

SECTION 170
CEMENT-TREATED SUBGRADE

170-1 Description.

Construct a cement-treated subgrade, composed of a combination of soil and portland cement, uniformly mixed, moistened, shaped, compacted, finished, and cured.

170-2 Materials.

Meet the following requirements:

Cut-Back Asphalt, Grade RC-70 (Alternate for curing)	916-2
Emulsified Asphalt, Grade SS-1 (Alternate for curing).....	916-4
Portland Cement, Type I.....	Section 921
Water.....	Section 923

Use soil for this cement-treated subgrade consisting of the natural material in the roadway or select soil placed in the roadbed, as shown in the plans, or a combination of these materials proportioned as directed. Do not use soil containing gravel or stone retained on a 2 inch [50 mm] sieve or more than 45% retained on a No. 4 [4.75 mm] sieve.

170-3 Composition and Proportioning.

Apply portland cement at the rate determined by the Engineer for the particular soil used. Do not start any processing of the soil-cement mixture until all tests of the soil to be used to construct the subgrade are complete and the specified rate of application of portland cement for the particular soil has been determined. The Engineer will require a period of approximately three weeks, subsequent to the time that the Contractor substantially completes a particular section of roadbed to grade, for such testing. The Engineer will specify the rate of application in terms of either pounds [kilograms] of portland cement per square yard [square meter] of the area to be mixed, or pounds [kilograms] of cement per cubic yard [cubic meter] of soil-cement mixture.

170-4 Preparation.

Prior to beginning subgrade treatment, construct the roadbed to an elevation which will provide a subgrade conforming to the Contract Documents upon completion of the cement treatment. Ensure that the roadbed is firm enough to support the equipment used in the cement treatment without appreciable distortion or displacement. Correct soft or yielding areas prior to mixing.

When the cement-treated subgrade is constructed of central-plant-mixed material, ensure that the underlying roadbed is moist to a depth of at least 1 inch [25 mm] at the time the material is spread.

170-5 Construction Methods.

170-5.1 General: If cement treatment of the subgrade is to be accomplished in conjunction with lime treatment, do not start spreading cement in an area until a minimum of seven days has elapsed from completion of the lime treatment operation for that area.

Mix the soil, cement, and water either by the mixed-in-place or the central-plant-mix method.

Ensure that the percentage of moisture in the soil at the time of cement application does not exceed the quantity that will permit a uniform and intimate mixture of soil and cement during mixing operations. For clay soils, ensure that the moisture content does not exceed the optimum moisture content for the soil-cement mixture. For sandy soils, ensure that the moisture content is within 2% above or below the optimum moisture content.

With certain types of soils, the Engineer may designate a moisture range other than those specified above.

During seasons of probability of freezing temperatures, do not make or place any cement or soil-cement mixture when conditions indicate that the temperature may fall below 35°F [2°C] within 24 hours. Also, do not spread any material unless the temperature is at least 40°F [4°C] in the shade and rising.

At completion of moist-mixing, pulverize the soil so that 100% passes a 1 inch [25.0 mm] sieve and a minimum of 80% passes a No. 4 [4.75 mm] sieve, exclusive of gravel and stone retained on the No. 4 [4.75 mm] sieve.

Perform the operations as specified in this Article and in 170-6 and 170-7, continuously, and complete them within a period of four hours, starting from the time mixing commences.

170-5.2 Mixed-in-Place: Where feasible, process the entire width of the subgrade as a single operation. Spread the specified quantity of cement uniformly on the subgrade at the required rate of application, by means of an approved method. If spread cement becomes displaced, replace it before mixing begins.

After applying the cement, begin mixing within 30 minutes. Initially mix the soil and cement until the cement has sufficiently blended with the soil to prevent formation of cement balls. Then, add water as necessary, and remix the soil-cement mixture.

The Contractor may process the soil-cement mixture to full depth in one course, provided that he can satisfactorily distribute the cement and water and obtain the specified density of the subgrade. If not, the Contractor shall perform construction in courses of such thickness to obtain satisfactory results. Make provisions to achieve adequate bonding between courses.

Immediately after mixing the soil and cement, add any necessary additional water. If the moisture content exceeds that specified, manipulate the soil-cement mixture by remixing or blading, as required to reduce the moisture content to within the specified range. Avoid excessive concentrations of water. During the time of application of water and after applying all mixing water, continue mixing until a uniform and intimate mixture of soil, cement, and water has been obtained.

As an alternative to the above described procedure, the Contractor may use an approved machine that will blend the cement and the soil, and then add and mix-in any necessary additional water.

170-5.3 Central Plant Mix: Mix the soil, cement, and water in a pugmill of either the batch or continuous-flow type. Use a plant equipped with feeding and metering devices which will accurately proportion the soil, cement, and water in the quantities specified. Mix soil and cement sufficiently to prevent cement balls from forming when adding water. Continue mixing until an intimate and uniform mixture of soil, cement and water is obtained.

Haul the mixture to the roadway in trucks equipped with protective covers. Place the mixture on the moistened subgrade in a uniform layer with an approved spreader. Do not allow more than 30 minutes to elapse between the placement of soil-cement in adjacent passes of the spreader at any location. When portland cement concrete pavement is to be constructed on the cement-treated subgrade, plan operations such that the joint between adjacent passes of the spreader will be offset a minimum of 12 inches [300 mm] from any proposed longitudinal joint in the concrete pavement. Provide a layer of soil-cement uniform in thickness and surface contour, and in such quantity that the completed subgrade will conform to the required grade and cross-section. Do not dump the mixture in piles or windrows upon the grade.

170-6 Compaction.

Begin compaction of the soil-cement immediately after completing mixing. Do not allow more than 60 minutes to elapse between the last pass of moist-mixing and the start of compaction of the soil-cement mixture at a particular location.

At the start of the final compaction operation, ensure that the percentage of moisture in the mixture and in unpulverized soil lumps, based on dry weights, is not more than 2% above or below the optimum moisture content.

The Engineer will determine the optimum moisture content and maximum density in the field by the methods prescribed in AASHTO T 134 on representative samples of the soil-cement mixture he obtains from the area being processed.

Uniformly compact the loose mixture to not less than 95% of the maximum density as determined by AASHTO T 180.

170-7 Finishing.

After compaction, shape the surface of the soil-cement to the required lines, grades, and cross-section. Check the subgrade by the use of elevation stakes or other means approved by the Engineer. In all cases where soil-cement mixture is added to any portion of the surface, lightly scarify the surface with a spring tooth harrow, spike drag, or other approved device, such that the surface is uniformly loosened prior to the addition of material and prior to initial set of the soil-cement mixture. Then, compact the resulting surface to the specified density. Continue rolling until all rutting ceases and until the entire subgrade meets the density requirements as provided in 170-6. With certain granular soils, the Engineer may determine that minor tire marks are acceptable.

Maintain the moisture content of the surface material at not less than 2% below its specified optimum moisture content during finishing operations. Perform surface compaction and finishing in such a manner as to produce a smooth, dense surface, free of compaction planes, cracks, ridges, or loose material.

If the subgrade is to be trimmed to final elevation with an automatically controlled grading machine, ensure that the surface of the subgrade immediately prior to such trimming operation is parallel to, and not in excess of 1/2 inch [13 mm] above, the finished elevation of the subgrade.

170-8 Construction Joints.

At the end of each day's construction, make a straight transverse construction joint by cutting back into the completed work to form a true vertical face. Locate the construction joint so as to exclude all of that part of the subgrade at the end of the run which does not meet the requirements of this Section or the typical section.

170-9 Curing.

During the period when finishing and surface correction operations are being accomplished, keep the surface of the cement-treated subgrade continuously moist by sprinkling as necessary. Subsequent to this period, protect the finished treated subgrade from drying, for seven days, by application of either (1) cut-back asphalt, Grade RC-70, applied at the rate of 0.15 to 0.20 gal/yd² [0.68 to 0.91 L/m²]; or (2) a mixture containing equal parts of emulsified asphalt, Grade SS-1, and water, applied at the rate of 0.2 to 0.25 gal/yd² [0.91 to 1.13 L/m²]. The Engineer will specify the actual rate of application that provides complete coverage without excessive run-off. At the time of applying the bituminous material, ensure that the soil-cement surface is dense and free of loose and extraneous material, and contains sufficient moisture to prevent excessive penetration of the bituminous material.

Should it be necessary to allow construction equipment or other traffic to use the completed subgrade before the bituminous material has cured sufficiently to prevent pickup or displacement, apply clean sand to the bituminous material at a rate of approximately 10 lb/yd² [5.5 kg/m²].

170-10 Opening to Traffic.

Do not place traffic on the cement-treated subgrade subsequent to completion of the finishing operations as specified in 170-7 for a period of seven days. As an exception to this requirement, the Engineer will allow the equipment necessary for correction of surface irregularities and application of water and curing materials on the subgrade, provided that the tire contact pressures of such equipment do not exceed 45 psi [310 kPa]. After the seven day curing period, the Contractor may open the subgrade to

traffic, provided that the soil-cement either is protected or has hardened sufficiently to prevent marring or distorting of the surface by equipment or traffic.

170-11 Maintenance.

Maintain the completed subgrade to a true and satisfactory surface until placing the overlying course of materials. If repairs or patching is necessary, extend them to the full depth of the subgrade and perform them in a manner that will ensure restoration of a uniform subgrade meeting the requirements of this Section. Do not make repairs by adding a thin layer of soil-cement to the completed work. The Contractor may make full depth repairs to small or minor areas, such as to manholes, or inlets with Class I Concrete.

170-12 Thickness.

During various stages of construction, dig test holes in the mixture to determine the thickness. After completing the subgrade, dig or drill test holes, and determine the thickness of the subgrade from measurements made in these test holes.

Where the deficiency in subgrade thickness is (1) in excess of 1/2 inch [13 mm] for a subgrade up to 6 inches [150 mm] specified thickness, or (2) in excess of 1 inch [25 mm] for subgrade thicknesses over 6 inches [150 mm] specified thickness, remove the subgrade in the area of deficiency, and replace it with subgrade of the specified thickness, at no expense to the Department.

As an exception to the above, if the deficiency does not impair the required strength of the subgrade, in the opinion of the Engineer, the Contractor may leave the deficient area in place.

170-13 Method of Measurement.

170-13.1 Cement-Treated Subgrade: The quantity to be paid for will be the area, in square yards [square meters], completed and accepted.

170-13.2 Cement: The quantity to be paid for will be the weight, in tons [metric tons], of cement authorized and used in the operation.

170-14 Basis of Payment.

170-14.1 Cement-Treated Subgrade: Price and payment will be full compensation for all work specified in this Section, including pulverizing and mixing the soil and cement; furnishing, hauling, and applying the water and mixing the water with the soil-cement mixture; compacting the mixture; surface finishing; furnishing and placing curing materials; and removing and replacing materials deficient in density or thickness, as provided for in 170-7, 170-11, and 170-12.

170-14.2 Cement: Price and payment will be full compensation for furnishing, hauling, placing, and spreading the cement.

170-14.3 General: No separate payment will be made for bituminous material applied as a curing membrane. No additional compensation will be allowed for the labor and materials used in reconstructing defective and deficient thickness base as provided in 170-7, 170-11, and 170-12.

No payment will be made for the treatment of the subgrade or the theoretical amount of cement used in areas of deficient thickness left in place without correction.

170-14.4 Payment Items: Payment will be made under:

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| Item No. 170- 1- | Cement-Treated Subgrade - per square yard. |
| Item No. 2170- 1- | Cement-Treated Subgrade - per square meter. |
| Item No. 170- 2- | Cement - per ton. |
| Item No. 2170- 2- | Cement - per metric ton. |