

Item No. 204S
Portland Cement Treatment for Materials in Place

204S.1 Description

This item shall govern the treatment of materials in place by pulverizing soil or aggregate materials, adding Portland cement, mixing, wetting and then compacting the treated material to the required density, as herein specified and in conformity with the typical sections, lines, grades and thickness as shown on the Drawings or as established by the Engineer or designated representative. This item applies to natural subgrade soils, embankment materials, new base or existing base (with or without asphaltic concrete pavement layers) or combinations as shown on the Drawings.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text the inch-pound units are given preference followed by SI units shown within parentheses.

204S.2 Submittals

The submittal requirements of this specification item may include:

- A. A mix design identifying classification of in-place materials, type of cement, source of water and quantities of cement and water required in the proposed application to yield the specified compressive strength requirements, and
- B. An update in the mix design, if source of material changes during construction,
- C. A plan describing the construction equipment proposed for the work and identifying the type and condition of each equipment item.

204S.3 Materials

- A. Soil

Soil shall consist of approved material, free from vegetation or other objectionable matter, encountered in the existing roadway and/or other acceptable embankment or borrow material selected for use in preparation of the roadway in accordance with this specification.

- B. Portland Cement

Portland cement shall be either Type 1, 1P or II and shall conform to TxDOT Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges Item No. 524.

The Contractor may use bag or bulk cement.

C. Water

Water shall be free from oils, acids, organic matter or other substances deleterious to the cement treatment of materials. The water shall not contain more than 1000 parts per million of chlorides as Cl nor more than 1000 parts per million of sulfates as SO₄. Water from municipal supplies approved by the State Health Department will not require testing, but water from other sources will be sampled and tested in accordance with AASHTO T-26. The water source shall be approved by the Engineer or designated representative.

204S.4 Equipment

The equipment utilized for materials, which are specified to be measured or proportioned by weight (mass) shall be approved by the Engineer or designated representative. Prior to the start of construction operations the equipment necessary for the proper construction of the work shall be on the project site, in first class working condition and approved by the Engineer or designated representative, both as to type and condition. The Contractor shall at all times provide sufficient equipment to enable continuous prosecution of the work and to insure completion in the required number of working days.

"Portland Cement Treatment for Materials in Place" may be constructed with any machine or combination of machines and auxiliary equipment that will produce results as outlined in this specification.

Mixing may be accomplished by (1) a multiple-pass traveling mixing plant or (2) a single-pass traveling mixing plant.

The equipment provided by the Contractor shall be operated by experienced and capable workers and shall be that necessary to provide a cement treatment meeting the requirements herein specified.

204S.5 Mix Design

Cement content will be selected by the Engineer or designated representative, based on compressive strength test results from a testing laboratory approved by the City of Austin. The mix design shall meet the strength requirements as shown on the Drawings or indicated in the Specifications.

Unless otherwise indicated in the Drawings or established by the Engineer or designated representative, the mix will be designed with the intention of producing a minimum average 7 day compressive strength of 400 pounds per square inch (2750 kilopascals) using the unconfined compression testing procedures described in TxDOT Test Method Tex-120-E.

When material properties or sources change, Contractor shall provide additional mix design tests and adjust the cement content as necessary to meet the compressive strength requirements.

204S.6 Construction Methods

A. General

Prior to commencement of this work, all required erosion control and tree protection measures shall be in place and the utilities located and protected as specified in the City of Austin Standard Contract Document Section 00700, "General Conditions".

Construction equipment shall not be operated within the drip line of trees unless otherwise indicated on the Drawings. Construction materials shall not be stockpiled under the canopies of trees. Excavation or embankment materials shall not be placed within the drip line of trees until tree wells are constructed.

It is the primary requirement of this specification to secure a uniformly treated course of cement treated material, free from loose or segregated areas, of uniform density and moisture content, well bound for its full depth and with a smooth surface suitable for placing subsequent courses.

B. Preparation of Subgrade or existing surface

Prior to scarifying or pulverizing the existing material, the subgrade or existing surface shall be graded and shaped as required to construct the "Portland Cement Treatment for Materials in Place" in conformance with the lines, grades, thickness and cross section indicated on the Drawings or as approved by the Engineer or designated representative. Unsuitable material shall be removed and replaced with acceptable material.

The Contractor shall proof roll the subgrade or existing surface in accordance with Standard Specification Item No, 236S. The subgrade or existing surface shall be firm and able to support without displacement the construction equipment and the compaction hereinafter specified. Soft or yielding subgrade shall be corrected and made stable before construction proceeds.

When the Contractor elects to use a cutting and pulverizing machine that will process the material to the specified depth, the Contractor will not be required to excavate to the secondary grade or windrow the material. This method will be permitted only if a machine is provided which will insure that the material is cut uniformly to the proper depth and which has cutters that will plane the secondary grade to a smooth surface over the entire width of the cut. The machine shall be of such design that a visible indication is provided at all times that the machine is cutting to the proper depth. If the machine fails to achieve the proper cutting depth, it shall be removed from the project or adjusted to the satisfaction of the Engineer or designated representative to accomplish the work as specified

In lieu of using the cutting and pulverizing machine, the Contractor shall excavate and windrow the material to expose the secondary grade to the typical sections, lines and grades as shown on the Drawings or as established by the Engineer or

designated representative. The windrowed material shall be uniformly replaced before the cement is applied.

C. Pulverization

The existing subgrade material to be stabilized shall be so pulverized that, a minimum of 80 percent passes a No. 4 (4.75 mm) sieve, exclusive of gravel or stone retained on this sieve. When shown on the Drawings or approved by the Engineer or designated representative, this pulverization requirement may be waived if the material contains a substantial amount of aggregate.

Existing asphaltic concrete wearing surfaces, subbases and bases shall be pulverized so that 100 percent will pass a 2 inch (50 mm) sieve.

D. Application of Cement (Roadmix)

It shall be the responsibility of the Contractor to (1) regulate the sequence of work, (2) process a sufficient quantity of material to provide full depth as indicated on the Drawings, (3) use the proper amount of Portland cement, that is established by the approved job mix design or approved by the Engineer or designated representative and (4) maintain the work and rework the courses as necessary to meet the design strength requirements.

The cement shall be spread by an approved spreader or by bag distribution. It shall be distributed at a uniform rate and in such a manner as to reduce to a minimum the scattering of cement by wind. Cement treatment shall not be mixed or placed when the wind velocity exceeds 15 miles (25 kilometers) per hour or when the air temperature is below 400F (40C) and falling, but may be mixed or placed when the air temperature is above 350F (20C) and rising. The temperature shall be taken in the shade and away from artificial heat. In any event cement treatment shall be mixed or placed only when weather conditions, in the opinion of the Engineer or designated representative, are suitable. If a bulk cement spreader is used, it shall be positioned with string lines or other approved method during spreading to insure a uniform distribution of cement.

Cement shall be applied only in that area where the mixing, compacting and finishing operations can be continuous and completed in daylight within 6 hours of such application.

The percentage of moisture in the soil at the time of cement application shall not exceed the quantity that will permit uniform and intimate mixture of material and cement during dry mixing operations. The percentage of moisture in the soil at the time of cement application shall not exceed the optimum moisture content for the cement-stabilized mixture.

No equipment, except that used in spreading and mixing, will be allowed to pass over the freshly spread cement until it is mixed.

E. Mixing and Processing

Either single or multiple soil stabilizer mixers shall be used.

After any required mixing of the material(s), the cement shall be dry mixed with the material(s) prior to the addition of water. Immediately after dry mixing, water shall

be uniformly applied. After mixing, the mixture shall be in a loose, evenly spread state ready for compaction. The mixture shall be mixed and compacted in one (1) lift.

The mixer shall be provided with means for the visible and accurate gauging of the water application. The water shall be uniformly applied through a pressure spray bar.

After the cement is spread, the mixing operation shall proceed as follows:

1. The mixer shall in one continuous operation: mix the air-dry material and cement to the full depth indicated on the Drawings, provide for the addition of water uniformly, thoroughly moist-mix the material, cement and water, spread the completed cement mixture evenly over the machine processed width of the subgrade, and leave it in a loose condition ready for immediate compaction.
2. The stabilized cement mixture shall not remain undisturbed after mixing and before compacting for more than 30 minutes.

F. Compaction

Unless otherwise shown on the Drawings or established by the Engineer or designated representative, the cement treated course shall be sprinkled as required herein and compacted to the extent necessary to provide not less than 95 percent of the density as determined by TxDOT Test Method Tex-120-E, Part II. The in place roadway density will be determined by TxDOT Test Method Tex-115-E.

At the start of compaction, the percentage of moisture in the mixture and in unpulverized soil lumps, shall be within 2 percentage points either side of the specified optimum moisture content as determined by TxDOT Test Method Tex-120-E, unless otherwise approved by the Engineer or designated representative. The percent of moisture will be determined in accordance with TxDOT Test Method Tex-103-E.

If the percent of moisture is outside the allowable tolerance, the Contractor shall adjust operations to meet this requirement. When the uncompacted cement stabilized mixture is wetted by rain so that the average moisture content exceeds the specified tolerance at the time of final compaction, the entire section shall be reconstructed in accordance with this specification at the sole expense of the Contractor.

When the material fails to meet the density requirements or should the material lose the required stability, density or finish before the next course is placed or the project is accepted, the treated material shall be removed and replaced, unless otherwise approved by the Engineer or designated representative. Removal and replacement with acceptable treated material will be at the Contractor's expense. All initial density testing will be paid for by the City of Austin. All retesting shall be paid for by the Contractor.

G. Finishing

The resulting surface shall be "clipped", "skinned" or "tight bladed" by a maintainer or subgrade trimmer to a depth of approximately 1/4 inch (6 mm), removing all loosened materials. The loosened materials will be disposed of at the Contractor's expense and at a location approved by the Engineer or designated representative. The surface shall then be rolled with the pneumatic roller in accordance with Standard Specification Item No. 232S, adding small increments of moisture as needed during rolling. Throughout this operation, the shape of the course shall be maintained and the surface upon completion shall be smooth and in conformity with the typical sections, lines and grades as shown on the Drawings or as established by the Engineer or designated representative.

If plus No. 4 (4.75 mm) aggregate is present in the mixture, one complete coverage of the section with the flat wheel roller in accordance with Standard Specification Item No. 230S shall be made immediately after the "clipping" operation. When directed by the Engineer or designated representative, surface finishing methods may be varied from this procedure, provided a dense, uniform surface, free of surface compaction planes, is produced.

The moisture content of the surface material must be maintained within two (2) percentage points of optimum during all finishing operations. Surface compaction and finishing shall proceed in such a manner as to produce, in not more than 2 hours, a smooth, closely knit surface conforming to the crown, grade and line indicated which is free of cracks, ridges or loose material.

204S.7 Curing

A. Protection and Cover

After the cement treated course has been finished as specified herein, the surface shall be protected against rapid drying by either one of the following curing methods. The protection measures shall be continued: (a) for the specified period, but in no case less than 3 days, or (b) until the surface or subsequent courses are placed:

1. Maintain in a thorough and continuously moist condition by sprinkling.
2. Apply a 2 inch (50 mm) layer of earth on the completed course and maintain in a moist condition.
3. Apply an asphaltic material to the treated course at the rate of 0.05 to 0.20 gallon per square yard (0.25 to 0.90 liters per square meter), as determined by the Engineer or designated representative. The asphalt used shall be the type and grade shown on the Drawings or as approved by the Engineer or designated representative, in accordance with Standard Specification Item No. 301. The asphalt shall completely cover and seal the total surface of the base and fill all voids.

If this method is used, it shall be the Contractor's responsibility to protect the asphalt membrane from being picked up by traffic by either sanding or dusting the membrane surface. The asphalt membrane may remain in place when the proposed surface or other base courses are placed.

B. Surface

The surface or other base courses may be applied on the finished base as soon after completion as operations will permit.

204S.8 Construction Joints

At the end of each day's construction, a straight transverse construction joint shall be formed by cutting back into the total width of completed work to form a vertical face free of loose and shattered material.

Cement treatment for large, wide areas shall be built in a series of parallel lanes of convenient length and width meeting the approval of the Engineer or designated representative.

204S.9 Traffic

Completed sections of cement treated material in place may be opened immediately to local traffic, construction equipment and all traffic after the curing period, provided the cement treated course has hardened sufficiently to prevent marring or distorting of the surface by equipment or traffic.

204S.10 Maintenance

The Contractor shall be required to maintain the cement treated course in good condition until all work has been completed and accepted. Maintenance shall include immediate repairs of any defects that may occur. This work shall be done by the Contractor at no additional cost to the Owner and shall be repeated as often as needed to keep the area continuously intact. Any improper, insufficient or faulty work shall be replaced to the full depth of treatment.

It is the intent of this specification that the Contractor construct the plan depth of cement treatment in one homogeneous mass. The addition of thin stabilized layers will not be permitted to provide the minimum specified depth.

204S.11 Measurement

"Portland Cement Treatment for Materials in Place" will be measured as follows:

Cement treatment for materials in place will be measured by the square yard (square meter: 1 square meter equals 1.196 square yards) of surface area of completed and accepted work.

<u>SPECIFIC CROSS REFERENCE MATERIALS</u>
Item 204S, "PORTLAND CEMENT TREATMENT FOR MATERIALS IN PLACE"

City of Austin Standard Contract Documents

<u>Designation</u>	<u>Description</u>
Section 00700	General Conditions

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 230S	Rolling (Flat Wheel)
Item No. 232S	Rolling (Pneumatic Tire)
Item No. 236S	Proof Rolling
Item No. 30S	Asphalts, Oils and Emulsions

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item No. 524	Hydraulic Cement

Texas Department of Transportation: Manual of Testing Procedures

<u>Designation</u>	<u>Description</u>
Tex-103-E	Determination of Moisture Content of Soil Materials
Tex-115-E	Field Method for Determination of In-Place Density Soils & Base Materials

Tex-120-E Soil Cement Testing

American Association of Highway and Transportation Officials, Standard Specifications

Designation Description

T-26 Quality of Water Used in Concrete

<i>RELATED CROSS REFERENCE MATERIALS</i>
Item 204S, "PORTLAND CEMENT TREATMENT FOR MATERIALS IN PLACE"

City of Austin Standard Specification Items

<u>Designation</u>	<u>Description</u>
Item No. 101S	Preparing Right of Way
Item No. 102S	Clearing and Grubbing
Item No. 104S	Removing Portland Cement Concrete
Item No. 110S	Street Excavation
Item No. 111S	Excavation
Item No. 130S	Borrow
Item No. 132S	Embankment
Item No. 202S	Hydrated Lime and Lime Slurry
Item No. 203S	Lime Treatment for Materials in Place
Item No. 210S	Flexible Base

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

Designation	Description
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 112	Subgrade Widening

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item No. 132	Embankment
Item No. 150	Blading
Item No. 158	Specialized Excavation Work
Item No. 204	Sprinkling
Item No. 210	Rolling (Flat Wheel)
Item No. 211	Rolling (Tamping)
Item No. 213	Rolling (Pneumatic Tire)
Item No. 275	Portland Cement Treated Materials (Road Mixed)
Item No. 276	Portland Cement Treated Base (Plant Mixed)
Item No. 421	Portland Cement Concrete
Item No. 522	Portland Cement Concrete Plants

Texas Department of Transportation: Manual of Testing Procedures

<u>Designation</u>	<u>Description</u>
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Tex-101-E	Surveying and Sampling Soils for Highways
Tex-104-E	Determination of Liquid Limit of Soils
Tex-105-E	Determination of Plastic limit of Soils
Tex-106-E	Method of Calculating the Plasticity Index of Soils
Tex-112-E	Methods of Admixing Lime to Reduce Plasticity Index of Soils
Tex-114-E	Laboratory Compaction Characteristics & Moisture Density Relationship of Subgrade & Embankment Soil
Tex-117-E	Triaxial Compression Tests for Disturbed Soils and Base Materials