

5-05 CEMENT CONCRETE PAVEMENT

5-05.1 Description

This Work shall consist of constructing a pavement composed of Portland cement concrete on a prepared Subgrade or base in accordance with these Specifications and in conformity with the lines, grades, thicknesses, and typical cross-sections shown in the Plans or established by the Engineer.

5-05.2 Materials

Materials shall meet the requirements of the following sections:

Portland Cement	9-01
Fine Aggregate	9-03
Coarse Aggregate	9-03
Combined Aggregate	9-03
Joint Filler	9-04.1
Joint Sealants	9-04.2
Reinforcing Steel	9-07
Dowel Bars	9-07.5
Tie Bars	9-07.6
Curing Materials and Admixtures	9-23
Water	9-25
Epoxy Resins	9-26

5-05.3 Construction Requirements

5-05.3(1) Concrete Mix Design for Paving

The Contractor shall provide a concrete mix design for each design of concrete specified in the Contract. The Contractor shall use ACI 211.1 as a guide to determine proportions. Concrete strength, placement, and workability shall be the responsibility of the Contractor. Following approval of the Contractor's proposal, all other requirements of [Section 5-05](#) shall apply.

1. **Materials.** Materials shall conform to [Section 5-05.2](#). Fine aggregate shall conform to [Section 9-03.1\(2\)](#), Class 1. Coarse aggregate shall conform to [Section 9-03.1\(4\)](#) AASHTO grading No. 467. An alternate combined gradation may be proposed, which has a maximum aggregate size equal to or greater than a 2-inch square sieve. The combined aggregate gradation shall conform to [Section 9-03.1\(5\)](#).

Fly ash, if used, shall not exceed 35-percent by weight of the total cementitious material, shall conform to [Section 9-23.9](#) and shall be limited to Class F with a maximum CaO content of 15-percent by weight.

Ground granulated blast furnace slag, if used, shall not exceed 25-percent by weight of the total cementitious material and shall conform to [Section 9-23.10](#). When both ground granulated blast furnace slag and fly ash are included in the concrete mix, the total weight of both these materials is limited to 35-percent by weight of the total cementitious material. As an alternative to the use of fly ash, ground granulated blast furnace slag and cement as separate components, a blended hydraulic cement that meets the requirements of [Section 9-01.2\(4\)](#) Blended Hydraulic Cements may be used.

The water/cement ratio shall be calculated on the total weight of cementitious material. The following are considered cementitious materials: Portland cement, fly ash, ground granulated blast furnace slag and microsilica. The minimum cementitious material for any mix design shall be 564-pounds per cubic yard.

2. **Submittals.** The Contractor's submittal shall include the mix proportions per cubic yard and the proposed sources for all ingredients including the power plant that generated the fly ash. The mix shall be capable of providing a minimum flexural strength of 650-psi at 14-days. Evaluation of strength shall be based on statistically analyzed results of 5 beam specimens made according to WSDOT T 808 and tested according to WSDOT T 802 that demonstrate a quality level of not less than 80-percent analyzed in accordance with [Section 1-06.2\(2\)D](#). In addition the Contractor shall fabricate, cure, and test 5 sets of cylinders, for evaluation of both 14 and 28-day strengths, according to WSDOT FOP's for AASHTO T 22 and AASHTO T 23 using the same mix design as used in fabrication of the beams. Compressive strength data (for 28-day strength) shall be submitted to the Engineer for use in determination of a conversion factor of flexural strength to compressive strength, which will be used by the Engineer for strength acceptance testing.

Mix designs submitted by the Contractor shall provide a unique identification for each proposal and shall include test data confirming that concrete made in accordance with the proposed design will meet the requirements of these Specifications. Test data shall be from an independent testing lab or from a commercial concrete producer's lab. If the test data is developed at a producer's lab, the Engineer or a representative may witness all testing.

3. **Mix Design Modifications.** The Contractor may initiate minor adjustments to the approved mix proportions. A plus or minus 200-pound variation in both the coarse and fine aggregate target weight will be allowed from the approved Contractor provided mix design weight as a modification without resubmittal. Utilizing admixtures to accelerate the set or to increase workability will be permitted only when approved by the Engineer. Only non-chloride accelerating admixtures that meet the requirements of [Section 9-23.6](#) Admixture for Concrete, shall be used.

The Contractor shall notify the Engineer in writing of any proposed modification. A new mix design will designate a new lot.

5-05.3(2) Consistency

The materials shall be mixed with sufficient water to produce a stiff concrete which will hold its shape when deposited upon the Subgrade. Concrete placed during wet weather must be mixed with sufficient water to produce a very stiff mixture. The consistency shall be such that separation of the mortar from the coarse aggregate will not occur in handling.

The water/cementitious material ratio, by weight, shall not exceed 0.44. When slip form paving equipment is used, the Contractor shall further control concrete consistency to ensure that edge slump conforms to the requirements of [Section 5-05.3\(11\)](#).

5-05.3(3) Equipment

Equipment necessary for handling materials and performing all parts of the Work shall be approved by the Engineer as to design, capacity, and mechanical condition. The equipment shall be at the jobsite sufficiently ahead of the start of paving operations to be examined thoroughly and approved.

5-05.3(3)A Batching Plant and Equipment

1. **General.** The batching plant shall include bins, weighing hoppers, and scales for the fine aggregate and for each size of coarse aggregate. If cement is used in bulk, a bin, hopper, and separate scale for cement shall be included. The weighing hoppers shall be properly sealed and vented to preclude dusting during operation. The batching plant shall be equipped with a suitable batch counter that cannot be reset, which will correctly indicate the number of batches proportioned.
2. **Bins and Hoppers.** Bins with adequate separate compartments for fine aggregate and for each size of the coarse aggregate shall be provided in the batching plant.

5-05.3(3)B Mixing Equipment

1. **General.** Concrete may be mixed at a batching plant or wholly or in part in truck mixers. Each mixer shall have attached in a prominent place a manufacturer's plate showing the capacity of the drum in terms of volume of mixed concrete and the speed of rotation of the mixing drum or blades.
2. **Batching Plant.** Mixing shall be in an approved mixer capable of combining the aggregates, cement, and water into a thoroughly mixed and uniform weight within the specified mixing period.

Mixers shall be cleaned at suitable intervals. The pickup and throw-over blades in the drum shall be repaired or replaced when they are worn down $\frac{3}{4}$ -inch or more. The Contractor shall have available at the jobsite a copy of the manufacturer's design, showing dimensions and arrangements of the blades in reference to original height and depth, or provide permanent marks on blades to show points of $\frac{3}{4}$ -inch wear from new conditions. Drilled holes $\frac{1}{4}$ -inch in diameter near each end and at midpoint of each blade are recommended.

3. **Truck Mixers and Truck Agitators.** Truck mixers used for mixing and hauling concrete, and truck agitators used for hauling plant-mixed concrete, shall conform to the requirements of [Section 6-02.3\(4\)A](#).
4. **Nonagitator Trucks.** Bodies of nonagitator hauling equipment for concrete shall be smooth, mortar-tight, metal containers and shall be capable of discharging the concrete at a satisfactory controlled rate without segregation. Covers shall be provided when needed for protection. Plant-mixed concrete may be transported in nonagitator vehicles provided that the concrete is delivered to the site of the Work and discharge is completed within 45-minutes after the introduction of mixing water to the cement and aggregates, and provided the concrete is in a workable condition when placed.

5-05.3(3)C Finishing Equipment

The standard method of constructing concrete pavement on State Highways shall be with approved slip-form paving equipment designed to spread, consolidate, screed, and float-finish the freshly placed concrete in one complete pass of the machine so a dense and homogeneous pavement is achieved with a minimum of hand finishing. On other roads and on WSDOT projects requiring less than 500-square yards of cement concrete pavement or requiring individual placement areas of less than 500-square yards, irregular areas, intersections and at locations inaccessible to slip-form paving equipment, cement concrete pavement may be placed with approved placement and finishing equipment utilizing stationary side forms. Hand screeding and float finishing of cement concrete pavement may only be utilized on small irregular areas as allowed by the Engineer.

5-05.3(3)D Joint Sawing Equipment

The Contractor shall provide approved power driven concrete saws for sawing joints, adequate in number of units and power to complete the sawing at the required rate. The Contractor shall provide at least one standby saw in good working order. An ample supply of saw blades shall be maintained at the site of the Work at all times during sawing operations. The Contractor shall provide adequate artificial lighting facilities for night sawing. All of this equipment shall be on the job both before and continuously during concrete placement. Sawing equipment shall be available immediately and continuously upon call by the Engineer on a 24-hour basis, including Saturdays, Sundays and holidays.

5-05.3(3)E Smoothness Testing Equipment

The Contractor shall provide a California-type computerized profilograph, complete with recorder, for determining the profile index of the pavement according to WSDOT Test Method No. 807. The profilograph shall be on the project, calibrated, in good working condition, and ready for operation before construction of any concrete pavement begins. The operator shall be competent and experienced in operation of the equipment.

5-05.3(4) Measuring, and Batching Materials

The batch plant site, layout, equipment, and provisions for transporting material shall ensure a continuous supply of material to the Work.

1. Measuring Materials

- a. Aggregates. The fine aggregate and each size of coarse aggregate shall be measured by weighing, the weight for the particular aggregates used being proportional to their respective bulk specific gravities. The weighing of each size of material shall be a separate and distinct operation.
Corrections shall be made for variations in weight of materials due to the moisture content.
The equipment for weighing aggregates shall conform to the requirements of [Section 1-09.2](#).
- b. Cement. Cement shall be weighed on scales meeting the requirements of [Section 1-09.2](#). Adequate provision shall be made to prevent loss of cement between the batch box and the mixer.
- c. Water. Water may be measured either by volume or by weight. The accuracy of measuring the water shall be within a range of error of not over 1-percent.

2. **Batching Materials.** On all projects requiring more than 2500-cubic yards of Portland cement concrete for paving, the batching plant shall be equipped to proportion aggregates and cement by weight by means of automatic and interlocked proportioning devices of approved type.

5-05.3(4)A Acceptance of Portland Cement Concrete Pavement

Acceptance of Portland cement concrete pavement shall be as provided under statistical or nonstatistical acceptance. Determination of statistical or nonstatistical shall be based on Proposal quantities and shall consider the total of all Bid items involving of a specific class.

Statistical acceptance will apply only to Contracts advertised, Awarded and administered by WSDOT, unless specifically provided otherwise in the Special Provisions. Contracting agencies other than WSDOT must specifically invoke statistical acceptance in their Special Provisions if it is desired.

Statistical Acceptance, (1) applies only to WSDOT projects, (2) is administered under the provisions of [Section 5-05.5](#), and (3) will be used for a class of mix when the Proposal quantities for that class of mix is 1500-cubic yards or greater.

Nonstatistical Acceptance will be used (1) for a class of mix when the Proposal quantities for that class of mix is less than 1500-cubic yards and (2) all contracts advertised, Awarded and administered by agencies other than WSDOT.

The point of acceptance will be per WAQTC FOP for TM 2 (Western Alliance for Quality Transportation Construction) or at the point of discharge when a pump is used.

Acceptance of Concrete. The concrete producer shall provide a certificate of compliance for each truckload of concrete in accordance with [Section 6-02.3\(5\)B](#).

For the purpose of acceptance sampling and testing, a lot is defined as the total quantity of material to be used that was produced for the same class of mix. All of the test results obtained from the same material shall be evaluated collectively and shall constitute a lot. The quantity represented by each sample will constitute a subplot. Sampling and testing for statistical acceptance shall be performed on a random basis at the frequency of one sample per subplot. Subplot size shall be determined to the nearest 10-cubic yards to provide not less than three uniform sized sublots with a maximum subplot size of 500-cubic yards.

The Engineer will furnish the Contractor with a copy of the results of all acceptance testing performed within 2-working days after testing. The Engineer will also provide the Composite Pay Factor (CPF) of the completed sublots after 3 have been tested.

Acceptance testing for compliance of air content and 28-day compressive strength shall be conducted from samples prepared according to WAQTC FOP TM 2. Air content shall be determined by conducting WAQTC FOP for AASHTO T 152. If the Contractor fails to provide the Aggregate Correction Factor per WAQTC FOP for AASHTO T 152 with the mix design, one will not be applied. Compressive Strength shall be determined by AASHTO T 23 and AASHTO T 22.

The Contractor shall provide cure boxes in accordance with [Section 6-02.3\(5\)H](#), and protect concrete cylinders in cure boxes from excessive vibration and shock waves during the curing period in accordance with [Section 6-02.3\(6\)D](#). Payment for cure boxes shall be in accordance with [Section 6-02.5](#).

The Specification limits as defined in Section 1-06.2(2)D shall be as follows. The lower Specification limit for Air Content shall be 3.0-percent, and the upper Specification limit for Air Content shall be 7.0-percent. The lower Specification limit for compressive strength shall be 1200-psi less than that established in the mix design as the arithmetic mean of the 5 sets of 28-day compressive strength cylinders, or 3000-psi, whichever is higher. These compressive strength cylinders are to be cast at the same time as the flexural beams that were used to prequalify the mix design under [Section 5-05.3\(1\)](#). There is no upper Specification limit for 28-day compressive strength.

The price adjustment factor (f) defined in [Section 1-06.2\(2\)D](#) shall be 6 for compressive strength and 4 for air content.

If either the air content or compressive strength is not measured in accordance with this section its individual pay factor will be considered to be 1.00 in calculating the Composite Pay Factor.

Rejection of Concrete

1. **Rejection by the Contractor.** The Contractor may, prior to sampling, elect to remove any defective material and replace it with new material at no expense to the Contracting Agency. Any such new material will be sampled, tested and evaluated for acceptance.
2. **Rejection Without Testing.** The Engineer may reject any load that appears defective prior to placement. Material rejected before placement shall not be incorporated into the pavement. No payment will be made for the rejected materials unless the Contractor requests that the rejected material be tested. If the Contractor elects to have the rejected materials tested, a sample will be taken and both the air content and strength shall be tested by WSDOT.

Payment for rejected material will be based on the results of the 1 sample, which was taken and tested. If the rejected material fails either test, no payment will be made for the rejected material and in addition, the cost of sampling and testing, at the rate of \$250.00 per sample shall be borne by the Contractor. If the rejected material passes both tests the mix will be compensated at a CPF of 1.00 and the cost of the sampling and testing will borne by the Contracting Agency.

5-05.3(5) Mixing Concrete

The concrete may be mixed in a batching plant or in truck mixers. The mixer shall be of an approved type and capacity. Mixing time shall be measured from the time all materials are in the drum. Ready-mixed concrete shall be mixed and delivered in accordance with the requirements of [Section 6-02.3\(4\)](#), [6-02.3\(4\)A](#) and [6-02.3\(4\)B](#).

When mixed in a batching plant, the mixing time shall not be less than 50-seconds nor more than 90-seconds.

The mixer shall be operated at a drum speed as shown on the manufacturer's nameplate on the mixer. Any concrete mixed less than the specified time shall be discarded and disposed of by the Contractor at no expense to the Contracting Agency. The volume of concrete mixed per batch shall not exceed the mixer's rated capacity, as shown on the manufacturer's standard rating plate on the mixer.

Each concrete mixing machine shall be equipped with a device for counting automatically the number of batches mixed during the day's operation.

Retempering concrete by adding water or by other means will not be permitted.

5-05.3(5)A Limitations of Mixing

Concrete shall not be mixed, placed, or finished when the natural light is inadequate, as determined by the Engineer, unless an adequate and approved artificial lighting system is operated.

Mixing and placing concrete shall be discontinued when a descending air temperature in the shade away from artificial heat reaches 40°F and shall not be resumed until an ascending air temperature in the shade and away from artificial heat reaches 35°F unless authorized in writing by the Engineer.

When mixing and placing is authorized during cold weather, the aggregates may be heated by either steam or dry heat prior to being placed in the mixer. The apparatus used shall heat the mass uniformly and shall be arranged to preclude the possible occurrence of overheated areas which might injure the materials. Unless otherwise authorized, the temperature of the mixed concrete shall be not less than 50°F and not more than 90°F at the time of discharge into the hauling conveyance. No concrete shall be mixed with frozen aggregates.

5-05.3(6) Subgrade

The Subgrade shall be constructed in accordance with [Section 2-06](#).

The Subgrade shall be prepared and compacted a minimum of 3-feet beyond each edge of the area which is to receive concrete pavement in order to accommodate the slip-form equipment. Concrete shall not be placed on a frozen Subgrade nor during heavy rainfall.

The Subgrade shall be moist before the concrete is placed.

When the Subgrade is an asphalt treated base the surface shall be clean and free of any deleterious materials. When placing concrete on a treated base, the surface temperature shall not exceed 90°F. If water is used for cooling any excess water standing in pools or flowing on the surface shall be removed prior to placing concrete.

5-05.3(7) Placing, Spreading, and Compacting Concrete

The provisions relating to the frequency and amplitude of internal vibration shall be considered the minimum requirements and are intended to ensure adequate density in the hardened concrete. Referee testing of hardened concrete will be performed by cutting cores from the finished pavement after a minimum of 24-hours of curing. Density determination will be made based on the water content of the core as taken. WSDOT Test Method T 810 shall be used for the determination of core density. Reference cores will be taken at the minimum rate of 1 for each 500-cubic yards of pavement, or fraction thereof. These same cores will be used for thickness measurements as required by [Section 5-05.5\(1\)](#).

The average density of the cores shall be at least 97-percent of the approved mix design density or the actual concrete density when determined by the Contractor using AASHTO T 121 with no cores having a density of less than 96-percent.

Failure to meet the above requirement will be considered as evidence that the minimum requirements for vibration are inadequate for the job conditions, and additional vibrating units or other means of increasing the effect of vibration shall be employed so that the density of the hardened concrete as indicated by further referee testing shall conform to the above listed requirements. Primary units of pavement, as defined in [Section 5-05.5\(1\)](#), not meeting the prescribed minimum density shall be removed and replaced with satisfactory material. At the option of the Engineer, noncompliant material may be accepted at a reduced price.

5-05.3(7)A Slip-Form Construction

The concrete shall be distributed uniformly into final position by a self-propelled slip-form paver without delay. The alignment and elevation of the paver shall be regulated from outside reference lines established for this purpose. The paver shall vibrate the concrete for the full width and depth of the strip of pavement being placed and the vibration shall be adequate to provide a consistency of concrete that will stand normal to the surface with sharp well-defined edges. The sliding forms shall be rigidly held together laterally to prevent spreading of the forms.

The plastic concrete shall be effectively consolidated by internal vibration with transverse vibrating units for the full width of pavement and/or a series of equally spaced longitudinal vibrating units. The space from the outer edge of the pavement to the outer longitudinal unit shall not exceed 9-inches. The spacing of internal units shall be uniform and not exceed 18-inches.

The term internal vibration means vibration by vibrating units located within the specified thickness of pavement section.

The rate of vibration of each vibrating unit shall be not less than 7,500-cycles per minute, and the amplitude of vibration shall be sufficient to be perceptible on the surface of the concrete along the entire length of the vibrating unit and for a distance of at least 1-foot. The frequency of vibration or amplitude shall be varied proportionately with the rate of travel to result in a uniform density and air content. The paving machine shall be equipped with a tachometer or other suitable device for measuring and indicating the actual frequency of vibrations.

The concrete shall be held at a uniform consistency. The slip-form paver shall be operated with as nearly a continuous forward movement as possible and all operations of mixing, delivering, and spreading concrete shall be coordinated to provide uniform progress with stopping and starting of the paver held to a minimum. If, for any reason, it is necessary to stop the forward movement of the paver, the vibratory and tamping elements shall also be stopped immediately. No tractive force shall be applied to the machine, except that which is controlled from the machine.

When concrete is being placed adjacent to an existing pavement, that part of the equipment which is supported on the existing pavement shall be equipped with protective pads on crawler tracks or rubber-tired wheels on which the bearing surface is offset to run a sufficient distance from the edge of the pavement to avoid breaking the pavement edge.

5-05.3(7)B Stationary Side Form Construction

Side form sections shall be straight, free from warps, bends, indentations, or other defects. Defective forms shall be removed from the Work. Metal side forms shall be used unless other forms are approved by the Project Engineer.

Side forms may be built up by rigidly attaching a section to either top or bottom of forms. If such buildup is attached to the top of metal forms, the buildup shall be of metal.

Side forms shall be of sufficient rigidity, both in the form and in the interlocking connection with adjoining forms, that springing will not occur under the weight of subgrading and paving equipment or from the pressure of concrete. The Contractor shall provide sufficient forms so that there will be no delay in placing the concrete due to lack of forms.

Before placing side forms, the underlying material shall be at the proper grade. Side forms shall be placed to the required grade and alignment of the edge of the finished pavement. Wood wedges may be used to adjust the form elevation provided they do not extend into the concrete. The forms shall be firmly supported during the entire operation of placing, compacting, and finishing the pavement.

Forms shall be drilled in advance of being placed to line and grade to accommodate tie bars where these are specified.

Immediately in advance of placing concrete and after all Subgrade operations are completed, side forms shall be trued and maintained to the required line and grade for a distance sufficient to prevent delay in placing concrete.

Side forms shall remain in place at least 12-hours after the concrete has been placed, and in all cases until the edge of the pavement no longer requires the protection of the forms. Curing compound shall be applied to the concrete immediately after the forms are removed.

Side forms shall be thoroughly cleaned and oiled each time they are used and before concrete is placed against them.

Concrete shall be spread, screeded, shaped, and consolidated by one or more self-propelled machines. These machines shall uniformly distribute and consolidate concrete without segregation so that completed pavement will conform to required cross section with a minimum of handwork.

The number and capacity of machines furnished shall be adequate to perform the Work required at a rate equal to that of concrete delivery.

Concrete for the full paving width shall be effectively consolidated by means of surface vibrators, in combination with internal vibrators, or by some other method of consolidation that produces equivalent results without segregation.

When vibrators are used to consolidate concrete, the rate of vibration shall be not less than 3,500-cycles per minute for surface vibrators and shall be not less than 7,000-cycles per minute for internal vibrators. Amplitude of vibration shall be sufficient to be perceptible on the surface of the concrete more than 1-foot from the vibrating element. The Contractor shall furnish a tachometer or other suitable device for measuring and indicating frequency of vibration.

Power to vibrators shall be connected so that vibration ceases when forward or backward motion of the machine is stopped.

5-05.3(8) Joints

Joints in cement concrete pavement will be designated as longitudinal and transverse contraction joints and longitudinal and transverse construction joints, and shall be constructed as shown in the Plans and in accordance with the following provisions:

All contraction joints shall be constructed at the locations, intervals, and depths shown in the Standard Plan. The faces of all joints shall be constructed perpendicular to the surface of the cement concrete pavement.

5-05.3(8)A Contraction Joints

All transverse and longitudinal contraction joints shall be formed with suitable power-driven concrete saws. The Contractor shall provide sufficient sawing equipment capable of completing the sawing to the required dimensions and at the required rate to control cracking. The Contractor shall provide adequate artificial lighting facilities for night sawing. Joints shall not vary from the specified or indicated line by more than $\frac{3}{4}$ -inch.

Commencement of sawing transverse contraction joints will be dependent upon the setting time of the concrete and shall be done at the earliest possible time following placement of the concrete without tearing or raveling the adjacent concrete excessively.

Longitudinal contraction joints shall be sawed as required to control cracking and as soon as practical after the initial control transverse contraction joints are completed.

Any damage to the curing material during the sawing operations shall be repaired immediately after the sawing is completed.

When cement concrete pavement is placed adjacent to existing cement concrete pavement, the vertical face of all existing working joints shall be covered with polyethylene film or building paper in accordance with AASHTO M 171.

5-05.3(8)B Sealing Sawed Contraction Joints

Sawed contraction joints shall be filled with a joint sealant filler conforming to the requirements of [Section 9-04.2](#). Joints shall be thoroughly clean at the time of sealing and if the hot-poured type is used the joints shall be dry. Care shall be taken to avoid air pockets. The hot-poured compound shall be applied in two or more layers, if necessary. The hot-poured compound and the cold-poured compound shall be applied under sufficient pressure to fill the groove from bottom to top and the cured joint sealant shall be $\frac{1}{4}$ -inch and $\frac{5}{8}$ -inch below the top surface of the concrete. The joint filled with cold-poured compound shall then be covered with a strip of nonabsorbent paper at least twice as wide as the joint and the paper shall be left in place.

5-05.3(8)C Construction Joints

When placing of concrete is discontinued for more than 45-minutes, a transverse construction joint shall be installed. Construction joints shall be as shown in the Standard Plan.

Transverse construction joints shall be constructed between cement concrete pavement and reinforced concrete bridge approach slabs.

All transverse and longitudinal construction joints, including the joint between new and existing pavement when widened, shall be sawed and sealed with joint filler conforming to the requirements of Sections [5-05.3\(8\)A](#) and [9-04.2](#).

5-05.3(9) Vacant

5-05.3(10) Tie Bars and Dowel Bars

Epoxy-coated tie bars shall be placed at all longitudinal contraction and construction joints, in accordance with the requirements shown in the Standard Plan. In addition, tie bars shall be installed when concrete Shoulders are placed as a separate operation or when widening existing pavement.

Epoxy-coated tie bars shall be placed at longitudinal construction joints between lanes in a manner that the individual bars are located at the required elevation and spaced as shown in the Standard Plan and in a manner that the vertical edge of the concrete is not deformed or otherwise damaged during placement of the bars.

Placement tolerances for tie bars shall be within 1-inch of the middle of the concrete slab, within 1-inch of being centered over the joint and placed parallel or perpendicular to centerline within 1-inch of the vertical and horizontal plane.

Epoxy-coated dowel bars will be required for the construction joint at the end of paving operations each day and they shall be placed in accordance with the Standard Plan. Epoxy coated dowel bars shall be placed at all transverse contraction joints as

shown in the Contract or in accordance with the Standard Plans. All dowel bars shall have a parting compound, such as curing compound, grease or other Engineer approved equal applied to them prior to placement.

Placement tolerances for dowel bars shall be within 1-inch of the middle of the concrete slab, within 1-inch of being centered over the transverse joint and parallel to centerline within ½-inch of the vertical and the horizontal plane.

Dowel bars that are mounted in a cage for placing shall allow for movement of the bars within the cage. Cutting of stiffeners within the cage is not recommended.

When fresh concrete pavement is to be placed against pre-project existing cement concrete pavement, epoxy-coated tie bars shall be drilled and set into the existing pavement with an epoxy bonding agent in accordance with the Standard Plan and specified tolerances for placement of tie bars. The epoxy-bonding agent shall be either Type I or IV epoxy resin as specified in [Section 9-26](#). The Contractor may use any method for drilling the holes, provided the method selected does not damage the existing concrete. Any damage caused by the Contractor's operations shall be repaired by the Contractor at no cost to the Contracting Agency and the repair shall be to the satisfaction of the Engineer.

The tie bar holes shall be blown clean with compressed air before grouting. The bar shall be centered in the hole for the full length of embedment before grouting. The grout shall then be pumped into the hole around the bar in a manner that the back of the hole will be filled first. Blocking or shimming shall not impede the flow of the grout into the hole. Dams, if needed, shall be placed at the front of the holes to confine the grout. The dams shall permit the escape of air without leaking grout and shall not be removed until grout has cured in the hole.

5-05.3(11) Finishing

After the concrete has been given a preliminary finish by means of finishing devices incorporated in the slip-form paving equipment, the surface of the fresh concrete shall be checked by the Contractor with a straightedge device not less than 10-feet in length. High areas indicated by the straightedge device shall be removed by the hand-float method. Each successive check with the straightedge device shall lap the previous check path by at least ½ of the length of the straightedge. The requirements of this paragraph may be waived if it is successfully demonstrated that other means will consistently produce a surface with a satisfactory profile index and meeting the 10-foot straightedge requirement specified in [Section 5-05.3\(12\)](#).

Any edge slump of the pavement, exclusive of specified edging, in excess of ¼-inch shall be erected before the concrete has hardened. If edge slump on any 1-foot or greater length of hardened concrete exceeds 1-inch, the concrete shall be repaired as provided in [Section 5-05.3\(22\)](#).

The pavement shall be given a final finish surface by texturing with a comb perpendicular to the centerline of the pavement. The comb shall produce striations approximately ⅛-inch to ⅜-inch in depth. Randomly space the striations from ½-inch to 1¼-inch. The comb shall be operated mechanically either singly or in gangs with several placed end to end. Finishing shall take place with the elements of the comb as nearly perpendicular to the concrete surface as is practical, to eliminate dragging the mortar. If the striation equipment has not been previously approved, a test section shall be constructed prior to approval of the equipment. If the pavement has a raised curb without a formed concrete gutter, the texturing shall end 2-feet from the curb line.

At the beginning and end of paving each day, the Contractor shall, with an approved stamp, indent the concrete surface near the right hand edge of the panel to indicate the date, month, and year of placement.

At approximate 500-foot intervals where designated by the Engineer the Contractor shall, with an approved stamp, indent the concrete surface near the right hand edge of the pavement with the stationing of the Roadway.

5-05.3(12) Surface Smoothness

The pavement smoothness will be checked with equipment furnished and operated by the Contractor, under supervision of the Engineer, within 48-hours following placement of concrete. Smoothness of all pavement placed except Shoulders, ramp tapers, intersections and small or irregular areas as defined by [Section 5-05.3\(3\)](#) unless specified otherwise, will be measured with a recording profilograph, as specified in [Section 5-05.3\(3\)](#), parallel to centerline, from which the profile index will be determined in accordance with WSDOT Test Method 807.

For the purpose of qualifying the equipment and methods used by the Contractor, a daily profile index will be computed. For pavement placed in a 12-foot width or less, the daily profile index will be the average of two profiles made approximately 3-feet from and parallel to each edge of the pavement. If the pavement is placed in a width greater than 12-feet, the daily profile index will be computed as the average of profiles made approximately 3-feet from and parallel to each edge and at the approximate location of each planned longitudinal joint.

The daily profile index of the finished pavement thus determined will be 7-inches per mile, or less. Only equipment and methods that consistently produce a finished surface meeting this requirement shall be used. Should the daily profile index exceed the rate of 7-inches per mile, the paving operations shall be discontinued until other methods or equipment are provided by the Contractor. Such revised methods and equipment shall again be discontinued if they do not produce a finished surface having a daily profile index of 7-inches per mile, or less. Operations shall not be resumed until the Engineer approves further changes in methods and equipment as proposed by the Contractor.

All areas representing high points having deviations in excess of 0.3-inch as determined by procedures described in WSDOT Test Method 807, shall be reduced by abrasive methods until such deviations do not exceed 0.1-inch as determined by reruns of the profilograph. High areas of individual profiles shall be reduced by abrasive means so that the profile index will not exceed 0.7-inch in any 0.1-mile section. All high areas in excess of 0.1-inch shall be reduced to 0.0-inch prior to reducing any high points of 0.1-inch or less. Low spots exceeding .25-inch shall be corrected in a manner approved by the Engineer.

When any of the daily profile indexes exceed 7-inches per mile, final acceptance of the pavement for smoothness parallel to the centerline will be based on profile indexes as measured with the profilograph, operating by the Contractor under the supervision of the Engineer, along a line parallel to the edge of pavement and each longitudinal joint and will not be averaged for acceptance purposes. The final acceptance profile indexes will be measured after all corrective Work is complete and will demonstrate that all 0.1-mile sections on the project are within the 0.7-inch Specification.

When cement concrete pavement abuts bridges, the finished pavement parallel to centerline within 15-feet of the abutting joint shall be uniform to a degree that no variations greater than 1/8-inch are present when tested with a 10-foot straightedge.

When paving intersections, small or irregular areas, as defined in [Section 5-05.3\(3\)](#), surface smoothness will be measured with a 10-foot straightedge no later than 5:00 p.m. of the day following the placing of the concrete. A 10-foot straightedge will be placed parallel to the centerline so as to bridge any depressions and touch all high spots. Should the surface vary more than $\frac{1}{8}$ -inch from the lower edge of the straightedge, the high portion shall be reduced by the Contractor to the $\frac{1}{8}$ -inch tolerance by abrasive means at no expense to the Contracting Agency. It is further provided that if reduction of high portions of the surface involves breaking, dislodging, or other disturbance of the aggregates, such cutting will not be permitted until the pavement has achieved its design age. If in the opinion of the Engineer irregularities cannot be satisfactorily removed by such methods, the Contractor shall remove and replace the pavement at no expense to the Contracting Agency.

Smoothness perpendicular to the centerline will be measured with a 10-foot straight edge. The transverse slope of the finished pavement shall be uniform to a degree such that no variations greater than $\frac{1}{4}$ -inch are present when tested with a 10-foot long straightedge laid in a direction perpendicular to the centerline. Any areas that are in excess of this specified tolerance shall be corrected by abrasive means.

5-05.3(13) Curing

Immediately after the finishing operations have been completed and as soon as marring of the concrete will not occur, the entire surface of the newly placed concrete shall be cured in accordance with one of the following methods the Contractor may elect.

5-05.3(13)A Curing Compound

Liquid membrane-forming concrete curing compound Type 2 meeting the requirements of [Section 9-23.2](#) shall be applied to the entire area of the exposed surface of the concrete with an approved mechanical spray machine. The spray fog shall be protected from the wind with an adequate shield. It shall be applied uniformly at the rate of one gallon to not more than 150-square feet.

The compound shall be applied with equipment of the pressure tank or pump type equipped with a feed tank agitator which ensures continuous agitation of the compound during spraying operations. The nozzle shall be of the two-line type with sufficient air to properly atomize the compound.

The curing compound shall not be applied during or immediately after rainfall. If it becomes necessary to leave the pavement uncoated overnight, it shall be covered with polyethylene sheeting, which shall remain in place until weather conditions are favorable for the application of the curing compound.

In the event that rain falls on the newly coated pavement before the film has dried sufficiently to resist damage, or in the event of damage to the film from any cause, the Contractor shall apply a new coat of curing compound in one or two applications to the affected area at the rate which, in the opinion of the Engineer, will result in a film of curing value equal to that specified in the original coat.

Before placing the curing compound in the spray tank, it shall be thoroughly agitated as recommended by the Manufacturer. The compound shall not be diluted by the addition of solvents nor be altered in any manner. If the compound has become chilled to the extent that it is too viscous for proper stirring or application or if portions of the vehicle have been precipitated from solution, it shall be heated to restore proper fluidity but it shall not be heated above 100°F. All curing compound shall have approval prior to placing in the spray tanks.

The curing compound shall be applied immediately after the concrete has been finished and after any bleed water that has collected on the surface has disappeared, or at a time designated by the Engineer. If hair checking develops in the pavement before finishing is completed, the Engineer may order the application of the curing compound at an earlier stage, in which event any concrete cut from the surface in finishing operations shall be removed entirely from the pavement. If additional mortar is then needed to fill torn areas, it shall be obtained ahead of the spraying operations. All areas cut by finishing tools subsequent to the application of the curing compound shall immediately be given new applications at the rate specified above.

The curing compound, after application, shall be protected by the Contractor from injury until the pavement has reached a minimum compressive strength of 2500-psi. All traffic, either by foot or otherwise, shall be considered as injurious to the film of the applied compound.

The Contractor shall provide on the job a sufficient quantity of white polyethylene sheeting to cover all the pavement laid in 3-hours of maximum operation. This sheeting shall be reserved exclusively for the protection of the pavement in case of rain or breakdown of the spray equipment used for applying the curing compound. The protective sheeting shall be placed over the pavement when ordered, and in the manner specified by the Engineer.

Areas from which it is impossible to exclude traffic shall be protected by a covering of sand or earth not less than 1-foot in thickness or by other suitable and effective means. The protective covering shall be placed no earlier than 24-hours after application of the compound.

All liquid membrane-forming curing compounds shall be removed from the Portland cement concrete pavement to which traffic delineators are to be bonded. Curing compound removal shall not be started until the pavement has attained sufficient flexural strength for traffic to be allowed on it. The Contractor shall submit a proposed removal method to the Engineer and shall not begin the removal process until the Engineer has approved the removal method.

The Contractor shall assume all liabilities for and protect the Contracting Agency from any damages or claims arising from the use of materials or processes described herein.

5-05.3(13)B White Polyethylene Sheeting

The sheeting shall be placed over the pavement immediately after finishing operations are completed, or at a time designated by the Engineer.

The sheeting shall be laid so that individual sheets overlap at least 2-feet, and the lapped areas shall be held in close contact with the pavement by weighting with earth or boards to prevent movement by the wind. The sheeting shall extend downward to cover the edges of the pavement and shall be secured to the Subgrade with a continuous bank of earth or surfacing material. Any holes occurring in the sheeting shall be patched immediately to the satisfaction of the Engineer. The sheeting shall be maintained against injury and remain in place until the pavement has reached a minimum compressive strength of 2500-psi.

5-05.3(13)C Wet Curing

Wet curing shall be accomplished by applying a continuous fog or mist spray to the entire pavement surface until it has reached a minimum compressive strength of 2500-psi. If water runoff is not a concern, continuous sprinkling is acceptable. Sprinkling shall not begin until the concrete has achieved initial set as determined by AASHTO T 197 or other approved method.

5-05.3(14) Cold Weather Work

When the air temperature is expected to reach the freezing point during the day or night and the pavement has not reached 50-percent of its design strength or 2500-psi which ever is greater the concrete shall be protected from freezing. The Contractor shall, at no expense to the Contracting Agency, provide a sufficient supply of straw, hay, grass, earth, blankets, or other suitable blanketing material and spread it over the pavement to a sufficient depth to prevent freezing of the concrete. The Contractor shall be responsible for the quality and strength of the concrete thus cured. Any concrete injured by frost action or freezing shall be removed and replaced at the Contractor's expense in accordance with these Specifications.

5-05.3(15) Concrete Pavement Construction in Adjacent Lanes

Unless otherwise shown in the Plans or in the Special Provisions, the pavement shall be constructed in multiple lanes; that is, 2 or more adjacent lanes paved in a single operation. Longitudinal contraction joints shall be used between adjacent lanes that are paved concurrently, and construction joints shall be used when lanes are paved separately. Tie bars shall be installed during initial lane construction.

The Contractor shall replace, at no expense to the Contracting Agency, any panels on the new pavement that are cracked or broken as a result of the Contractor's operations.

5-05.3(16) Protection of Pavement

The Contractor shall protect the pavement and its appurtenances from any damage. Protection shall include personnel to direct traffic and the erection and maintenance of warning signs, lights, barricades, temporary take-down bridges across the pavement with adequate approaches, and whatever other means may be necessary to accommodate local traffic and to protect the pavement during the curing period or until opened to traffic as determined by the Engineer.

The operation of construction equipment on the new pavement will not be allowed until the pavement has developed a compressive strength of 2500-psi as determined from cylinders, made at the time of placement, cured under comparable conditions, and tested in accordance with AASHTO T 22. Exceptions would be one track from a slip form-paving machine when paving adjacent lanes or light vehicles required for sawing operations or taking cores.

Placement of Shoulder material may commence when the pavement has developed a compressive strength of 1800-psi as determined from cylinders made at the time of placement, cured under comparable conditions, and tested in accordance with AASHTO T 22 as long as construction equipment is not operated on the new pavement.

A continuous barrier of the design shown in the Plans shall be constructed and maintained along the edge of the pavement being constructed and adjacent to the portion of the Roadway used for traffic. The barriers shall be left in place until the new pavement is ready to be opened to traffic and shall then be removed by the Contractor.

Any damage to the pavement occurring prior to final acceptance shall be replaced or repaired in accordance with [Section 5-05.3\(22\)](#).

5-05.3(17) Opening to Traffic

The pavement may be opened to traffic when the concrete has developed a compressive strength of 2500-psi as determined from cylinders, made at the time of placement, cured under comparable conditions, and tested in accordance with AASHTO T 22.

Fabrication, curing, and testing of cylinders to measure early strength shall be the responsibility of the Contractor. The Contractor shall obtain the services of an independent Laboratory to perform these activities and these laboratories shall be approved by the Engineer. At the Contractor's option, the time for opening pavement may be determined through the use of the maturity test in accordance with ASTM C 1074. The Contractor shall develop the maturity-strength relationship and provide maturity curves along with supporting data for approval by the Engineer. The Contractor shall furnish all equipment, including thermal or maturity meter, thermocouples, wire, and qualified personnel to monitor maturity and provide information to the Engineer. Field procedures to monitor maturity shall be submitted to the Engineer for approval prior to use. The pavement shall not be opened to traffic until the maturity-strength relationship shows the pavement has a compressive strength of 2500-psi and approved by the Engineer.

The pavement shall be cleaned prior to opening to traffic.

All costs associated with early-strength cylinders shall be at the Contractor's expense.

5-05.3(18) Vacant**5-05.3(19) Vacant****5-05.3(20) Vacant****5-05.3(21) Vacant****5-05.3(22) Repair of Defective Pavement Slabs**

Broken slabs, slabs with random cracks, nonworking contraction joints near cracks, edge slumping and spalls along joints and cracks shall be replaced or repaired as specified at no expense to the Contracting Agency, and shall be accomplished prior to completion of joint sealing.

Pavement slabs containing more than one crack shall be entirely removed and replaced. Pavement slabs containing a single crack shall be removed and replaced such that the minimum dimension of the removed slab is 6-feet long and full panel width. The portion of the panel to remain in place shall have a minimum dimension of 6-feet in length and full panel width, otherwise entire removal and replacement of the slab is required. There shall be no new joints closer than 3-feet to an existing transverse joints. Saw cutting full pavement depth is required along all longitudinal joints and at transverse locations. Tie bars and dowel bars shall be used in accordance [Section 5-05.3\(10\)](#).

Spalls and edge slumping shall be repaired by making vertical saw cuts at least 3-inches outside the affected area and to a minimum depth of 3-inches. Repair depths that exceed one third of the total slab depth or encounter dowel bars or reinforcing steel

will require full depth repair. When the affected area is directly against a longitudinal or transverse joint, a debonding medium, (compressible joint insert or polyethylene strip) must be placed between the existing concrete and the area to be patched. For transverse joints, the compressible joint material must be placed into the existing joint 1-inch below the depth of the repair and extended at least 3-inches beyond each end of the patch boundaries. If the affected area is directly against an asphalt pavement, a formed edge even with the surface is required. The concrete in the affected area shall be chipped out to sound concrete with a pneumatic hammer with a maximum weight of 30-pounds. The formed cavity shall be sand blasted with dry, oil-free air and thoroughly cleaned of all loose material. Where required, an epoxy bonding agent shall be applied to the dry, cleaned surface of the cavity in a thin even coat, using a stiff-bristle brush. Placement of Portland cement concrete or epoxy concrete or mortar shall immediately follow the application of the epoxy bonding agent. The epoxy bonding agent shall meet the requirements of [Section 9-26.1\(1\)](#) for Type II epoxy (Portland cement concrete placement) or Type III epoxy (epoxy concrete or mortar placement). Epoxy concrete or mortar shall meet the requirements of [Section 9-26.3\(1\)A](#). Low areas which grinding cannot feasibly remedy, shall be sandblasted, filled with epoxy bonded mortar, and textured by grinding. The epoxy bonding agent shall meet the requirements of [Section 9-26.1\(1\)B](#) for Type II epoxy. The patch mixture should be placed and vibrated to eliminate any voids. Vibrators greater than 1-inch shall not be used. If cementitious repair material is used, the patch perimeter shall be sealed with a 1:1 cement-water grout. The patch mixture shall be cured according to the manufactures recommendation.

5-05.4 Measurement

Cement concrete pavement will be measured by the cubic yard for the completed pavement. The volume will be determined from measurements taken as listed below.

1. The width measurement will be the width of the pavement shown on the typical cross-section in the Plans, additional widening where called for, or as otherwise specified in writing by the Engineer.
2. The length will be measured horizontally along the center of each Roadway or ramp.
3. The depth will be determined from the reference cores. The depth utilized to calculate the volume shall not exceed the Plan depth plus 0.04-feet.

The volume of the pavement section represented by the reference core shall equal the measured length x width x reference core depth.

Epoxy coated dowel bar will be measured per each for the actual number of bars used in the completed Work.

Epoxy-coated tie bar with drill hole will be measured per each for the actual number of bars used in the completed Work.

The ride smoothness compliance adjustment calculation is the volume of pavement, in cubic yards, represented by the profilograph.

The calculation for Portland cement concrete compliance adjustment is the volume of concrete represented by the CPF and the Thickness deficiency adjustment.

5-05.5 Payment

Payment will be made in accordance with [Section 1-04.1](#), for each of the following Bid items that are included in the Proposal:

“Cement Conc. Pavement”, per cubic yard.

The unit Contract price per cubic yard for “Cement Conc. Pavement” shall include saw cutting and sealing joints, furnishing and installing tie bars, except those tie bars drilled into cement concrete pavement will be paid under the item “Epoxy-Coated Tie Bar with Drill Hole”.

“Epoxy Coated Dowel Bar”, per each,

The unit Contract price per each for “Epoxy Coated Dowel Bar” shall be full payment for furnishing, and installing epoxy coated dowel bars and any costs for drilling holes, placing dowel bars with baskets, furnishing and installing parting compound and all other costs associated with completing the installation of epoxy coated dowel bars.

“Cement Conc. Pavement - Including Dowels ”, per cubic yard.

The unit Contract price per cubic yard for “Cement Conc. Pavement - Including Dowels” shall include saw cutting and sealing joints, furnishing and installing epoxy coated dowel bars and tie bars, except those tie bars drilled into cement concrete pavement will be paid under the item “Epoxy-Coated Tie Bar with Drill Hole”.

“Epoxy-Coated Tie Bar with Drill Hole”, per each.

The unit Contract price per each, “Epoxy-Coated Tie Bar with Drill Hole” shall be full payment for furnishing, and installing epoxy coated tie bars and any costs for drilling holes, and all other costs associated with installation of epoxy coated tie bars.

“Ride Smoothness Compliance Adjustment”, by calculation.

Payment for “Ride Smoothness Compliance Adjustment” will be calculated by multiplying the unit Contract price for cement concrete pavement, times the volume for adjustment, times the percent of adjustment determined from the schedule below.

1. Adjustment will be based on the initial profile index before corrective Work.
2. “Ride Smoothness Compliance Adjustment” will be calculated for each 0.1-mile section represented by profilogram using the following schedule:

Ride Smoothness Profile Index (Inches per mile)	Compliance Adjustment (Percent adjustment)
1.0 or less	+4
over 1.0 to 2.0	+3
over 2.0 to 3.0	+2
over 3.0 to 4.0	+1
over 4.0 to 7.0	0
over 7.0	-2*

*Also requires correction to 7-inches per mile.

“Portland Cement Concrete Compliance Adjustment”, by calculation.

Payment for “Portland Cement Concrete Compliance Adjustment” will be calculated by multiplying the unit Contract price for the cement concrete pavement, times the volume for adjustment, times the percent of adjustment determined from the calculated CPF and the Deficiency Adjustment listed in [Section 5-05.5\(1\)A](#).

5-05.5(1) Pavement Thickness

Cement concrete pavement shall be constructed in accordance with the thickness requirements in the Plans and Specifications. Tolerances allowed for Subgrade construction and other provisions, which may affect thickness, shall not be construed to modify such thickness requirements.

A primary unit of pavement is defined as the area of pavement placed in each day’s paving operations or a complete intersection. Within such primary unit of pavement, there may be an area or areas, which are deficient in thickness by more than 0.05-foot. This deficient area or areas will be defined as a secondary unit or units. If secondary units are found to exist, the primary unit area will be reduced by the secondary unit area included therein. At a time determined by the Engineer, thickness measurements will be made in each primary unit of pavement at the minimum rate of one measurement for each 500-cubic yards of pavement, or fraction thereof. The exact location and number of thickness measurements within each primary unit, both longitudinally and transversely, will be determined by the Engineer. In general, thickness measurements will be made at uniform intervals throughout each primary unit of pavement.

If thickness deficiencies greater than 0.05-foot are found to exist, supplemental thickness measurements will be made in accordance with [Section 5-05.5\(1\)B](#). Pavement thickness variations, if any, from the thickness requirements in the Plans and Specifications will be determined by comparing the actual thickness measurement with the thickness specified at the location where the measurement was made. Such variation will be determined to the nearest 0.01-foot as either excess or deficient thickness.

Additional cores may be requested by the Contractor to isolate the area that has a thickness deficiency within the 0.05-feet of the design thickness. These cores will be used to create a secondary unit. All costs for the additional cores including grouting the core holes will be the responsibility of the Contractor.

5-05.5(1)A Thickness Deficiency of 0.05-Foot or Less

If no thickness measurements in a primary unit are deficient by more than 0.05-foot, all thickness measurements in such unit will be averaged to the nearest 0.01-foot to determine the average thickness deficiency, if any, in that primary unit. For the purpose of determining the average thickness deficiency, an excess thickness variation of more than 0.04-foot will be considered to be 0.04-foot greater than the specified thickness.

For each primary unit of pavement which is deficient in average thickness by not more than 0.05-foot, the Contractor shall pay to the Contracting Agency, or the Contracting Agency may deduct from any moneys due or that may become due the Contractor under the Contract, a sum computed by multiplying the deficiency adjustment from the following table by the unit Contract price by the volume of such unit.

Average Thickness Deficiency (feet)	Deficiency Adjustment (per cubic yard)
0.01	2%
0.02	4%
0.03	9%
0.04	16%
0.05	25%

5-05.5(1)B Thickness Deficiency of More Than 0.05-Foot

Where a thickness deficiency greater than 0.05-foot is encountered, the Engineer will determine from supplemental thickness measurements the limits of the secondary unit area. Thickness measurements will be made in each panel of pavement adjacent transversely and longitudinally to the panel of the original measurement. This procedure will continue, regardless of unit boundaries, until such secondary unit area is bounded by panels with a thickness deficiency of 0.05-foot or less. Cores taken to isolate the secondary unit will not be used to compute average thickness of the primary unit.

Panels are the areas bounded by longitudinal and transverse joints and pavement edges. If longitudinal or transverse joints are eliminated by the Special Provisions, by the Plans, or for any other reasons, the limits of panels will be determined by the Engineer as if such joints had been constructed.

The secondary unit area will be made up of entire panels only. The entire panel will be considered to be of the thickness shown by measurement.

After the Engineer has determined the limits of the secondary unit area, a further determination will be made whether any panels within this area are usable and may be left in place. Following this determination, the Contractor shall remove and replace at no expense to the Contracting Agency such panels as the Engineer may designate in accordance with the following:

If the area to be removed is not bounded by longitudinal or transverse joints, the Contractor shall saw, at no expense to the Contracting Agency, weakened plane joints at the locations designated by the Engineer. The Subgrade shall be lowered to meet the full thickness requirements. The replaced pavement will be tested for thickness by means of additional measurements and will be subject to all of the requirements of the Specifications.

Usable panels may be removed and replaced as outlined above at the option of the Contractor, or these panels will be permitted to remain in place, provided that no payment will be made for any panels which are left in place, and that a further penalty will be assessed in the amount of 25-percent of the Contractor's unit Bid price for all such panels. The Contracting Agency may deduct such amount from any moneys due or that may become due the Contractor under the Contract.

The cost of all thickness measurements made to determine the secondary unit areas, including filling the core holes with concrete, will be deducted at the rate of \$150.00 per core from any moneys due or that may become due the Contractor under the Contract.

All additional Work required and any delay to the Contractor's operations as a result of this Specification shall not be cause for additional pay nor for an extension of time.