURFACE COURSE) PLACED IN LIFTS NOT EXCEEDING 3 INCHES TO REPAIR PAVEMENT TO THE SURFACE. DURING THE LATER MILL AND ASPHALT OVERLAY OPERATION, USE ITEM 441 ASPHALT CONCRETE SURFACE COURSE, TYPE 1.
2. IF NO LANE WIDTH RESURFACING: USE ITEM 441 ASPHALT CONCRETE, INTERMEDIATE COURSE, TYPE 2, PLACED IN LIFTS NOT EXCEEDING 3 INCHES AND ITEM 441 ASPHALT CONCRETE, SURFACE COURSE, TYPE 1 PLACED AT A MAXIMUM 1.5 INCH LIFT THICKNESS. THE INTERMEDIATE COURSE MATERIAL IS NOT PERMITTED AS THE FINAL SURFACE COURSE.

THE ASPHALT BINDER FOR INTERMEDIATE AND SURFACE COURSE ASPHALT SHALL BE PG 70-22 ON ARTERIAL ROADWAYS, BUS ROUTES, AND WHERE SPECIFIED BY THE PERMIT OFFICE. ALL OTHER ROADS SHALL BE PG 64-22.

FULL LANE WIDTH/COLD JOINT RESURFACING

THE INTENT OF RESURFACING FULL LANE WIDTH(S) IS TO MINIMIZE ADDING ADDITIONAL COLD JOINTS TO THE ROADWAY. IF THE UTILITY CUT OR TRENCH REPAIR REQUIRES TO MILL AND PAVE THE FULL LANE WIDTH, SEE BELOW AND EXAMPLES SHEETS 9-11, THE EXISTING JOINT SHALL BE LOCATED AND WHEN THE EXISTING JOINT IS WITHIN (2') TWO FEET OF A FULL LANE WIDTH THE PAVEMENT SHALL BE REPLACED TO THE COLD JOINT. A FULL LANE WIDTH IS CONSIDERED TO BE TO THE NEAREST LANE LINE, CHANNEL OR CENTERLINE.

TRENCHES THAT REQUIRE FULL LANE RESURFACING SHALL INCLUDE FULL LANE RESURFACING ON ALL CONNECTING TRENCHES AND ASSOCIATED VALVE OR CASTING WORK AREAS ALONG ADJACENT STREETS (UTILITY SERVICE REPAIRS SHALL BE AS PER SHEETS 9, 10 AND 11.) REGARDLESS OF THE LENGTH OF THE CONNECTING TRENCH.

WHEN AN EXCAVATION EXCEEDS 100 FT IN LENGTH, THE REPAIR SHALL INCLUDE ITEM 254 PLANING OF A FULL LANE WIDTH (OR ANY OTHER LANE WIDTH AS DIRECTED BY THE DEPARTMENT OF PUBLIC SERVICE) TO A DEPTH OF 1- 1/2 INCHES FOR THE ENTIRE LENGTH OF THE EXCAVATION. THE RESURFACING SHALL NOT INTRODUCE ANY LONGITUDINAL PAVEMENT JOINTS. WHEN RESURFACING OUTSIDE LANES, RESURFACING SHALL EXTEND TO THE FACE OF CURB OR EDGE OF PAVEMENT. IF PAVEMENT PLANING DOES NOT PROVIDE A UNIFORM PLANED SURFACE DUE TO THE EXISTING PAVEMENT CONDITION, THE DEPTH OF THE PAVEMENT REMOVAL AND RESURFACING SHALL BE ADJUSTED ACCORDINGLY. WHERE THE PROPOSED RESURFACING IS IN CLOSE PROXIMITY TO AN EXISTING LONGITUDINAL JOINT, THE RESURFACING SHALL BE EXTENDED TO MEET OR OVERLAP THAT JOINT. WHEN RESURFACING ADJOINS AN AREA WITH EXISTING OVERLAID GUTTER, THE RESURFACING SHALL EXTEND THE FULL LANE WIDTH TO THE EXISTING PAVEMENT EDGE AT THE FACE OF CURB. THE PLANED AREA SHALL BE TACKED USING ITEM 407.02 MATERIAL PRIOR TO PLACING AND COMPACTING APPROVED ASPHALT CONCRETE WITH A PAVER IN ACCORDANCE WITH CURRENT CITY STANDARD SPECIFICATIONS. ITEM 423 -CRACK SEALING, TYPE II OR III SHALL BE APPLIED TO EXPOSED JOINTS ONCE THE PAVING OPERATION HAS BEEN COMPLETED.

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SPECIAL NOTES

WHEN AN EXCAVATION CROSSES LANES, ALL LANES AFFECTED SHALL REQUIRE PLANING AND RESURFACING AS DESCRIBED ABOVE. THIS WORK SHALL INCLUDE ALL OF THE AFFECTED PAVEMENT AREA. WHEN EXCAVATION WORK FOR LATERALS CROSS LANES AT A FREQUENCY OF 2 OR MORE TRENCHES WITHIN 100 FT OF ROADWAY, THE REPAIR SHALL INCLUDE THE RESURFACING OF A FULL LANE WIDTH AS DESCRIBED ABOVE FOR THE AFFECTED LANES EXTENDING A MINIMUM OF 2 FT BEYOND THE LATERAL EXCAVATIONS LOCATED FARTHEST APART.

FULL LANE WIDTH RESURFACING OUTSIDE TRAVEL LANES SHALL EXTEND TO THE EDGE OF PAVEMENT FACE OF CURB UNLESS A SHOULDER WIDER THAN 4 FEET IS SEPARATED BY AN EXISTING LONGITUDINAL JOINT.

WHEN 2 OR MORE PAVEMENT REPAIRS ARE LOCATED WITHIN 100 FT OF EACH OTHER IN THE SAME LANE, THE REPAIR SHALL INCLUDE THE RESURFACING OF A FULL LANE WIDTH AS DESCRIBED ABOVE OF THE AFFECTED LANES EXTENDING A MINIMUM OF 2 FT BEYOND THE PAVEMENT REPAIRS LOCATED FARTHEST APART.

IF APPROVED BY THE CITY OF COLUMBUS, WHEN A PAVEMENT REPAIR AREA IS GREATER THAN 5 FT IN WIDTH AND/OR GREATER THAN 100 FT IN LENGTH, THE PAVEMENT REPAIR SECTION MAY CONFORM TO 3 INCHES OF ITEM 441 ASPHALT CONCRETE ON 7 INCHES OF ITEM 301 ASPHALT CONCRETE BASE (PLACED IN 2 LIFTS). LANE WIDTH RESURFACING REQUIREMENTS STILL APPLY. THIS OPTION MUST BE NOTED ON THE PERMIT APPLICATION AND APPROVED BY THE CITY OF COLUMBUS.

NOTE 'D' : TYPE II BITUMINOUS COLD MIX PLACEMENT

COLD MIX SHALL BE ITEM 405 BITUMINOUS COLD MIX OR OTHER COLD MIX APPROVED BY THE CITY OF COLUMBUS. IN LIEU OF COLD MIX, THE CONTRACTOR MAY USE STOCKPILED ITEM 441 ASPHALT CONCRETE AND REHEAT IT TO PLACE IN CUT AS TEMPORARY PAVEMENT REPAIR. TYPE II PAVEMENT REPLACEMENT SHALL CONSIST OF FULL DEPTH ITEM 405 COLD MIX FOR SMALL EXCAVATIONS.

NOTE 'E' : TYPE II TEMPORARY COLD MIX PLACEMENT

THE TEMPORARY COLD MIX IS TO BE REPLACED WITH ITEM 441 ASPHALT CONCRETE FOLLOWING PAVEMENT REPAIR PROCEDURES. THIS WORK SHALL BE PERFORMED AS SOON AS ASPHALT IS AVAILABLE.

NOTE 'F' : TYPE III REPAIR OF BRICK STREETS

1. THE CITY OF COLUMBUS MAINTAINS TWO TYPES OF BRICK STREETS: 1) HISTORICAL BRICK STREETS; AND 2) NEWER STYLE ROADWAY PAVER STREETS THAT COMPLY WITH SUPPLEMENTAL SPECIFICATION 1524. WHEN EXCAVATING AND REPAIRING BRICK STREETS, THE MATERIAL USED FOR REPLACEMENT SHALL MATCH THE EXISTING.
2. BRICKS OR PAVERS REMOVED FROM A REPAIR AREA SHALL BE STORED IN A SAFE PLACE BY THE CONTRACTOR FOR REUSE. THE CONTRACTOR SHALL BE RESPONSIBLE FOR REPLACING ANY BRICKS OR PAVERS THAT ARE STOLEN OR DAMAGED, AT NO ADDITIONAL COST TO THE CITY.
3. IF BRICKS OR PAVERS ARE SUPPLIED BY THE CONTRACTOR, THEY MUST CLOSELY MATCH THE EXISTING BRICKS OR PAVERS AND FIRST BE APPROVED BY THE CITY BEFORE THEY ARE USED. SEE THE DEPARTMENT OF PUBLIC SERVICE APPROVED PRODUCERS / PRODUCTS LISTS THAT CAN BE FOUND AT THE "DOCUMENT LIBRARY ON DEPARTMENT OF PUBLIC SERVICE WEBSITE"
4. SAW CUTTING: ALL PARTIAL BRICKS SHALL BE SAWCUT. FURTHER, NO BRICK WILL BE PERMITTED TO BE CUT, FOR REPLACEMENT, TO A LENGTH LESS THAN 1/2 ITS ORIGINAL LENGTH. THIS MAY REQUIRE SAW CUTTING OF ADJACENT UNDISTURBED BRICK(S).
5. DURING REMOVAL OF THE EXISTING BASE MATERIAL, IT SHALL BE CUT BACK TO AS NEARLY VERTICAL AS POSSIBLE. IF SHEARING OF THE ADJACENT BASE RESULTS, THE CONTRACTOR SHALL REMOVE ADDITIONAL BASE MATERIAL UNTIL A VERTICAL FACE IS ACHIEVED.

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SPECIAL NOTES

NOTE 'F' CONT. :

- 6. DURING INSTALLATION, THE BRICK IS TO BE RESET IN REASONABLY CLOSE CONFORMITY TO THE PATTERN OF THE EXISTING BRICK PAVEMENT ON A SETTING BED OVER ITEM 305 CONCRETE BASE. THE SETTING BED FOR HISTORICAL BRICK STREETS SHALL CONSIST OF 1 INCH OF SAND; WHEREAS, 3/4-INCH BITUMINOUS SETTING BED FOR NEWER STYLE ROADWAY PAVERS. THE CONCRETE BASE THICKNESS SHALL MATCH THE EXISTING BASE OR A MINIMUM OF 7 INCHES.

- 6A. HISTORICAL BRICKS WITHOUT SPACING LUGS: THE MAXIMUM WIDTH OF A BRICK JOINT SHALL BE 1/2 INCH. THIS RESTRICTION SHALL ALSO APPLY TO THE JOINT FORMED ADJACENT TO THE PERIMETER OF A REPAIR AREA, WHERE THE ROWS MAY NOT BE PARALLEL TO ONE ANOTHER. ALL JOINTS SHALL BE FILLED WITH POLYMERIC SAND FROM THE APPROVED MATERIALS LIST FOLLOWING MANUFACTURER'S INSTRUCTIONS. THIS MAY REQUIRE MORE THAN ONE APPLICATION. FURTHER, MECHANICAL VIBRATION WILL BE REQUIRED FOR CONSOLIDATION OF DRY MORTAR MIX.

- 6B. NEWER STYLE ROADWAY PAVERS: INSTALLATION AND MATERIALS SHALL MEET THE REQUIREMENTS OF COLUMBUS SUPPLEMENTAL SPECIFICATION 1524.

NOTE 'G' : TYPE IV ALLEY REPAIR

FOR ASPHALT OR CHIP SEAL ALLEYS, THE PAVEMENT REPAIR SHALL CONSIST OF A MINIMUM THICKNESS OF 6" (INCHES) OF ITEM 441 ASPHALT CONCRETE, OR MATCH THE THICKNESS OF THE EXISTING PAVEMENT (WHICHEVER IS GREATER). FINISHED CONCRETE PAVEMENT IS NOT PERMITTED. MATERIALS SHALL CONFORM TO THE REQUIREMENTS OF THE CURRENT CMSC.

IF MORE THAN 1/3 OF THE WIDTH OF THE ASPHALT OR CHIP SEAL ALLEY IS REMOVED, THE PAVEMENT SHALL BE REPAIRED AS PER TYPE 1 WITH THE ENTIRE EXISTING WIDTH OF THE ALLEY PAVEMENT MILLED AND OVERLAYED WITH 1.5" (INCHES) OF ITEM 441 ASPHALT CONCRETE. FOR BRICK ALLEYS, SEE NOTE 'F'. FOR CONCRETE ALLEYS, SEE NOTE 'I'.

NOTE 'H' : ITEM 912 - COMPACTED GRANULAR MATERIAL

THIS METHOD OF BACKFILL CAN ONLY BE USED WITH FULL TIME CITY INSPECTION. AN INSPECTION FEE MUST BE POSTED WHEN THE PERMIT IS ISSUED.

NOTE 'I' : CONCRETE BASE OR FULL DEPTH CONCRETE PAVEMENT

FULL DEPTH CONCRETE PAVEMENT

IF THE UTILITY TRENCH CUT IS WITHIN 6 FT OF A TRANSVERSE OR LONGITUDINAL JOINT, THE LIMITS OF THE REPAIR SHALL EXTEND TO THE JOINT. THIS MAY REQUIRE THE ENTIRE PANEL TO BE REPLACED. AT A MINIMUM, THE LIMITS OF THE CONCRETE REPAIR SHALL EXTEND 1 FT BEYOND THE LIMITS OF THE TRENCH. IF MAINTENANCE OF TRAFFIC REQUIREMENTS ALLOW FOR SUFFICIENT CURING TIME SO THAT FAST SETTING CONCRETE IS NOT NEEDED, STANDARD CONCRETE BASE OR FULL DEPTH CONCRETE PAVEMENT MAY BE PLACED AS PER CMSC ITEM 255. THIS OPTION MUST BE NOTED ON THE PERMIT APPLICATION AND APPROVED BY THE CITY OF COLUMBUS. THE ENTIRE IMPACTED CONCRETE PANEL SHALL BE REPLACED WHEN THE UTILITY CUT IS LOCATED IN THE DOWNTOWN BUSINESS DISTRICT.

PAVEMENT WITH A CONCRETE BASE

THE NEW CONCRETE BASE THICKNESS SHALL MATCH THE EXISTING WITH A (7" MINIMUM) AND IT SHALL BE PLACED TO THE LEVEL OF THE ADJACENT CONCRETE BASE WITH 1-1/2 INCHES OF ITEM 441 ASPHALT CONCRETE OVERLAY. LANE WIDTH RESURFACING REQUIREMENTS OF TYPE 1 STILL APPLY.

NOTE 'J' : MINIMUM TRENCH RESTORATION WIDTH

THE TRENCH WIDTH FOR SMALL PIPES AND CONDUITS SHALL BE OF SUFFICIENT WIDTH TO ALLOW FOR THE PROPER PLACEMENT OF THE BACKFILL MATERIAL. THE PAVEMENT PORTION OF THE TRENCH SHALL BE A MINIMUM OF 2 FT IN WIDTH. THIS IS TO ALLOW FOR THE PROPER COMPACTION OF THE ASPHALT PAVEMENT. IF THE TRENCH FOR PLACING CONDUIT IS NARROWER THAN 2 FT THEN THE PAVEMENT PORTION SHALL BE CUT BACK TO PROVIDE THE 2 FT MINIMUM FOR PAVING OPERATIONS.

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SPECIAL NOTES

NOTE 'K' : TEMPORARY CONCRETE PAVEMENT

CONCRETE MAY BE USED AS A PAVEMENT REPAIR OPTION AND A TEMPORARY PAVEMENT SURFACE FOR TYPE 1 PAVEMENT REPAIR IF APPROVED BY THE CITY. THE CONCRETE SHALL BE PLACED PER CMSC ITEM 255 AND FOLLOW THE REQUIREMENTS OF TYPE V PAVEMENT REPAIR. 1-1/2 INCHES OF ITEM 441 ASPHALT OVERLAY WILL BE REQUIRED OVER THE CONCRETE WHEN WORK IS COMPLETED. THIS OPTION MUST BE NOTED ON THE PERMIT APPLICATION APPROVED BY THE CITY OF COLUMBUS.

NOTE 'L' : SURFACE REPAIR SHAPE (SEE SHEET 11) THE SURFACE REPAIR OF ALL IRREGULAR-SHAPED EXCAVATIONS SHALL ALWAYS BE RECTANGULAR WITH PARALLEL SIDES THAT ARE PERPENDICULAR TO THE DIRECTION OF TRAVEL OF THE ROADWAY.

NOTE 'M' : RESTORATION OF BRICK SIDEWALK OR SPECIAL NON-STANDARD MATERIAL

IF THE EXISTING SIDEWALK MATERIAL CONSISTS OF BRICK, THE CONTRACTOR SHALL REMOVE THE EXISTING SALVAGEABLE BRICKS WITHOUT UNNECESSARY DAMAGE AND STORED IN A SAFE PLACE BY THE CONTRACTOR FOR REUSE. THE CONTRACTOR SHALL BE RESPONSIBLE FOR REPLACING ANY BRICKS THAT ARE STOLEN OR DAMAGED. NO BRICKS ARE TO BE SAWCUT DURING REMOVAL. THE LIMITS OF THE BRICK AREA TO BE REMOVED SHALL EXTEND AT LEAST 12" (INCHES) BEYOND THE LIMITS OF THE TRENCH. AFTER THE TRENCH RESTORATION(S) HAVE BEEN COMPLETED TO SUBGRADE ELEVATION, THE SIDEWALK BASE IS TO BE RESTORED TO MATCH THE EXISTING MATERIAL (I.E. CONCRETE, LEVELING COURSE, ETC.) AND THICKNESS. THE BRICKS ARE TO BE RESET MATCHING THE PATTERN OF THE EXISTING BRICK SIDEWALK.

ANY ADDITIONAL BRICKS REQUIRED TO COMPLETE THE WORK MAY BE RETRIEVED BY THE CONTRACTOR FROM THE CITY'S MATERIAL YARD. IF BRICKS ARE SUPPLIED BY THE CONTRACTOR, THEY MUST CLOSELY MATCH THE EXISTING BRICK AND FIRST BE APPROVED BY THE CITY BEFORE THEY ARE USED. SEE THE DEPARTMENT OF PUBLIC SERVICE APPROVED PRODUCERS/PRODUCTS LISTS.

IF THE EXISTING SIDEWALK CONSISTS OF A SPECIAL NON-STANDARD MATERIAL OR FINISH, THE CONTRACTOR MUST DEMONSTRATE TO THE ROW PERMIT OFFICE THAT THEY CAN RESTORE THE NON-STANDARD SIDEWALK MATERIAL OR FINISH IN-KIND BEFORE A PERMIT WILL BE ISSUED.

NOTE 'N' : SHARED-USE PATH RESTORATION

REGARDLESS OF HOW MUCH THE EXCAVATION IMPACTS THE SHARED-USE PATH (SUP) THE ENTIRE WIDTH OF THE SUP ASPHALT PAVEMENT SHALL BE REMOVED WITH TRANSVERSE SAWCUTS. NO LONGITUDINAL SAWCUTS PERMITTED. THE LIMITS OF THE ASPHALT REPAIR SHALL EXTEND 1' (FOOT) BEYOND THE LIMITS OF THE TRENCH. THE PAVEMENT REPLACEMENT SHALL CONSIST OF ITEM 1530 1-1/4" SURFACE COURSE, 1-3/4" INTERMEDIATE ASPHALT CONCRETE TYPE 2, PLACED IN 2 (TWO) LIFTS MATCHING THE THICKNESS OF THE EXISTING SUP OVER 6" (INCHES) OF ITEM 304 AGGREGATE BASE. SEE SCD 2310 FOR PAVEMENT BUILDUP. THE TRANSVERSE JOINTS SHALL BE CRACK SEALED.

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ACCEPTABLE UTILITY CUT REPAIRS

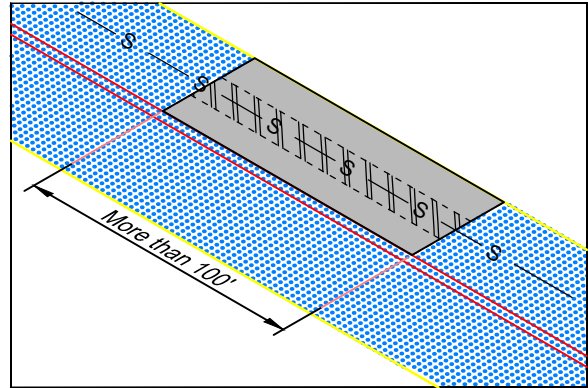
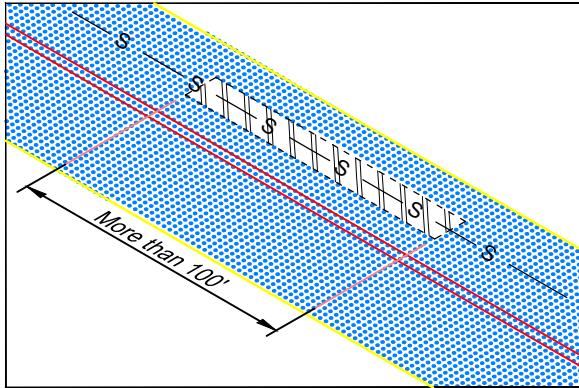
EXCAVATION EXCEEDING 100' IN LENGTH LOCATED WITHIN LANE

WHEN AN EXCAVATION EXCEEDS 100 FT IN LENGTH, THE REPAIR SHALL INCLUDE ITEM 254 PAVEMENT PLANING OF A FULL LANE WIDTH (OR ANY OTHER LANE WIDTH AS DIRECTED BY THE DEPARTMENT OF PUBLIC SERVICE) TO A DEPTH OF 1-1/2 INCHES FOR THE ENTIRE LENGTH OF THE EXCAVATION. THE PLANED AREA SHALL BE THOROUGHLY CLEANED AND DRY, THEN TACKED USING ITEM 407 TACK COAT MATERIAL PRIOR TO PLACING AND COMPACTING APPROVED ASPHALT CONCRETE WITH A PAVER IN ACCORDANCE WITH CURRENT CITY STANDARD SPECIFICATIONS. ITEM 423 CRACK SEALING, TYPE II OR III, SHALL BE APPLIED TO EXPOSED JOINTS ONCE THE PAVING OPERATION HAS BEEN COMPLETED.

NOT ACCEPTABLE

SEE NOTE "C"

ACCEPTABLE



FOR AN EXCAVATION IN A SINGLE LANE, PERFORM A FULL-LANE-WIDTH PLANE AND REPAIR.

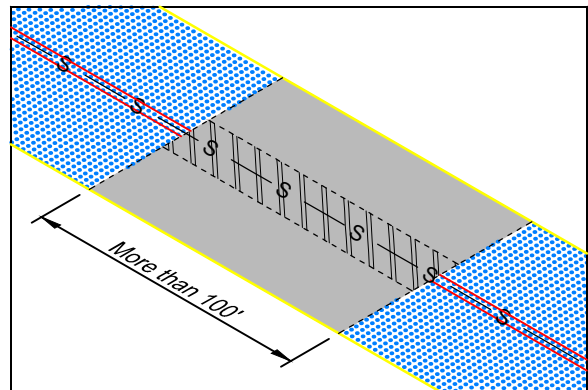
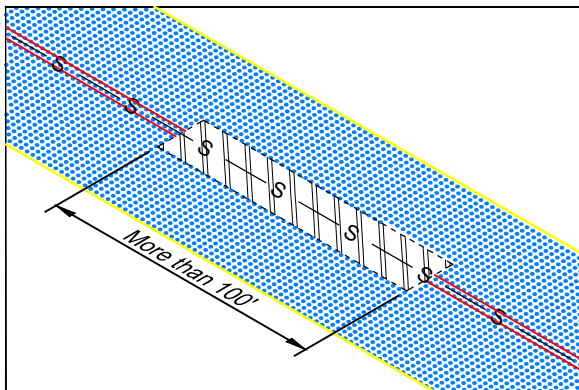
EXCAVATION EXCEEDING 100' IN LENGTH BETWEEN OR CROSSING LANES

WHEN AN EXCAVATION CROSSES LANES, ALL AFFECTED LANES SHALL REQUIRE PLANING AND RESURFACING AS DESCRIBED ABOVE. THIS WORK SHALL INCLUDE ALL OF THE PAVEMENT AREA WITHIN THE FULL WIDTH OF THE AFFECTED LANE(S) FOR THE LIMITS OF THE EXCAVATION.

NOT ACCEPTABLE




SEE NOTE "C"

ACCEPTABLE



FOR AN EXCAVATION IN MULTIPLE LANES, PERFORM A FULL-LANE-WIDTH PLANE AND REPAIR FOR ALL IMPACTED LANES.

LEGEND

-  EXISTING PAVEMENT
-  FULL DEPTH REPAIR
-  MILL/PAVE

NOTE:
EXCAVATIONS ARE CONCEPTUAL ONLY. SEE DETAILED CROSS SECTION AND PROFILE SHEETS FOR CONSTRUCTION PROCEDURES AND WIDTHS.

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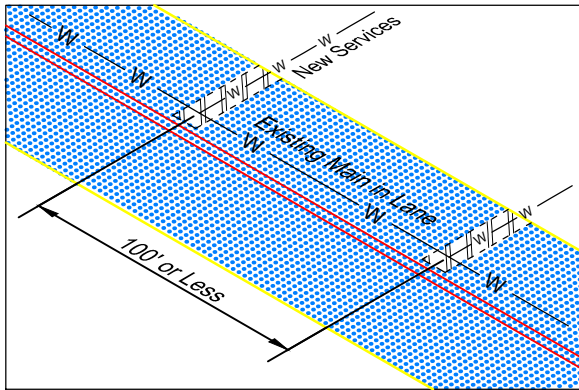
ACCEPTABLE UTILITY CUT REPAIRS

UTILITY EXCAVATIONS CROSSING ONE LANE WITHIN 100'

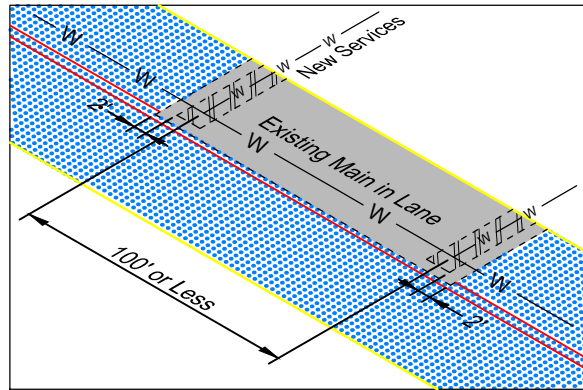
WHEN EXCAVATION WORK FOR LATERALS CROSSES A LANE AT A FREQUENCY OF 2 OR MORE LATERAL EXCAVATIONS WITHIN 100 FEET OF EACH OTHER, THE REPAIR SHALL INCLUDE ITEM 254 PAVEMENT PLANING FOR THE FULL LANE WIDTH TO A DEPTH OF 1- 1/2 INCHES AND FOR A MINIMUM OF 2 FEET BEYOND THE FURTHEST LATERAL EXCAVATIONS. THE PLANED AREA SHALL BE THOROUGHLY CLEANED AND DRY, THEN TACKED USING ITEM 407 TACK COAT MATERIAL PRIOR TO PLACING AND COMPACTING APPROVED ASPHALT CONCRETE WITH A PAVER IN ACCORDANCE WITH CURRENT CITY STANDARD SPECIFICATIONS. ITEM 423 CRACK SEALING, TYPE II OR III, SHALL BE APPLIED TO EXPOSED JOINTS ONCE THE PAVING OPERATION HAS BEEN COMPLETED.

SEE NOTE "C"

NOT ACCEPTABLE



ACCEPTABLE



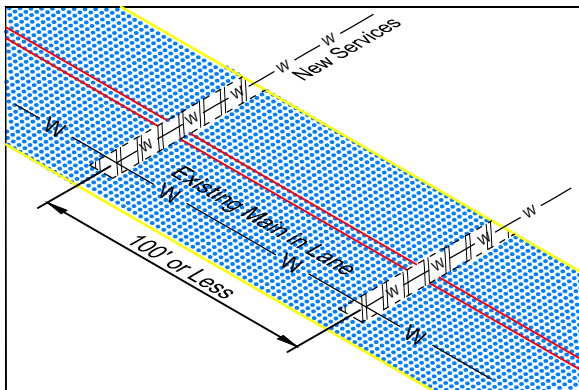
FOR MULTIPLE EXCAVATIONS WITHIN 100', PERFORM A FULL-LANE-WIDTH PLANE AND REPAIR.

UTILITY EXCAVATIONS CROSSING MULTIPLE LANES WITHIN 100'

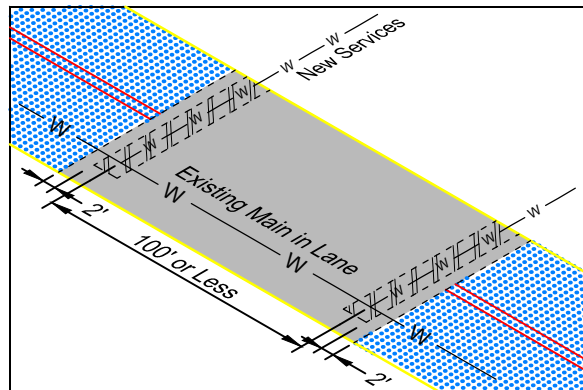
WHEN EXCAVATION WORK CROSSES MULTIPLE LANES, ALL AFFECTED LANES SHALL REQUIRE PLANING AND RESURFACING AS DESCRIBED ABOVE. THIS WORK SHALL INCLUDE ALL OF THE PAVEMENT AREA WITHIN THE AFFECTED LANES FOR THE LIMITS OF THE LATERAL EXCAVATIONS.

SEE NOTE "C"

NOT ACCEPTABLE






ACCEPTABLE



FOR MULTIPLE EXCAVATIONS WITHIN 100' IN MULTIPLE LANES, PERFORM A FULL-LANE-WIDTH PLANE AND REPAIR FOR ALL IMPACTED LANES.

LEGEND

-  EXISTING PAVEMENT
-  FULL DEPTH REPAIR
-  MILL/PAVE

NOTE:
EXCAVATIONS ARE CONCEPTUAL ONLY. SEE DETAILED CROSS SECTION AND PROFILE SHEETS FOR CONSTRUCTION PROCEDURES AND WIDTHS.

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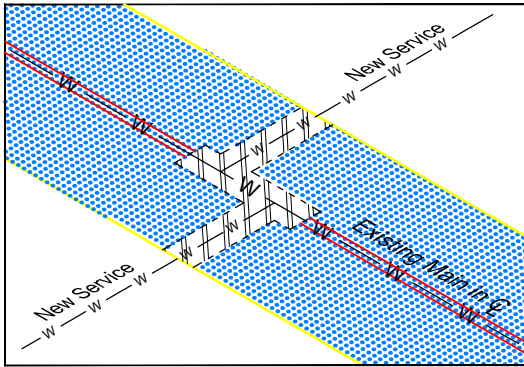
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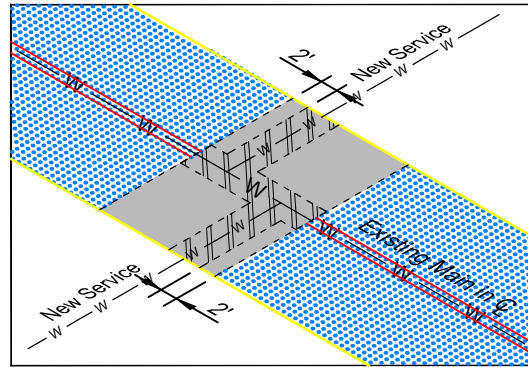
ACCEPTABLE UTILITY CUT REPAIRS

SEE NOTE "C"

NOT ACCEPTABLE

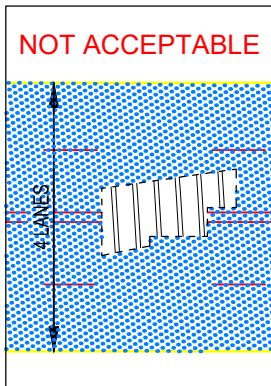


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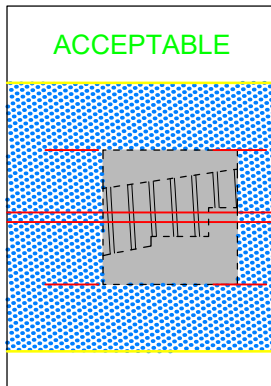


IRREGULAR SHAPES - SEE NOTE "L"

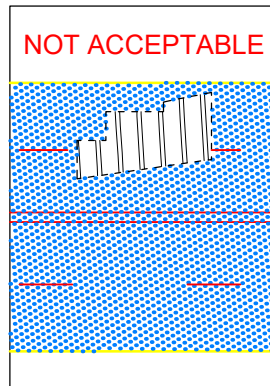
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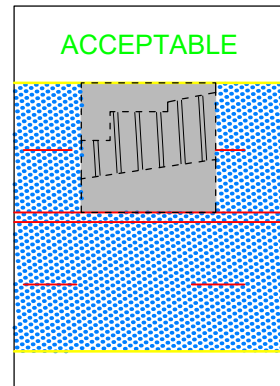
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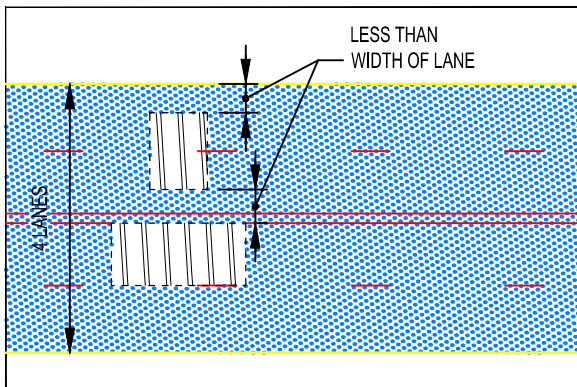
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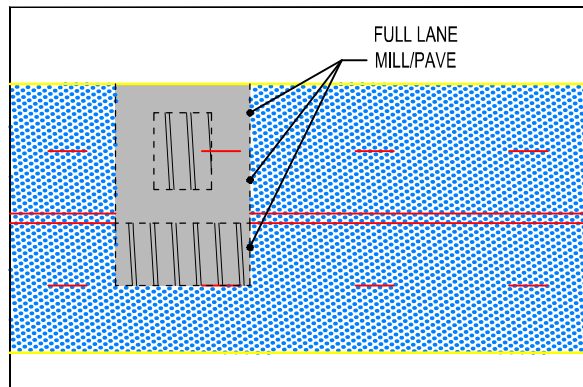
ACCEPTABLE






NOT ACCEPTABLE



ACCEPTABLE



LEGEND

-  EXISTING PAVEMENT
-  FULL DEPTH REPAIR
-  MILL/PAVE

NOTE:
EXCAVATIONS ARE CONCEPTUAL ONLY. SEE
DETAILED CROSS SECTION AND PROFILE
SHEETS FOR CONSTRUCTION PROCEDURES
AND WIDTHS.

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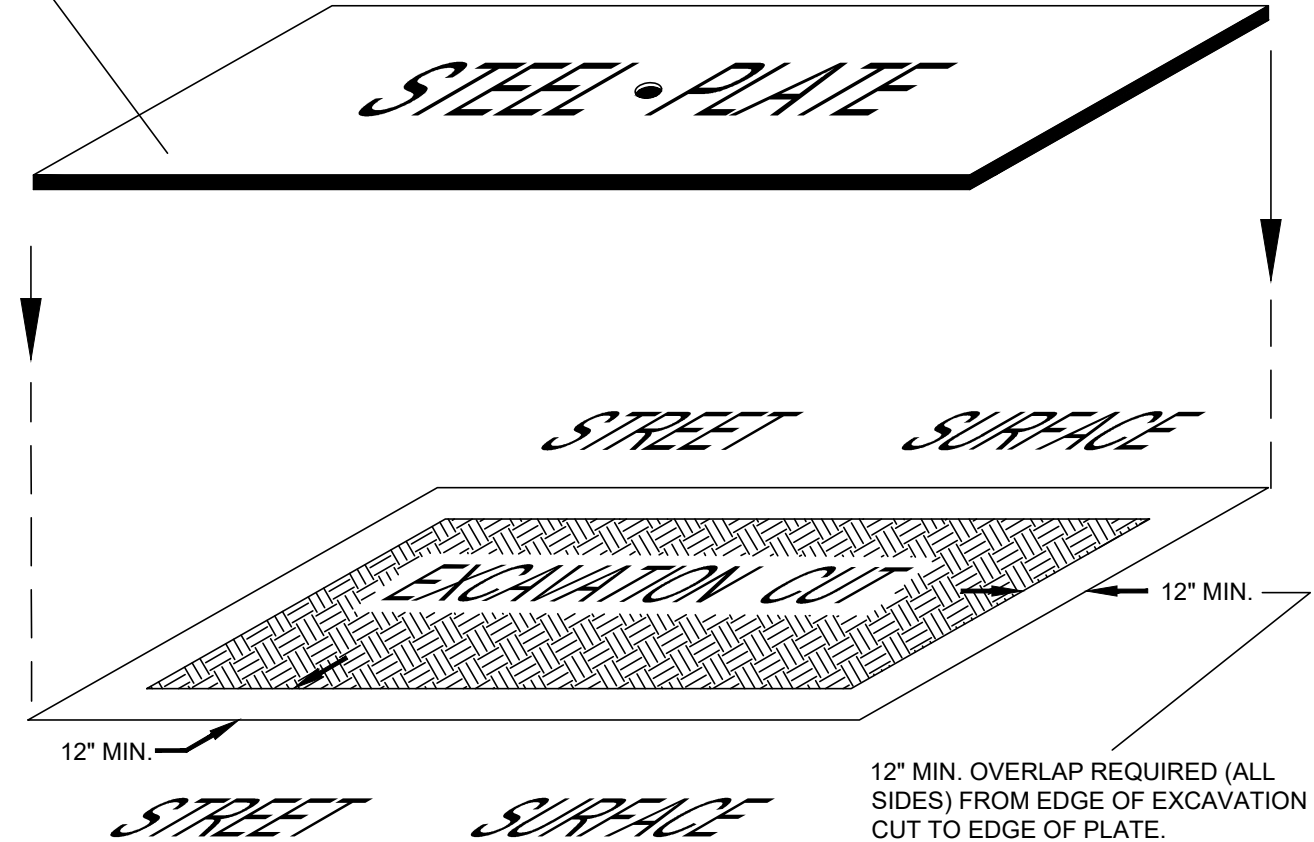
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1. OWNER'S NAME.
2. A 24 HOUR EMERGENCY CONTACT PHONE NUMBER.



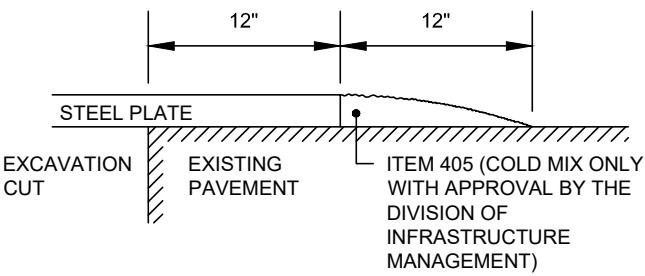
12" MIN. OVERLAP REQUIRED (ALL SIDES) FROM EDGE OF EXCAVATION CUT TO EDGE OF PLATE.

ALL STEEL PLATES MUST HAVE THE FOLLOWING INFORMATION CLEARLY AND LEGIBLY 'ETCHED' INTO THEIR TOP SURFACE:

1. OWNER'S NAME.
2. A 24 HOUR EMERGENCY CONTACT PHONE NUMBER.
3. CONTACT CITY OF COLUMBUS ROW PERMIT OFFICE TO REPORT LOCATION OF STEEL PLATE (614) 645-5550.
4. ALL PLANNED, CURRENT, AND EMERGENCY LANE CLOSURES AND/OR STEEL PLATE PLACEMENTS IN THE CITY OF COLUMBUS RIGHT OF WAY MUST BE REPORTED USING THE CLOSED LANES OR STEEL PLATE EVENTS (CLOSE) PROGRAM FORM. THE FORM CAN BE FOUND AT [HTTP://WWW.COLUMBUS.GOV/CLOSE](http://www.columbus.gov/close)

MINIMUM THICKNESS OF STEEL PLATES	
SIZE OF PLATE	THICKNESS
4' x 4'	1/2"
4' x 6'	3/4"
LARGER	1"

NO STEEL PINS ARE PERMITTED.
SEE SHEET 13 FOR SIGNING REQUIREMENTS.



STEEL PLATE REQUIREMENTS

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SIGNS ARE TO BE 36"x36" FOR RESIDENTIAL AND DOWNTOWN AREAS AND 48"x48" ON MULTI-LANE, HIGH SPEED (45 MPH OR GREATER) ROADWAYS.

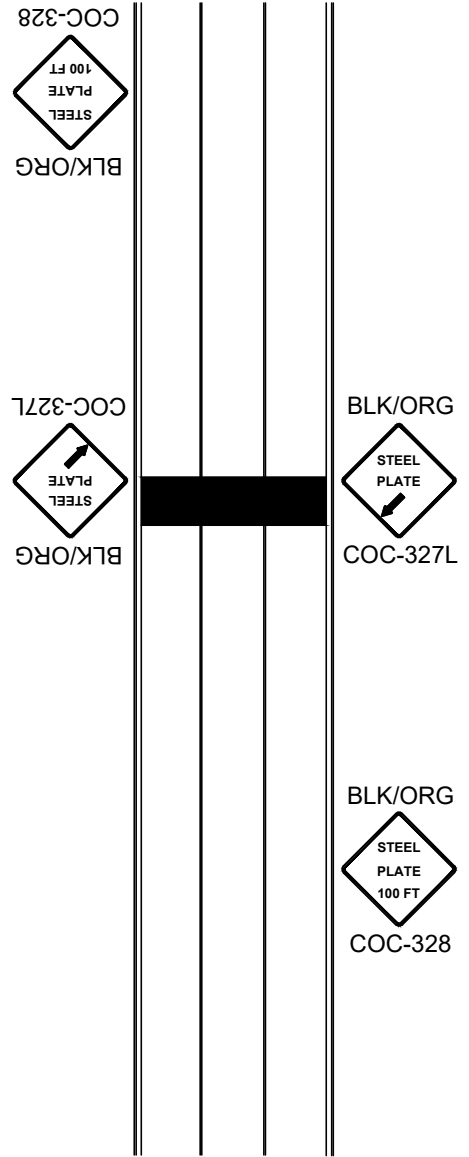
SIGN COC-327 (R/L) IS REQUIRED AT ALL PLATE LOCATIONS. SIGN COC-328 IS REQUIRED WHEN POSTED SPEED IS 35 MPH OR GREATER.

SIGNS SHOULD BE PLACED IN ALL DIRECTIONS THAT ARE AFFECTED. SIGN SPACING SHALL INCREASE TO 250' WHEN SPEED EXCEEDS 45 MPH.

SIGNS SHOULD BE DUAL MOUNTED ON MULTI-LANE, ONE-WAY ROADWAYS.

ALL SIGNS SHALL BE MOUNTED IN ACCORDANCE WITH THE OHIO MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES (OMUTCD).

SIGNS SHALL NOT BE PLACED IN A MANNER THAT WOULD BLOCK PARKING, BIKE LANES, OR RESTRICT A PEDESTRIAN FROM USING ANY SIDEWALK INCLUDING CURB RAMPS. PAR SHALL BE MAINTAINED AT ALL TIMES.



STEEL PLATE REQUIREMENTS

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Appendix C Landowner List

APPENDIX C LANDOWNER LIST

Parcel Number	Property Owner	Property Address
010-110681	CITY OF COLUMBUS	345 GRACELAND BLVD, COLUMBUS OH 43214
010-009359-00	ATVAYA LLC	750 MORSE RD
010-002433-00	900-71 LLC	900-908 MORSE RD
010-143735	PUBLIC LIBRARY OF COLUMBUS & FRANKLIN COUNTY OH	5590 KARL RD, COLUMBUS OH 43229
010-110285-00	STATE OF OHIO/ SCHOOL OF THE DEAF	500 MORSE RD, COLUMBUS, OH 43214
010-058157-00	CITY ONE, LLC, AN OHIO LIMITED LIABILITY COMPANY	700 MORSE RD, COLUMBUS, OH 43214
010-204047	STATE OF OHIO	894 WOODY HAYES DRIVE - EXISTING LAYDOWN YARD