

**DIVISION 500  
RIGID PAVEMENT**

**SECTION 501  
PORTLAND CEMENT CONCRETE PAVEMENT**

**501.01 Description.** This item shall consist of constructing a pavement composed of portland cement concrete, with or without reinforcement as specified, constructed on a prepared subgrade or base course according to these specifications and conforming to the lines, grades, thicknesses, and typical cross sections shown on the plans or established by the Engineer.

Design and Quality Control of Portland Cement Concrete Pavement will consist of the Contractor furnishing acceptable mix designs and performing all applicable quality control sampling and testing for portland cement concrete pavement according to these provisions.

**501.02 Materials.** The materials used shall comply with the requirements as set out herein. No materials shall be used containing foreign matter, frost, or lumps or crusts of hardened substances.

**(a) Cement.** Unless otherwise specified, portland cement conforming to the requirements of AASHTO M 85, Type I shall be furnished. One of the following blended cements may be used in lieu of Type I:

- Portland-Pozzolan Cement, AASHTO M 240, Type IP (20% maximum)
- Pozzolan-Modified Portland Cement, AASHTO M 240, Type I (PM)
- Slag-Modified Portland Cement, AASHTO M 240, Type I (SM)

Fly ash or ground granulated blast-furnace slag shall not be substituted for blended cements. Cement, blended cement, fly ash, and ground granulated blast-furnace slag shall be from sources that

are listed on the Department's Qualified Products List and that have executed a certification agreement with the Department.

The total alkalis in the portland cement ( $\text{Na}_2\text{O} + 0.658 \text{K}_2\text{O}$ ) shall not exceed 0.60%. The total alkalis in the cementitious material (portland cement, fly ash or ground granulated blast-furnace slag) shall not exceed 5 lbs./cu yd (3 kg/cu m). In lieu of using low alkali cement as specified, the contractor may choose alternative testing of the proposed aggregates and cementitious materials as follows:

Option 1 – Test the fine and coarse aggregate sources in accordance with AASHTO T 303. If the 14 day expansion  $\leq 0.10\%$ , the requirement for low-alkali cement is waived. If the 14 day expansion is greater than 0.10%, further testing per Option 2 below is required using GGBFS or fly ash.

Option 2 – Test using the specific job materials and selected replacement level of supplemental cementitious materials (GGBFS or fly ash) proposed for the project according to AASHTO T 303. If the 14 day expansion is  $\leq 0.10\%$ , the requirement for low-alkali cement is waived. If the 14 day expansion is greater than 0.10%, additional testing with a different cement, different supplemental cementitious material, and/or different replacement level is required.

Cement shall be furnished in bulk. The mixing or alternate use of cement from different manufacturing plants will not be permitted. The source of cement shall not be changed without the written approval of the Engineer. The use of cement salvaged from spillage will not be allowed. Cement placed in storage shall be suitably protected. Loss in quality occurring during the storage period will be cause for rejection. If the cement furnished produces erratic results under the field conditions incident to the placing of the concrete, or in regard to the strength of the finished product, or in the time of the initial or final set, the Contractor shall, without notice from the Engineer, cease the use of that source of cement.

**(b) Fine Aggregate.** The fine aggregate shall consist of clean, hard, durable particles of natural sand or other approved inert material with similar characteristics.

When determined necessary by visual observation, the amount of deleterious substances will be tested by laboratory methods and shall not exceed the following limits:

	<b>Maximum Permissible Percentage by Weight</b>
Removed by decantation (AASHTO T 11)	2
Clay lumps (AHTD Test Method 302)	0.5
Coal and lignite (AASHTO T 113)	0.25
Soft and flaky particles (AHTD Test Method 302)	2

All fine aggregate shall be free from injurious amount of organic impurities. Aggregates shall be subjected to testing according to AASHTO T 21. Should AASHTO T 21 produce results that indicate that the sand may possibly contain injurious or damaging organic compounds, mortar strength test specimens shall be tested according to AHTD Test Method 530.

Fine aggregate shall comply with the following grading requirements when tested according to AASHTO T 27:

<b>Sieve, (mm)</b>	<b>Percent Passing</b>
3/8" (9.5)	100
#4 (4.75)	95-100
#8 (2.36)	70-95
#16 (1.18)	45-85
#30 (0.600)	20-65
#50 (0.300)	5-30
#100 (0.150)	0-5

The fineness modulus of the fine aggregate shall not vary more than 20 points from the established value of the fine aggregate used in the mix design. In the event that the fineness modulus exceeds 20 points, a new mix design will be required.

**(c) Coarse Aggregate.** The coarse aggregate shall consist of crushed stone or gravel. A coarse aggregate consisting of a combination of crushed stone and gravel shall be used only when specifically approved by the Engineer.

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Crushed stone shall consist of clean, hard, durable fragments of rock of uniform quality. The stone shall have a percent of wear by the Los Angeles Test (AASHTO T 96) not greater than 40, and when subjected to 5 cycles of the Soundness Test (Sodium Sulfate, AASHTO T 104), shall have a loss not to exceed 12%.

Gravel shall consist of clean, hard, durable, uncoated aggregate, crushed or uncrushed, having a percent of wear by the Los Angeles Test (AASHTO T 96) not greater than 40.

When determined necessary by visual observation, the amount of deleterious substances will be tested by laboratory methods and shall not exceed the following limits:

	<b>Maximum Permissible Percentage by Weight</b>
Removed by decantation (AASHTO T 11)	1
Coal and Lignite (AASHTO T 113)	0.25
Clay lumps (AHTD Test Method 302)	0.25
Soft fragments (AHTD Test Method 302)	5
Total Deleterious substances	5

The maximum percentage by weight removed by decantation (AASHTO T 11) from crushed stone coarse aggregate may be increased to 1.5% provided the percent loss (AASHTO T 11) from the fine aggregate does not exceed 1%, or to 1.8% provided the percent loss from the fine aggregate does not exceed 0.5%.

Coarse aggregate shall comply with the following grading requirements when tested according to AASHTO T 27:

Sieve, (mm)	% Passing	
	Standard Gradation AHTD	Alternative Gradation AASHTO M43 #57
1½" (37.5)	100	100

1" (25.0)	60-100	95-100
3/4" (19.0)	35-75	-
1/2" (12.5)	-	25-60
3/8" (9.5)	10-30	-
#4 (4.75)	0-5	0-10
#8 (2.36)	-	0-5

The fineness modulus of the coarse aggregate shall not vary more than 20 points from the established value of the coarse aggregate used in the mix design. In the event that the fineness modulus exceeds 20 points, a new mix design will be required.

**(d) Water.** Water used in mixing or curing shall be clean and free from injurious amounts of oil, salts, or other deleterious substances and shall not contain more than 1000 ppm of chlorides. Tests will be made according to AASHTO T 26.

Water from municipal supplies approved by the State Department of Health will not require testing but water from other sources shall be sampled and tested before use in concrete.

Where the source of water is relatively shallow, it shall be maintained at such depth and the intake so enclosed as to exclude silt, mud, grass, or other foreign materials.

**(e) Admixtures. (1) General.** Admixtures shall be used to improve certain characteristics of the concrete when specified on the plans or may be used when requested by the Contractor and approval is given by the Engineer. The Contractor's request shall be supported with the manufacturer's certified formulation of the proposed admixture and with sufficient evidence that the proposed admixture has given satisfactory results on other similar work. Chlorides shall not be added during the manufacturing process.

Either prior to or at any time during construction, the Engineer may require that the admixture selected by the Contractor be further

tested to determine its effect upon the strength or properties of the concrete. Permission to use the admixture may be withdrawn at any time by the Engineer when satisfactory results are not being obtained.

Admixtures which are used shall be listed on the Department's Qualified Products List or approved by the Engineer. Admixtures shall be compatible with each other, as advised by the manufacturer. The admixture dosage rate range recommended by the manufacturer shall be used. Should the dosage rate for any admixture not yield desirable characteristics in the concrete, the dosage shall be adjusted based on test results obtained by trial batches.

Admixtures shall be added to the mixing water by means of a mechanical dispenser that will accurately meter the additive throughout the mix water cycle.

**(2) Air Entraining Agent.** Air entraining agent shall comply with the requirements of AASHTO M 154 and be approved by the Engineer.

**(3) Retarding Agent.** In order to permit the retarding of the set and extend the finishing time of concrete, a retarding agent shall be used when specified on the plans or may be used when permission for its use is requested by the Contractor and approved by the Engineer. The retarding agent shall be a Type B or Type D admixture as defined in AASHTO M 194.

When air-entrained concrete is specified, the air-entraining agent and the retarding agent shall be so incorporated that the air content of the concrete shall fall within the percentage range stipulated in the specifications. When air-entrained concrete is not specified, the concrete to which the retarding agent has been added shall have an air content not greater than 3 percent.

No compensation will be made for furnishing and incorporating the agent in the mix. No additional compensation will be made for furnishing, placing, finishing, and curing the concrete involved.

**(4) Other Admixtures.** The use of other admixtures will be considered by the Engineer on a case by case basis upon written request from the Contractor. If approved, the admixture used shall be furnished at no additional cost to the Department.

**(f) Cement Replacements. (1) Fly Ash.** Fly ash for use with portland cement shall comply with the requirements of AASHTO M 295, Class C or Class F. Mixing of Class C and Class F fly ashes will not be permitted.

**(2) Ground Granulated Blast-Furnace Slag.** Ground granulated blast-furnace slag shall comply with the requirements of AASHTO M 302, Grade 100 or higher.

**(g) Reinforcing Steel and Dowel Bars. (1) General.** Reinforcing steel, dowel bars, and other steel bars shall comply with Subsection 502.02. Epoxy coated dowel bars and tie bars shall be used.

The epoxy coated dowel bars and tie bars shall be coated according to the provisions of AASHTO M 284 using a coating material meeting Annex A1. The Contractor shall certify the epoxy coating in accordance with Subsection 804.02(d) and comply with the requirements of Subsection 804.04 for epoxy coated bars. Damage to epoxy coated bars shall be repaired according to the epoxy powder manufacturer's recommendations and Subsection 804.05. Shipping, handling, and protection of epoxy coated bars shall be in accordance with Subsection 804.05.

**(2) Dowel Bars.** No coating repairs will be required for uncoated cut or sheared ends of the dowel bars or at the locations where the wire basket has been welded to the dowel bar.

**(3) Tie Bars.** No coating repairs will be required for uncoated cut or sheared ends of tie bars. Tie bars that must be bent and later straightened to facilitate construction shall comply with AASHTO M 31, Grade 40 (Grade 300). Tie bars shall be bent back reasonably straight and any damage to the epoxy coating during the rebending shall be repaired in accordance with (1) above. Tie bars broken during the rebending shall be replaced by the Contractor at no cost

to the Department by drilling a hole and installing replacement bars using a polyester/epoxy resin system from the Department's Qualified Products List.

**(h) Joint Materials.**

(1) Materials for filling and sealing expansion joints shall be as shown on the plans and shall comply with the following requirements, as applicable:

a. Type 1: A joint filler that is a uniform mixture of sawdust and asphalt material in the proportion of one part asphalt to four parts sawdust, by volume. Asphalt material used shall be either MC-250 or SS-1 according to Subsection 403.03. When this material is specified, the joint shall be filled to within 1" (25 mm) of the pavement surface. The top 1" (25 mm) shall be sealed with a material complying with the requirements of AASHTO M 173.

b. Type 2: A joint filler that is preformed, non-extruding, and resilient type, complying with AASHTO M 153 Type I (sponge rubber).

(2) The material for filling and sealing longitudinal, warping, contraction, and other specified joints shall be as shown on the plans and shall comply with the following requirements:

a. Backer rod filler for Types 3, 4, and 5 joints shall meet ASTM D 5249, Type 1 for Types 3, 4, and 5 joint sealers or Type 2 for Types 3 and 4 joint sealers and shall be approximately 1/8" (3 mm) larger in diameter than the width of the joint to be sealed. All components of the joint sealant system, including the backer rod, shall be compatible. No bond shall occur between the backup material and the sealant system for Types 3 and 4 joint sealer.

b. Type 3: A joint sealer that is a cold applied, single component, chemically curing silicone sealant that meets the requirements of ASTM D 5893. The formulation shall



not require a primer for bond to concrete. The compound shall be compatible with concrete. The material shall be one that has been approved by the Engineer.

c. Type 4: A joint sealer that is a cold applied, single component, chemically curing silicone sealant that meets the requirements of ASTM D 5893. The formulation shall require a primer for bond to concrete. The compound shall be compatible with concrete. The material shall be one that has been approved by the Engineer.

d. Type 5: A joint sealer that is a hot poured elastomeric joint sealant. The material shall comply with AASHTO M 282. The appendix of that specification shall be considered a part of this specification.

e. Type 6: A joint sealer that is a 2 component, cold poured, synthetic polymer, complying with ASTM D 1850 with the exception of penetration, which shall not exceed 100, and resilience, both original cured sample and oven aged, which shall be a minimum of 70%.

f. Type 7: A joint sealer that is a hot poured elastic type complying with AASHTO M 173.

**(i) Curing Materials.** Curing materials shall be one of the following types:

(1) Polyethylene-burlap mats complying with AASHTO M 171. Polyethylene-burlap mats shall consist of one 9 ounces per square yard (300 g/sq m) thickness of burlap, impregnated on one side with one opaque 4 mil (0.10 mm) thickness of polyethylene, and free from visible defects.

(2) Membrane curing compound complying with AASHTO M 148 for Type 1-D or Type 2.

(3) Polyethylene sheeting shall be 4 mil (0.10 mm) minimum thickness, uniform in appearance, and free from visible defects.

(4) Copolymer/synthetic blanket complying with the performance requirements of AASHTO M 171. Copolymer/synthetic blankets shall be a composite of a copolymer membrane material coated over a layer of absorbent nonwoven synthetic fabric weighing at least 6 ounces per square yard (200 g/sq m), uniform in appearance, and free from visible defects.

(5) Other approved sheeting materials complying with the performance requirements of AASHTO M 171.

**501.03. Mix Design. (a) General** The portland cement concrete pavement mix shall be composed of portland cement, water, air entraining agent, fine aggregate, and coarse aggregate of the gradation and quality specified in Subsection 501.02 and the proportions specified below.

The air content of the fresh concrete, as determined by AASHTO T 152, shall be  $6\% \pm 2\%$ . The air entrainment shall be accomplished by adding to the mixing water the proper amount of an air entraining agent in solution.

The minimum cement content shall be 564 pounds (6 sacks) of cement per cubic yard (335 kg of cement per cubic meter) of concrete.

The water/cement ratio shall not exceed 0.45 pound per pound (5.1 gallons per bag)[ 0.45 kg/kg] (including the free moisture content of the aggregate). When fly ash or ground granulated blast-furnance slag (GGBFS) is used as a partial replacement for cement, the total weight of both cement and fly ash or GGBFS shall be used to determine the water/cement ratio.

Fly ash may be used as a partial replacement for Type I cement, not exceeding 20% by weight. Substitution shall be made at the rate of one pound (kilogram) of fly ash for each pound (kilogram) of cement replaced. Mixtures with fly ash shall meet the same requirements as mixtures without fly ash. Fly ash will not be allowed as a substitute for high early strength or blended cements.

Ground granulated blast-furnace slag (GGBFS) may be used as a partial replacement for Type I cement, not exceeding 25% by weight. Substitution shall be made at a rate of one kilogram (pound) of GGBFS for each pound (kilogram) of cement replaced. GGBFS will not be allowed as a substitute for high early strength or blended cements. Ternary mixes (cement, fly ash, and GGBFS) are not allowed.

The minimum 28 day compressive strength shall be 4000 psi (28.0 MPa) when tested according to AASHTO T 22. Test specimens will be made and cured according to AASHTO T 23 or T 126 as applicable.

The mixed concrete shall have a uniform consistency with a slump, as determined by AASHTO T 119, of not more than 2" (50 mm).

A Type A water reducing concrete admixture or mid-range water reducing concrete admixture may be used with the approval of the Engineer. All admixtures shall comply with Subsection 501.02.

Fine and coarse aggregate shall be added only in such proportion that satisfactory plasticity, workability, and consistency of the mix are maintained, with the further provision that the ratio of the fine aggregate to cement, based on dry and rodded measure, shall be not less than 1.5 nor more than 2.5.

The specified water/cement ratio shall not be exceeded and the minimum cement content shall be met.

A minimum of 15 working days prior to the commencement of paving operations, the contractor shall submit to the Engineer for review and approval the following:

- Certification for the low alkali cement proposed for use OR the results of the fine and coarse aggregates Potential Alkali Reactivity test (AASHTO T 303) in accordance with Options 1 or 2 of Subsection 501.02.

- A Job Mix Formula (JMF) that contains sources of all aggregates proposed for use, a composite gradation of all aggregates, and proportions of each aggregate. Individual gradations of each aggregate shall be included. The Job Mix Formula may only be changed upon written approval of the Engineer. Composite gradations will be calculated using AHTD Test Method 588.

**(b) Mix Design by the Contractor.** The proportions to be used in the mix shall be determined by the Contractor using the absolute volume method. The Contractor may use the procedure provided in the ACI Standard 211.1, modified to comply with the minimum cement content and maximum water/cement ratio specified. Prior to the start of production of the concrete mixture, the Contractor shall submit test results and/or certifications for all materials and detailed mix design data to the Engineer. Aggregate, fly ash, and ground granulated blast-furnace slag (GGBFS) material properties used in the mix design shall be representative of the exact materials proposed for use. The testing source (commercial laboratory, qualified technician, AHTD provided data, etc.) and the date of the test shall be provided. The specific plant sources for the cement, fly ash or GGBFS, and aggregates shall be shown on the mix design. The documentation submitted with the mix design shall specify which procedure was used and whether oven dry or saturated surface dry weights were used in the calculations. The mix design shall specify the quantity of each component of the mix, including all authorized additives. Acceptance of the mix design by the Engineer will be based on apparent conformity to the requirements in Subsection 501.03(a). If the mix design fails to produce acceptable results or if there is a change in the aggregates, fly ash, GGBFS, or cement being used, a new mix design will be required. It shall remain the Contractor's responsibility during production to produce concrete conforming to the mix design and the minimum acceptance criteria specified. When requested by the Engineer, the Contractor shall submit samples of all materials for verification

testing. Production shall not begin until the mix design is accepted by the Engineer.

A mix design submitted for acceptance need not be prepared specifically for this project, but may be a previously accepted design that uses the same materials and meets the same design criteria.

Mix designs accepted under this section will become the property of the Department and may be accepted for use on other projects, by other contractors, or by the Department.

**501.04 Quality Control, Acceptance, and Adjustments in Payments.** (a) **Quality Control by the Contractor.** The Contractor shall perform all applicable quality control sampling and testing of the portland cement concrete pavements used on the project.

The Contractor is responsible for product quality control during handling, blending, mixing, transporting, and placement operations, and for necessary adjustments in proportioning of the materials to produce an acceptable mix. The Contractor shall perform all applicable quality control sampling and testing required to ensure that the completed concrete pavement complies with all requirements of the specifications. The Contractor shall furnish all personnel, equipment, and facilities necessary to perform the required sampling and testing. The Contractor's facilities shall be separate from any Field Laboratory and/or Field Office furnished to the Department under the Contract. Quality control sampling and testing by the Contractor shall be performed in a qualified laboratory by a certified technician. Requirements for technician certification and laboratory qualification are contained in the Department's *Manual of Field Sampling and Testing Procedures*.

Quality control sampling and testing shall be accomplished in a timely manner. Sampling and testing shall be planned and conducted so that a representative sample is obtained and tested. The Contractor shall determine the specific locations for samples and frequency of sampling for quality control, except the minimum frequency which is listed below for aggregate gradation shall be

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used. In addition, the Contractor shall be required to perform acceptance sampling and testing at specific times and/or locations specified by the Engineer according to Subsection 501.04(b). The Contractor may use the results of these required tests in his quality control program.

Sampling shall be performed under AHTD 465.

Test methods for Contractor quality control shall be as shown below:

<b>Property</b>	<b>Test Method(s)</b>	<b>Remarks</b>
Gradation (coarse & fine aggregates)	AASHTO T 27	1 test per 1000 cubic yards (750 cubic meters) of mix (minimum). Split samples for Department verification testing.
Aggregate Moisture	AASHTO T 255	
Air Content & Slump	AASHTO T 152 AASHTO T 119	Sampled after placement on grade, but before consolidation by paver or vibrators.
Compressive Strength	AASHTO T 22	Test specimens for compressive strength determined by cores will be obtained according to AASHTO T 24 <u>OR</u> test specimens for compressive strength determined by cylinders will be obtained according to AASHTO T 23.

The Contractor shall certify to the Engineer that the calibration of the concrete cylinder compression testing machine has been verified. This verification shall be performed in accordance with AASHTO T 22 and T 67 under any of the following conditions and documented in accordance with AASHTO T 67:

1. After an elapsed interval of 18 months (maximum) since the previous calibration.
2. After original installation of the machine or following relocation of the machine.
3. Immediately after repairs or adjustments.
4. Whenever there is a reason to doubt the accuracy of the results, without regard to the time interval since the last verification.

An adequate supply of aggregate must be stockpiled to allow representative sampling in advance of any placement, with the minimum amount being that required to complete the day's planned placement. The initial quality control test results for gradation must be completed and the test results submitted to the Engineer prior to the beginning of mix production each day. Subsequent tests shall be taken and tested during production and test reports submitted to the Engineer by the end of the next business day after the sample is taken. Any failing gradation test result will result in halting production. The aggregate remaining in the stockpile will be resampled and tested by the Contractor and the Engineer. If the test results indicate that the aggregate is outside of the specification limits in Subsection 501.02(b) and (c) or varies from the Job Mix Formula in excess of the limits shown below, the stockpile shall either be corrected or replaced. Passing test reports must be submitted to the Engineer before work resumes.

Sieve Size	Permitted Variation from % passing shown on Job Mix Formula	
	Minimum	Maximum
1 ½" (37.5 mm)	-7%	+7%
1" (25.0 mm)	-7%	+7%
¾" (19.0 mm)	-7%	+7%
½" (12.5 mm)	-7%	+7%
3/8" (9.5 mm)	-7%	+7%
#4 (4.75 mm)	-7%	+7%
#8 (2.36 mm)	-7%	+7%

#16 (1.18 mm)	-4%	+4%
#30 (0.600 mm)	-4%	+4%
#50 (0.300 mm)	-4%	+4%
#100 (0.150 mm)	-4%	+4%

Sampling and testing for acceptance and adjustment of payment will be performed as specified in Subsection 501.04(b) and 501.04(c).

The Contractor shall provide an opportunity for the Engineer to observe all quality control sampling and testing procedures. The Contractor's quality control personnel may observe the AHTD project personnel during acceptance sampling and testing for the purpose of comparing sampling and testing procedures.

The Contractor shall maintain a daily plot of all test results, and make the plots available to the Engineer. Upon completion of work on the item, these plots shall be furnished to the Resident Engineer for inclusion in the project files. The Resident Engineer will make acceptance test results available to the Contractor's personnel.

If the test results show that the material is outside the mix design limits, is widely varying, or is consistently marginal, corrective action shall be taken. Corrective actions taken shall be based on the Contractor's quality control test results. The Department's inspector will be notified of all proposed corrective actions before their implementation. If excessive changes are required, production will be suspended and a new mix design shall be developed according to the applicable specifications.

Quality Control and Acceptance testing of Portland Cement Concrete Pavements will not be paid for separately, but full compensation therefor will be considered included in the contract unit prices bid for the portland cement concrete pavements used on the project.

**(b) Acceptance Testing.** Acceptance will be by lot. The standard lot size for acceptance will be 4000 cubic yards (3000 cubic meters), with each standard lot divided into four sublots of



1000 cubic yards (750 cubic meters) each. The Engineer may establish a partial lot at any time. The Engineer will determine the size of any partial lots established and the number and size(s) of the sublots, if any. Although there are no specified limits for the size of such partial lots, they normally will be not less than 400 cubic yards (300 cubic meters) nor more than 4400 cubic yards (3300 cubic meters).

Thickness determination shall be made from cores sampled for compressive strength tests. The Contractor shall drill and fill core holes with a material approved by the Engineer at no cost to the Department. Slump and air content will be determined by testing fresh concrete. Compressive strength will be determined by testing pavement cores at least 28 days and no more than 90 days after the concrete has been placed. Test methods for acceptance shall be the same as specified for quality control testing. Acceptance sampling and testing by the Contractor shall be performed in a qualified laboratory by a certified technician. Requirements for technician certification and laboratory qualification are contained in the Department's *Manual of Field Sampling and Testing Procedures*.

The Contractor shall obtain and test one sample taken at random from each subplot. The Department will determine the location for each sample in the subplot by AHTD Test Method 465. The Department's inspector shall be provided an opportunity to witness all Contractor sampling and testing. The test reports of all Contractor acceptance tests shall be provided to the Engineer on the next business day after the tests are performed.

The Department will obtain and test a minimum of one sample taken at random from each lot, including partial lots, to be used both for verification and for acceptance. Verification testing will be conducted in accordance with Subsection 106.11 and the Department's *Manual of Field Sampling and Testing Procedures*. The location of the lot sample will be determined by the Department using AHTD Test Method 465.

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The Contractor's acceptance sampling and testing procedures, equipment, and results will be subject to independent assurance sampling and testing conducted by the Department. Independent assurance sampling and testing will be conducted at the frequencies indicated in the Department's *Manual of Field Sampling and Testing Procedures*. The Contractor shall be required to make changes to the equipment and/or procedures used if the results of the independent assurance tests do not correlate with the Contractor's test results.

The Department will perform all tests for acceptance of material used to replace unacceptable material removed by the Contractor. The number of tests and the location(s) for sampling will be determined by the Engineer using the same procedures used for the original material. The results of these tests will be used for acceptance of the lot or subplot, as applicable.

Additional requirements for concrete pavement are specified in Subsection 501.05(m), Surface Evenness and Testing, and Subsection 501.10, Tolerance in Pavement Thickness.

It is anticipated that when portland cement concrete pavement is placed over the open graded base course, the concrete will penetrate the open graded base course. However, no adjustment in payment for portland cement concrete pavement will be made as a result of this penetration.

When cores are taken to determine the compressive strength and thickness of the portland cement concrete pavement, it is anticipated that a layer of open graded base course will adhere to the bottom of the core. All particles of open graded base course shall be removed from the bottom of the core prior to measuring the core for determining the thickness of the portland cement concrete pavement.

**(c) Acceptance of the Pavement and Adjustments in Payments.** Acceptance of Portland Cement Concrete Pavements courses will be based on the following criteria:

- The results of tests for the properties listed in Table 501-1

- Pavement smoothness, Subsection 501.05(m)
- Pavement thickness, Subsection 501.10.

All sampling and testing for acceptance and for adjustments in payments shall be performed using the test methods specified in Subsection 501.04(a) for quality control sampling and testing. Samples for all properties except gradation and moisture shall be obtained at the project site.

Acceptance with respect to the properties listed in Table 501-1 will be by lot. Acceptance of a standard lot will be based on the average of the five (5) tests performed on the lot. Acceptance of a partial lot will be based on the average of the actual number of tests made on that partial lot. Acceptance of a subplot will be based on the results of the test(s) performed on samples from that subplot.

When the average of the test results for a lot fall within the range shown in Table 501-1 as "Compliance Limits", the lot will be accepted with no price reduction for those properties. If the average of the test results for a lot for any single property listed in the table falls within the limits shown as "Price Reduction Limits", the material may be left in place at a reduced price as shown in Table 501-1. If the average of the test results for a lot for any single property listed in the table falls outside the limits shown as "Lot Rejection Limits", the entire lot shall be removed and replaced at no cost to the Department. Sampling and testing of the replacement material will be according to Subsection 501.04(b).

For any single property, if the result of the single test in a subplot falls outside the limits shown as "Sublot Rejection Limits", that subplot shall be removed and replaced at no cost to the Department. In the subplot containing the Department's lot test, if the result of either the Contractor's subplot test or the Department's lot test fall outside the subplot rejection limits, the two tests will be averaged and the average of the two test results used to determine acceptance or rejection. The average of the two test results will also be used as a single value to compute the average for the lot for acceptance and adjustment.

Pavement that is determined to be non-complying for any reason other than the properties listed in Table 501-1 will be evaluated under Subsection 105.04. The Engineer will determine whether the non-complying pavement must be corrected, removed and replaced, or may be left in place at a reduced cost to the Department. Price reductions determined under Subsection 105.04 will be in addition to the price reductions, if any, determined under this Subsection, 501.04(c). If the total price reduction is determined to be greater than 50% for any lot, that lot will not be accepted.

Any lot or section of any portland cement concrete pavement that is not accepted for any reason shall be removed and replaced by the Contractor at no cost to the Department. Payment for sections where removal and replacement is required will be withheld or recovered, and released after replacement has been acceptably completed. The quantity for payment will be the original quantity and measurement of the quantity used in replacement operations will not be considered.

At the Contractor's option additional testing for confirming price reductions or pavement rejection due to compressive strength results may be performed by the Contractor at locations determined by the Department. In such cases, three cores shall be taken in each subplot containing compressive strength results not in Compliance Limits. The compressive strength shall be determined by the average result of the cores. Cores shall be sampled according to AASHTO T 24. The average of the three cores must meet or exceed applicable price reductions limits or pavement rejection limits. Acceptance and pay adjustments will then be determined based on these results. This testing will be performed at no cost to the Department. The holes made in taking the samples shall be repaired by the Contractor at no cost to the Department.

Adjustments will be made by reducing the contract price of the lot according to Table 501-1. Price reductions will be computed from Table 501-1 for each property, and reductions for each property added together to obtain the total price reduction for the lot. The total price reduction will be applied to all components of

the pavement for the entire quantity of the lot. Price reductions will be accomplished by Change Order and will be shown on progress and final estimates as a separate item deduction. When the number of deviations for any property shown exceeds the maximum specified, or when the total price reduction for a lot is greater than 50%, that lot will not be accepted.

When two consecutive lots or any three out of five consecutive lots fail to qualify for full payment for any reason, work will be stopped until corrective action is taken. Continuous production of pavement not qualifying for full payment will not be allowed.

**501.05 Construction Requirements.** Equipment, tools, and machinery used on mainlane and ramp pavements shall be specifically designed for placing, consolidating, and finishing portland cement concrete pavement and shall be maintained in a satisfactory working condition. The methods employed in performing the work and all equipment, tools, and machinery used for handling materials and executing any part of the work shall be subject to the approval of the Engineer. Either the slip form paver or side form method may be used.

**(a) Subgrade.** The subgrade shall be prepared in compliance with Section 212.

**(b) Handling and Storage of Materials.** The handling and storage of concrete aggregates shall be such as to prevent segregation and contamination with foreign materials.

Coarse and fine aggregates shall be separated by bulkheads or stored in separate stockpiles sufficiently removed from each other to prevent the material at the edges of the piles from becoming inter-mixed. Coarse aggregate stockpiles that are not confined by bulkheads or bins shall be built up in layers or wedges not to exceed 4' (1.25 m) in height, and each layer shall be completely in place before beginning the next. Coning or building up of stockpiles by depositing material in one place will not be permitted.

Coarse aggregates secured from different sources shall be unloaded into separate stockpiles and proportioned through separate storage bins. The Contractor will be required to furnish such additional storage bins and auxiliary equipment as may be necessary to combine and proportion the aggregate for the accepted mix.

There shall be adequate aggregate stockpiled to allow representative sampling sufficiently in advance of any placement to determine its acceptability, with the minimum amount being that required to adequately complete the planned placement. The stockpiles shall be large enough to ensure that the moisture content of any class of aggregates will remain sufficiently uniform to allow the accurate control of the amount of water entering into the concrete.

Cement shall be stored in suitable weatherproof buildings or silos that will protect the cement from dampness.

**TABLE 501-1  
COMPLIANCE, PRICE REDUCTIONS, AND REJECTION LIMITS FOR  
PORTLAND CEMENT CONCRETE PAVEMENT**

<b>Property</b>	<b>Compliance Limits</b>	<b>Price Reduction Limits</b>	<b>Price Reduction</b>	<b>Lot Rejection Limits</b>	<b>Sublot Rejection Limits</b>
Air Content	4.0% -8.0%	3.5% - 3.9% and 8.1% - 8.4%	10%	less than 3.0% and more than 9.0%	less than 2.0% and more than 10.0%
		3.0% - 3.4% and 8.5% - 9.0%	20%		
Compressive Strength	4000 psi (min) (28.0 MPa)	3999 – 3800 psi (27.9 – 26.2 MPa)	10%	Less than 3400 psi (23.4 MPa)	Less than 3200 psi (22.1 MPa)
		3799 – 3600 psi (26.1 – 24.8 MPa)	20%		
		3599 – 3400 psi (24.7 – 23.4 MPa)	30%		

**(c) Measuring Materials.**

**(1) General.** Batch plants shall be equipped to proportion aggregates and bulk cement by weight by means of automatic and interlocking proportioning devices of approved type.

Measuring devices shall be operated in a manner that will consistently allow the exact weight of cement within  $\pm 1\%$ , individual aggregates within  $\pm 2\%$ , and total weight of aggregate within  $\pm 2\%$  of the required weight. Measuring devices shall be so designed and plainly marked that the weights can be accurately and conveniently verified for the quantities of each component actually being used.

The batching plant shall be equipped with an automatic weighing system, including an automatic ticket printer, as described in Subsection 109.01(f). A load ticket shall accompany each load delivered to the project and shall be furnished to the Engineer at the time of delivery. The load ticket shall show the following information:

1. Unique ticket number.
2. Identification of the truck.
3. Date and time of batching.
4. Total weights and/or volumes of each component.
5. Total volume of mix.
6. Total quantity of water added after batching.
7. Time of discharge.

A printout showing the above information for each truckload of mix may be maintained at the plant and provided to the Engineer at the end of the day's run whenever a dedicated central batch plant is used to provide concrete for the paving operation. This printout for the day's operation will be accepted in lieu of individual tickets accompanying each load.

**(2) Aggregates.** Aggregates shall be measured separately and accurately by weight. The batch plant shall include batcher bins, of either the stationary or mobile type, with adequate separate compartments for fine aggregate, each compartment designed to discharge efficiently and freely into the weighing hopper or hoppers. Means of control shall be provided in each case so that



as the quantity desired in the weighing hopper is being approached, the material may be added slowly in small quantities and shut off with precision. Means of removing any overload of any one of the several materials shall be provided.

In the type where more than one aggregate is weighed into one hopper, each aggregate shall be held in a separate compartment, so arranged that an overload of any aggregate can be removed. Hoppers shall be constructed so as to eliminate accumulations of tare materials and to fully discharge without jarring the scales. Partitions between compartments, both in bins and in hoppers, shall be ample to prevent mixing of adjacent materials under any working conditions. Batch plant structures shall be maintained properly leveled within the accuracy required by the design of the weighing mechanism.

The scales for weighing aggregates and cement may be the horizontal beam, the springless dial, or the electronic type, designed as an integral unit of the batch plant, of rugged construction to withstand hard usage due to working conditions, and shall have a maximum allowable error of  $\pm\frac{1}{2}\%$  of one net load. When beam-type scales are used, provisions such as a "tell-tale" dial, shall be made for indicating to the operator that the required load in the weighing hopper is being approached, which device shall indicate at least the last 200 pounds (90 kg) of load. A device on weighing beams shall indicate critical position clearly. Poises shall be designed for locking in any position and to prevent unauthorized removal. The weigh beam and the "tell-tale" device shall be in full view of the operator while charging the hopper. The operator shall have convenient access to all controls.

Clearance between scale parts, hoppers, and bin structures shall be such as to avoid displacement of, or friction between, parts due to accumulations, vibration, or other causes. Pivot mountings shall be designed so none of the parts will jar loose and so as to assure unchanging spacing of knife edges. Scales shall be so designed that all exposed fulcrums, clevises, and similar working parts may readily be kept clean. Scales shall be constructed of non-corrosive materials, excluding material softer than brass. Weight beams shall have leveling lugs, and weighing parts of other types shall be provided with means for precision adjustment. Scales shall be satisfactory to the Engineer and shall

be inspected, adjusted, and certified by a registered scale mechanic according to Subsection 109.01(f).

**(3) Cement.** Cement shall be proportioned on the basis of 94 pounds per cubic foot (1500 kg/cu m) and shall be measured by weight on scales as specified above.

Pneumatic charging of the weigh hopper shall be so arranged that the measurement will not be affected by air pressure in the supply line.

**(4) Water.** The mixer shall be equipped with an automatic water measuring device that shall be within a range of error not to exceed  $\pm 1\%$  and shall be so arranged that the measurement will not be affected by variations of pressure in the water supply line and will be accurate under all construction conditions encountered. Water may be measured either by volume or by weight.

**(5) Admixtures.** The mixer shall be equipped with an approved automatic dispenser for adding to the mixing water the desired amount of admixtures. The dispenser shall be constructed and connected so that the amount of admixture entering into the mixing water can be visually determined.

**(d) Mixing Concrete.** Concrete shall be mixed according to Subsection 802.08 except as follows:

Concrete shall be delivered and discharged from the truck mixer or agitator into the paver or forms within one hour after the introduction of the mixing water to the cement. The Contractor shall supply sufficient trucks to assure a steady forward progress of the paver.

**(e) Cold Weather Concreting.** Concreting operations will not be permitted when a descending air temperature falls below 40° F (5° C) nor resumed until an ascending air temperature reaches 35° F (2° C) without specific authority from the Engineer. When operations are authorized under such conditions or when it is anticipated that the air temperature will fall below 40° F (5° C) before the concrete has taken its final set, the concrete surface shall be covered with suitable material and to such depth as to prevent freezing. The covering shall remain in place until the slab has thoroughly cured. Under no circumstances will the placing of concrete on a frozen subgrade be permitted.

**(f) Protection Against Rain.** In order that concrete may be properly protected against the effects of rain before the concrete is sufficiently hardened, the Contractor shall have available at all times materials for the protection of the edges and surface of the unhardened concrete. When rain appears imminent, all paving operations shall stop. Any concrete damaged by rain shall be repaired or removed and replaced by the Contractor at no cost to the Department.

**(g) Dowel and Tie Bars.** The Contractor shall establish the location of all dowel bars and tie bars and place them as shown on the plans. The dowel bars shall be held in position parallel to the surface and centerline of the slab by a metal assembly of sufficient strength to prevent displacement during the paving operations. Special attention may be required when anchoring the dowel bar baskets to the open graded base course. Tie bars may be placed by mechanical equipment contingent upon satisfactory performance and the Engineer's approval.

Dowel bars extending across transverse joints shall be of the type and size shown on the plans. Each smooth bar shall be field coated for a minimum distance of 2" (50 mm) greater than half the length of the bar with an approved grease as a bond breaker just prior to placement of concrete.

Each bar across expansion joints shall be capped on the greased end with a close-fitting, non-compressible paper, plastic, or metal expansion sleeve of approved design, approximately 6" (150 mm) long, which shall extend 1" (25 mm) beyond the end of the bar and shall carry a stop of compressible material to provide space for subsequent movement of the bar.

Tie bars extending across and through longitudinal joints shall be deformed bars of the type and size shown on the plans.

Other types of ties and load transfer devices may be used when shown on the plans or approved in writing by the Engineer.

**(h) Placing Reinforcement.** Reinforcing steel shall be clean and free from foreign material and scaling rust. Reinforcing mats shall be handled carefully and kept straight and free from bends and warps. They shall be placed parallel to the finished surface and to the depth shown on the plans.

When the concrete is placed in one course, mechanical or vibratory equipment shall be used to place the mesh fabric reinforcement in position. The reinforcement shall be placed immediately behind the first strike-off and followed immediately by the finishing machine to erase all marks made by the insertion of the reinforcing fabric in the concrete. Use of equipment for the insertion of wire mesh will be contingent upon satisfactory performance and the Engineer's approval.

When reinforced concrete pavement is placed in two layers, the entire width of the bottom layer shall be struck off and consolidated to such length and depth that the sheet of mesh fabric may be layered full length on the concrete in its final position without further manipulation. The reinforcement shall then be placed directly upon the concrete before initial set of the concrete has occurred. The top layer of the concrete shall then be placed, struck off, and screeded to the required thickness and crown. Sleds, chairs, or other devices supporting the mesh fabric reinforcing steel, with the consequent depositing of the concrete through the steel, will not be permitted.

**(i) Placing Concrete.** Concrete shall not be placed on a soft, muddy, or frozen subgrade. The subgrade shall be moistened immediately before placing concrete unless a waterproof subgrade or base course material is specified. Moistening shall not be excessive to the point of forming mud or pools.

No concrete shall be placed without the approval of the Engineer.

The concrete shall be deposited on the subgrade in such manner as to require as little re-handling as possible. Spreading required shall be done by means of an approved mechanical spreader supplemented by hand shoveling as required. Spreading by rakes will not be allowed.

**(j) Joints.**

**(1) General.** The Contractor shall establish the location of all joints in concrete pavement. Longitudinal and transverse joints shall be located as shown on the plans in relation to the dowel or tie bars. Longitudinal and transverse joints shall be constructed to conform to the types, dimensions, and other details shown on the plans.

Longitudinal joints include the longitudinal joint between lanes, lanes and shoulders, and longitudinal construction joints between placements in sequence or placements against existing pavement. Transverse joints include expansion joints, contraction joints, warping joints, and construction joints.

All longitudinal and transverse joints shall be constructed, finished, filled, and sealed with joint material as shown on the plans. The joint grooves shall be thoroughly clean and dry when joint material is placed.

Sawed joints shall be formed by cutting the groove in the hardened concrete with an approved concrete saw capable of cutting the joint to the specified dimensions and true to line within the allowable variation.

Joints shall be sawed as soon as the concrete has hardened to the extent that tearing and raveling will not occur, but before development of any random cracking. Sufficient saws and saw blades to accomplish the work shall be available at all times. Should any procedure result in premature and uncontrolled cracking, the Contractor shall immediately revise the method and/or sequence of cutting the joints. Any curing media removed during sawing shall be immediately replaced.

All joints shall be constructed so that the plane of the finished joint is perpendicular to the surface of the pavement and shall be uniform and not deviate more than 1/2" (12 mm) from the planned alignment within any 24' (7 m) segment. In addition, all transverse joints shall be perpendicular to the centerline of the pavement.

The following methods shall apply for longitudinal, contraction, and warping joints when Type 3, 4, 5, or 6 joint sealer is used:

Within 15 minutes after sawing for joint installation, the joints shall be flushed with water under sufficient pressure to remove all slurry and residue left by the sawing operation. After flushing, the joints shall be blown out with compressed air to remove excess water.

Joints shall not be filled and sealed for a minimum of 6 days following placement of the concrete except that when High Early

Strength Concrete Pavement is specified, the period may be reduced to 18 hours.

When the joints are thoroughly dry, and just before sealer placement, both vertical faces shall be thoroughly cleaned by sandblasting with a nozzle attached to an aiming device that directs the sand blast at approximately a 45° angle and a maximum of 2" (50 mm) from the face of the joint. Each joint face shall be sandblasted individually. After sandblasting, the joints shall be blown out with compressed air that has been filtered and is completely free of oil and moisture. The joints shall be thoroughly dry before sealer is placed.

All joints shall be filled and sealed the same day of the final sandblasting. Cleaned joints left open overnight shall be re-cleaned by sandblasting before filling and sealing.

In the event freshly cleaned joints become contaminated before they are sealed, they shall be re-cleaned as specified above.

Backer material shall be installed in a manner that will result in the planned depth and shape for the sealant. If primer is required, the primer shall be applied before installing the backer material.

Joint sealer shall be applied by an approved mechanical device from inside the joint in a manner that causes it to wet the joint surfaces. Joint sealer application will not be permitted when the pavement surface temperature at the joint is less than the application temperature specified by the manufacturer.

In Type 3 and 4 joint sealant, the surface shall be tooled, using the appropriate tool, to produce a slightly concave surface as shown on the plans. Tooling shall be accomplished before a skin forms on the surface. The use of soap or oil as a tooling aid will not be permitted. When an approved self-leveling joint sealant is used, the Engineer may waive the requirement for tooling.

Failure of the joint material in either adhesion or cohesion will be cause for rejection. Removal, re-cleaning, and replacement of the failed material shall be at no cost to the Department.

**(2) Expansion Joints.** Standard transverse expansion joints shall be placed at or near the ends of bridges, unless otherwise specified, and at other points designated on the plans. Special

expansion joints shall be placed at all structures projecting through, into, or against the pavement such as drop inlets, junction boxes, etc. Unless otherwise specified, joints at such projecting structures shall be 1/2" (12 mm) in width and shall be filled with material complying with Subsection 501.02(h) Type 2.

Transverse expansion joints shall extend for the full cross section of the pavement and shall be formed by a template or as shown on the plans. The template shall be securely staked or fastened in place before placing the concrete and in a manner to ensure the joint and dowel bars will remain in their proper position after finishing operations have been completed.

**(3) Contraction and Warping Joints.** Contraction and warping joints shall be constructed according to the spacing and dimensions shown on the plans. The joints shall extend continuously across the full width of the concrete surface.

**(4) Construction Joints.** Transverse construction joints shall be constructed when there is an interruption in the concreting operations of more than 30 minutes. Time may be adjusted, due to weather conditions, as directed by the Engineer. No transverse joint shall be constructed within 10' (3 m) of an expansion joint, contraction joint, or place of weakness. If sufficient concrete has not been mixed at the time of interruption to form a slab at least 10' (3 m) long, the excess concrete back to the last preceding joint shall be removed. No payment will be made for the portion of the pavement which is discarded.

The header may be made of wood or metal and shall have openings for the dowel bars. The header may be of one or two pieces and shall be rigid and accurately set to grade perpendicular to the centerline and surface of the pavement. In lieu of using a header, the Contractor may make the construction joint by cutting back the hardened concrete by sawing and installing dowel bars according to the provisions of Section 507.

**(5) Longitudinal Joints.** Longitudinal joints shall be constructed along the center line of two lane pavements and approach slabs, between lanes of multiple lane pavements and approach slabs, between pavements (new or existing) and added concrete lanes or concrete shoulders, and between approach slabs and approach gutters.

**(k) Consolidating and Finishing.**

**(1) Mechanical Methods.** After the concrete has been deposited and spread it shall be consolidated by means of a mechanical vibrating machine of approved type and design. The vibrating machine may be mounted either on the mechanical spreader or operated as a separate unit on an individual carriage. Vibrators for full width vibration of concrete paving slabs shall be the internal type with either immersed tube or multiple spuds. They may be attached to the spreader or the finishing machine, or may be mounted on a separate carriage. They shall not come in contact with the joint, load transfer devices, subgrade, or side forms. The frequency of the internal type shall not be less than 5,000 impulses per minute for tube vibrators and not less than 7,000 impulses per minute for spud vibrators.

An electronic vibrator-monitoring device that displays the operating frequency of each individual internal vibrator shall be required. The monitoring device shall have a readout display near the operator's controls visible to the paver operator and the Department Inspector. It shall operate continuously while paving, and shall display all vibrator frequencies with manual or automatic sequencing among all individual vibrators. The monitoring system shall also record, at minimum, the clock time, station location, paver track speed, and operating frequency of individual vibrators. Recordings shall be made after each 25 feet (7.5 m) of paving or after 5 minutes of time. A record of the data shall be provided to the Engineer daily for the first 3 days of paving and weekly thereafter. The Engineer may determine that more frequent submission is necessary, particularly if equipment malfunctions occur.

If the electronic monitoring device fails to operate properly, the vibrators shall immediately be checked manually. If the vibrators are functioning properly, paving may continue but the Contractor shall make all efforts to correct the malfunction in a reasonable amount of time. If the recording device fails to operate, paving may continue but the Contractor shall monitor the vibrators continuously and correct the malfunction within 3 paving days.

When spud type internal vibrators, either hand operated or attached to spreaders or finishing machines, are used adjacent to



forms, they shall have a frequency of not less than 3,500 impulses per minute.

If, for any reason, equipment previously approved becomes unsatisfactory, it shall be replaced before proceeding with the work.

Vibration shall extend over the entire pavement area and the vibrating machine shall satisfactorily consolidate the mixes required for this type of construction and shall not displace the reinforcement, side forms, joints, or dowel bar assemblies. The concrete shall be deposited, spread, and vibrated in a manner that will ensure minimum segregation and develop a maximum density and strength in the finished pavement.

After vibratory consolidation, the concrete shall be struck off by means of an approved power driven, mechanical finishing machine equipped with double screeds adjusted to strike-off to the required crowned section on tangents and to the plane section on curves as shown on the typical cross section. The finishing machine shall be operated with a roll of concrete in front of each screed sufficient to fill depressions and leave the top of the slab smooth and even with the desired crown and at the proper elevation.

**(2) Hand Methods.** At intersections and turnouts, and on additional widths or other irregular sections not readily accessible to conventional equipment, the concrete may be spread and struck off by hand methods as approved by the Engineer. Over all such areas, however, consolidation shall be accomplished through use of a suitable and approved mechanical vibrator unit.

When striking-off and consolidating by hand methods is permitted, the work shall be done in the following manner:

After the concrete has been deposited, it shall be leveled and then struck-off to such depth above the finished grade specified that when properly consolidated the surface shall conform to the line and grade desired. Before striking-off, the concrete shall be thoroughly consolidated by means of a mechanical vibrator unit. The strike-board shall be moved forward with a combined longitudinal and transverse motion, so manipulated that neither end is raised from the side forms during the striking-off process.

A slight excess of material must be kept in front of the cutting edge at all times. Additional concrete shall be added to low places and porous spots and the striking and consolidating continued until the entire pavement has a uniform, even surface.

Strike-boards used must be straight, free from warp, shod on the striking surface with a strip of steel, shaped to the required crown, and have sufficient weight and rigidity to accomplish the purpose desired.

**(3) Floating.** After the concrete has been struck off and consolidated, it shall be further smoothed and consolidated by any approved method of mechanical floating, either longitudinal or transverse, which will satisfactorily finish the pavement to the required cross-section, elevation, and surface smoothness. The use of mechanical floating equipment will be contingent upon satisfactory results.

Excess water, laitance, or foreign materials brought to the surface during the floating operations shall not be reworked into the pavement but shall be removed immediately upon appearance by means of a squeegee or straightedge drawn from the center of the pavement toward either edge.

In general, the addition of water to the surface of the concrete to assist in finishing operations will not be permitted. If the application of water to the surface is permitted, it shall be applied as a fog spray by means of approved spray equipment.

**(4) Straightedging.** After the longitudinal floating has been completed and the excess water removed, but while the concrete is still plastic, the slab surface shall be checked by the Contractor in both directions for trueness, using a straightedge. For this purpose an accurate 10' (3 m) metal straightedge shall be used, swung from a handle longer than one-half the width of the slab. Additional floating may be necessary to eliminate all irregularities. The straightedge shall be held in successive positions parallel to the pavement centerline in contact with the surface and the surface checked for the full width of the slab.

Progression along the pavement shall be in successive stages of not more than one-half the length of the straightedge. Depressions found shall be immediately filled with freshly mixed concrete, struck-off, floated, and refinished. High areas shall be

cut down and refinished. Straightedge testing and surface correction shall continue until the entire surface conforms to the required grade and section.

**(5) Final Finish.** Following the straightedging and after all excess moisture has disappeared, the surface of the concrete pavement shall be given a final finish with a drag followed by grooving. The drag shall consist of a seamless strip of damp burlap, cotton fabric, or artificial turf that will produce a uniform surface of gritty texture after dragging longitudinally along the full width of pavement. For pavement 16' (5 m) or more in width, the drag shall be mounted on a bridge and moved along the surface by mechanical means. The dimensions of the drag shall be such that a strip at least 2' (0.6 m) wide is in contact with the full width of pavement surface while the drag is used. A burlap or fabric drag shall consist of not less than 2 layers with the bottom layer approximately 6" (150 mm) wider than the upper layer. The drag shall be maintained in such condition that the resultant surface is of uniform appearance and reasonably free from grooves over 1/16" (1.5 mm) in depth. Drags shall be maintained clean and free from encrusted mortar. Drags that cannot be cleaned shall be discarded and new drags furnished.

The final finish shall be produced by using the drag finish as described above along with the further application of a metal tine finishing device. The tines shall be approximately 0.032" by 0.125" (0.8 mm by 3 mm) steel flat wire, 2" to 5" in length (50 mm to 125 mm) and spaced on 1/2" to 3/4" (13 mm to 19 mm) centers. The grooves produced in the concrete shall be substantially from 1/8" to 3/16" (3 mm to 5 mm) in depth. The grooves shall be transverse to the centerline of the pavement. On main lanes the metal tine device shall be operated by an approved mechanical means. Manual methods may be used on ramps, connections, and miscellaneous sections when approved by the Engineer.

As an alternate to the use of a burlap drag and a metal tine finishing device, a finned float may be used according to the following requirements:

After a tight uniform surface meeting the straightedge requirements of Subsection 501.05(k)(4) has been achieved, the surface shall be given a texture by transverse grooving with a

finned float. The finned area of the float shall be at least 4" by 36" (100 mm by 900 mm). The fins shall extend the full length of the float and cover at least half the width. The grooving shall be approximately 3/16" (5 mm) in width at 3/4" (20 mm centers) and substantially between 1/8" to 3/16" (3 mm and 5 mm) in depth. This operation shall be performed at such time and in such manner that the desired texture will be achieved while minimizing displacement of the larger aggregate particles.

Other texturing equipment or methods may be approved by the Engineer provided it produces a texture equivalent to that produced by the metal tine or float.

**(6) Finishing Joints and Edging.** Longitudinal and transverse joints, where required, shall be so constructed as to allow the normal finishing operations to be executed and completed over the joint. After the final finish, but before the concrete has taken its initial set, the edges of the pavement along each side of each slab, and on each side of transverse expansion joints and formed joints, shall be worked with an approved tool and rounded to a 1/4" (6 mm) radius. A well-defined and continuous radius shall be produced and a smooth, dense mortar finish obtained. The surface of the slab shall not be unduly disturbed by tilting the tool during use.

At joints, tool marks appearing on the slab adjacent to the joints shall be eliminated by brooming the surface. In doing this, the rounding of the corner of the slab shall not be disturbed. Concrete on top of the joint filler shall be completely removed.

Joints shall be tested with a straightedge before the concrete has set. Corrections shall be made if one side of the joint is higher or lower than the other.

**(I) Curing.** Immediately after 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 covered and cured according to one of the following methods:

**(1) Polyethylene-Burlap Mats.** The mats used shall be of such length or width that as placed they will extend at least twice the thickness of the pavement beyond the edges of the slab. The mat shall be placed so that the entire surface and both edges of the slab are completely covered. Before being placed, the mats

shall be saturated thoroughly with water. The mats shall be so placed and weighted down as to cause them to remain in intimate contact with the surface covered, and the covering shall be maintained fully wetted and in position for 5 days after the concrete has been placed unless otherwise specified.

**(2) Polyethylene Sheeting or Copolymer/Synthetic Blanket.**

When this type of curing is used, the sheeting shall be so placed and weighted down as to cause it to remain in intimate contact with the surface covered. The sheeting as prepared for use shall have such width that each unit as placed will extend beyond the edges of the slab at least twice the thickness of the pavement. Unless otherwise specified, the covering shall be maintained in place for 5 days after the concrete has been placed.

**(3) Membrane Curing.** The entire surface of the pavement shall be sprayed uniformly with curing compound (Type 1-D or Type 2) immediately after the finishing of the surface and before the set of the concrete has taken place, or, if the pavement is cured initially with an alternate method, it may be applied upon removal of the covering. The curing compound shall not be applied during rainfall.

Curing compound shall be applied using pressure sprayers at the minimum rate of 1 gallon per 125 square feet (1 L/3 sq m). The spraying equipment shall be of the fully atomizing type equipped with a tank agitator. At the time of use, the compound shall be in a thoroughly mixed condition with the pigment or dye uniformly dispersed throughout the vehicle. During application, the compound shall be stirred continuously by effective mechanical means. Hand spraying of odd widths or shapes and concrete surfaces exposed by the removal of forms will be permitted. Curing compound shall not be applied to the inside faces of joints to be sealed.

The curing compound shall be of such character that the film will harden within 30 minutes after application. Should the film become damaged from any cause during the required curing period, the damaged portions shall be repaired immediately with additional compound.

Upon removal of side forms, when used, the sides of the slabs exposed shall be protected immediately to provide a curing treatment equal to that provided for the surface.

**(m) Surface Evenness and Testing.** The finished pavement surface shall have a maximum profile index of 5" per mile (75 mm/km) ( $\pm 0.1$ " [2.5 mm] blanking band) for each 0.1 mile (200 m) section, or portion thereof, for mainlane pavement and 10" per mile (150 mm/km) for each 0.1 mile (200 m) section, or portion thereof, for ramps and acceleration/deceleration lanes.

The cross slope of the pavement shall vary no more than 1/8" (3 mm) in 10' (3 m) when tested with a straightedge.

The Contractor shall furnish a California-style profilograph complying with ASTM E 1274 or an automated lightweight profilometer complying with ASTM E 950, Class I and calibrated to the California-style profilograph scale.

The Contractor will take all profiles required by this subsection, under the observation of the Engineer. All data obtained from the profiling operations will be furnished to the Engineer at the end of each day's operations. The Engineer will verify the calibration of the profilograph equipment as frequently as necessary to assure proper operation.

The Engineer will verify the profiles by testing approximately 10% of the pavement. This testing will be performed by the Engineer, using either the profilograph furnished by the Contractor or one provided by the Department, at the option of the Engineer.

A profile will be taken near the center of each traffic lane or ramp using the profilograph equipment. The profiles shall begin 25' (7.5 m) from an existing structure or from the end of the pavement or 25' (7.5 m) back onto the previous day's run. The finished surface of the 25' (7.5 m) sections adjacent to an existing structure or the end of pavement shall not show surface deviations in excess of 1/8" (3 mm) in 10' (3 m) when tested with a 10' (3 m) straight edge.

For the first day's run, profiles will be taken utilizing the profilograph equipment as soon as the hardness of the concrete is sufficient for proper testing. Smoothness profiles of the first day's run will be analyzed before the second day's run commences. Should the day's run not meet the profile index of 5" per mile (75 mm/km) or less (10" per mile [150 mm/km] for ramps and acceleration/deceleration lanes), the paving operations shall be discontinued until better methods and equipment are obtained or

until the present equipment is properly adjusted. If adjustments are necessary from the first day's run, the second day's run will be profiled to determine the ability of the equipment to finish the pavement within the specified tolerance. If the second day's operation fails to produce a finished surface having a profile index of 5" per mile (75 mm/km) or less (10" per mile [150 mm/km] for ramps and acceleration/deceleration lanes), the Contractor shall produce new methods and/or equipment that will obtain the specified results. The new methods and/or equipment will be given trial runs as indicated above for the original equipment.

For the duration of the work every reasonable effort shall be made to test smoothness within 5 working days after each day's run. Scheduling and testing shall be coordinated with the Engineer. The Contractor shall be responsible for traffic control associated with the testing operation.

All objects and foreign material on the pavement surface, including protective covers, shall be removed by the Contractor before testing. If appropriate, protective covers shall be properly replaced by the Contractor after testing.

Grinding shall be performed, if necessary, to reduce the profile index as determined by the profilograph to 5" per mile (75 mm/km) or 10" per mile (150 mm/km), as appropriate, in any 0.1 mile (200 m) section on all profiles, including the trial run. The grinding equipment shall be power driven and specifically designed to smooth and texture portland cement concrete by means of diamond blades. Areas that have been ground shall be re-grooved by grooving according to Subsection 802.19 for Class 7 surface finish, to provide a uniform texture equal in roughness to the surrounding unground pavement. However, if the ground area is less than 50' (15 m) in length and full width of the pavement lane, re-grooving will not be required.

Continual production of a final surface not qualifying for full payment will not be allowed.

In addition to the above requirements for profile indices, areas representing high points having deviations in excess of 0.3" (7.5 mm) in 25' (7.5 m) as determined by the profilograph equipment or 1/8" (3 mm) in 10' (3 m) as determined by the straightedge, shall be reduced by grinding until such deviations as indicated by retest do not exceed the above limits.

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Areas showing low spots of more than 1/4" (6 mm) in 10' (3 m) in the longitudinal direction shall be corrected by grinding or shall be removed and replaced according to Section 507 to an elevation that will not show surface deviations in excess of 1/8" (3 mm) in 10' (3 m).

**(n) Shoulder Construction.** In the construction of the shoulders, the base course material shall be placed directly on the shoulder area between the pavement edge and the outer shouldering limits indicated on the typical section. Material shall not be deposited on the surface of the pavement during placing. Care shall be exercised by the Contractor in manipulating and shaping of the material on the shoulders to assure a minimum amount of littering with base material on the pavement surface. Any littering of the surface of the pavement with base material shall be corrected by brooming.

**(o) Opening Pavement to Traffic.** The Contractor shall prevent all traffic, including construction traffic, from using newly constructed pavement until the concrete is found, by suitable tests of representative cylinders prepared at regular intervals and subjected to the same curing conditions as the pavement, to have a compressive strength of not less than 3000 psi (21.0 MPa). The pavement shall not be opened to traffic in less than 7 days, except that the minimum time for opening the pavement to traffic shall be reduced from 7 days to 24 hours when High Early Strength Pavement is specified and the requirements of Subsection 501.08 are met. Before opening the pavement to the public, all joints shall be cleaned and sealed, and the surface of the pavement cleaned of foreign substances.

**501.06 Slip Form Paver.** When a slip form paver is used, the following requirements shall apply:

**(a) Conditioning of Subgrade or Foundation Course.** After the subgrade or base has been placed and compacted to the required density, the area that will support the slip form paving machine and the area on which pavement is to be constructed shall be brought to the proper profile and cross section by means of a properly designed electronic or automatic screed control system for the control of grade and slope and recompact to the prescribed density. The subgrade and the top of each successive type of base course material shall be graded to a stringline tolerance of 0" (0 mm) high and 1/2" (12 mm) low when compared to the computed grade for the



subgrade or individual type of base course. Unless otherwise provided for in the plans or special provisions, no hauling will be allowed on the finished subgrade or base course except for dumping the concrete. Suitable temporary construction crossovers may be constructed when approved by the Engineer. The subgrade shall be prepared for a distance of not less than 500' (150 m) in advance of the paver or the entire remaining distance when within 500' (150 m) of the end of the paving or bridge end. The subgrade or base course shall be checked and corrected immediately ahead of the placing of the concrete.

**(b) Placing and Finishing.** The slip form paver shall be designed to spread, consolidate, screed, and finish the freshly placed concrete in one complete pass of the machine in such manner that a minimum of hand finishing will be necessary to provide a dense and homogeneous pavement conforming to the plans and specifications. The paver shall be self-propelled.

Final approval of spreading and finishing equipment will be based upon satisfactory performance during actual construction. If, for any reason, equipment previously approved becomes unsatisfactory, it shall be replaced or repaired before proceeding with the work.

The machine shall vibrate the concrete for the full width and depth of pavement being placed. This vibration shall be accomplished by means of satisfactory internal vibration in each course of concrete placed. The sliding forms shall be rigidly held together laterally to prevent spreading of the forms. Hand finishing shall be kept to a minimum. If the machine is of the trailing form type and hand finishing is required, it must be done within the length of the trailing forms.

**(c) Uniform Consistency and Progress.** The concrete shall have a uniform consistency. The slip form paver shall be operated with a continuous forward movement and all operations of mixing, delivery, and spreading concrete shall be so coordinated as to provide a 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.

**(d) Surface Test.** The surface tolerance of the finished pavement shall meet the requirements of Subsection 501.05(m). Any slump of the pavement edge in excess of 1/4" (6 mm) shall be corrected before the concrete has hardened.

**501.07 Stationary Side Forms. (a) General.** Side forms shall have a height and base width not less than the edge thickness of the pavement. Each section of forms shall be reasonably straight and free from warp. The method of connecting form sections shall be such that a joint is formed free from play or movement in any direction. The face of the forms shall be set normal to the cross-section slope of the pavement surface. When set to line and grade, the forms shall have a tolerance of 1/4" (6 mm) for alignment and 1/8" (3 mm) for grade, and shall be of such strength and so secured as to resist, without springing or settlement, the pressure of the concrete when placed and the impact and vibration of the finishing machine. The minimum length of sections of forms used on tangents shall be 10' (3 m).

Forms shall be cleaned before being set to line and grade and shall be oiled before placing concrete. Oiling shall be performed in such manner as to prevent contamination of reinforcing steel and dowels.

After the forms have been set to correct grade, the subgrade under and about them shall be thoroughly tamped by means of a mechanical form tamper so constructed that each side of the form will be tamped simultaneously. Hand tampers or other means shall be used to supplement the mechanical tamper as necessary to obtain an unyielding support for the forms. On treated bases, the forms may be supported by approved shimming methods.

The alignment and grade of forms shall be checked and must be approved immediately before placing the concrete. Forms that show a variation in excess of the surface tolerance requirements specified shall be removed and replaced or otherwise corrected.

**(b) Removing Forms.** Unless otherwise provided, forms shall not be removed from freshly placed concrete until it has set for at least 12 hours, except auxiliary forms used temporarily in widened areas. Forms shall be removed carefully to avoid damage to the pavement. Immediately after the forms have been removed, the side of the slab shall be cured by one of the approved methods.

Honeycombed areas will be considered as defective work and shall be repaired or replaced, as directed.

**501.08 High Early Strength Concrete Pavement.** When High Early Strength Concrete Pavement is specified and used, it shall be made with the use of high early strength portland cement complying with AASHTO M 85, Type III cement, in lieu of AASHTO M 85, Type I cement. Upon written permission of the Engineer, the Contractor may substitute standard portland cement with a cement factor of 25% in excess of that specified for Portland Cement Concrete Pavement for the high early strength cement in the High Early Strength Concrete Pavement. No additional compensation will be allowed above the price bid for High Early Strength Concrete Pavement for the 25% additional cement if standard portland cement is used. All other requirements specified for Portland Cement Concrete Pavement shall be applicable to High Early Strength Concrete Pavement.

**501.09 Repair of Defective Pavement Slabs.** Broken slabs, random cracks, nonworking contraction joints, major honey-combed areas, and spalls shall be replaced or repaired according to Sections 507 and/or 509, as appropriate, at no cost to the Department.

**501.10 Tolerance in Pavement Thickness.** The pavement shall be constructed according to the thickness required by the typical cross section shown on the plans.

Cores will be drilled according to the procedures in Subsection 501.04.

Where not constructed according to the planned thickness, the following procedure for adjustment of payment will govern:

When any core is more than 1/2" (12 mm) less than the specified thickness, additional cores will be taken to determine the extent of the thickness deficiency. 2" (50 mm) diameter cores may be drilled for thickness deficiency determination. Cores will be drilled on cross sections of the same slab of the pavement, measured parallel to the centerline, 10' (3 m) back and 10' (3 m) ahead of the station of the original core. If both of these cores are within 1/2" (12 mm) of the specified thickness, no further special corings for this individual zone of deficiency need be made. If either or both of these cores are not within 1/2" (12 mm) of the specified thickness, additional cores

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will be taken on cross-sections of the slab in question, 25', 50', 100', and 200' (7.5, 15, 30, and 60 m) ahead and back of the original core, and thereafter at 200' (60 m) intervals until a thickness within the 1/2" (12 mm) tolerance is found in each direction. The Contractor shall drill and fill core holes at no cost to the Department.

No payment will be made for any section of pavement that is more than 1/2" (12 mm) deficient in thickness. The length of such section will be the sum of the distances measured in both directions, parallel to the centerline, from the deficient core to the nearest core that shows a thickness not more than 1/2" (12 mm) deficient. In all cases deductions will be made for the full width of the slab of which the cores are represented (normally 2 traffic lanes placed simultaneously).

When a deficiency in thickness of any portion of pavement slab in excess of 1/2" (12 mm) may seriously impair traffic service of the pavement, the Contractor will be required to remove such deficient slab and to replace it with a slab of satisfactory quality and thickness that, when accepted, will be included in the measurement for payment. The Contractor shall receive no compensation for any cost incurred in the original placement and subsequent removal of the deficient slab.

In removing pavement that is deficient in thickness, the pavement shall be removed from the edge to a longitudinal joint, or between longitudinal joints, and on each side of any deficient area until no portion of the exposed section is more than 1/2" (12 mm) deficient, except that in no instance shall there be less than 10 linear feet (3 m) of pavement removed. If in meeting the above requirement, there remains less than 10' (3 m) of acceptable pavement between the section that has been removed and a transverse plane of weakness, then the Contractor shall remove the pavement to the plane of weakness at no cost to the Department. The Contractor shall then replace all the pavement that has been removed with satisfactory, acceptable pavement according to Section 507 and the details of the Department's applicable Standard Drawings for PCCP Patching. If the plane of weakness is a contraction, expansion, or construction joint, the joint shall be replaced with a joint of the same design as the one removed. If the plane of weakness is a warping joint, the new joint shall be formed to comply with Subsection 501.05(j)(3).

The thickness of the pavement of each lot will be computed from the average of the thickness of the core(s) taken from that lot, and the thickness of the pavement of the entire project will be computed from the average of the thickness determined for each lot, except that lots or sublots found more than 1/2" (12 mm) deficient in thickness will not be considered in such computation.

Should the thickness of the pavement as constructed, in any lot, exceed the thickness shown on the plans, the actual thickness as constructed, not to exceed 1/4" (6 mm) in excess of the thickness shown on the plans, will be used in computing the thickness of the pavement for that lot. No additional payment over the contract unit price will be made for any pavement in excess of the thickness specified.

Payment for pavement deficient in thickness, not in excess of 1/2" (12 mm), will be made by item deduction. Price reductions will be accomplished by Change Order and will be shown on progress and final estimates as a separate item deduction.

The total price reduction for the isolated area shall be calculated by the following formula:

$$\% \text{ Price Reduction} = 1 - \frac{\left( \text{avg. thickness}^2 \right)}{\left( \text{plan thickness}^2 \right)} \times 100$$

**501.11 Constructing Pavement in Half Widths.** When the pavement is placed in half widths, a longitudinal center joint with tie bars, as provided for by the plans and specifications, shall be used.

Where the pavement is being constructed in half widths, the Contractor shall maintain a safe passageway according to the provisions of Section 603.

**501.12 Incentives/Price Adjustments for Ride Smoothness.** It is the intent of this specification to produce a pavement that is durable and consistently exceeds the minimum test values in these specifications. Incentive payments will be accomplished by change order and will be shown on the final estimate as a separate item increase. Incentives will be calculated according to the following guidelines.

Price adjustments apply to the total area for the standard 12' (3.7 m) lane width represented by the profile index for a continuous

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mainlane section at least 0.1 mile (200 m) long. Price adjustments for incentives are only based on the initial measured profile index of continuous sections of at least 0.1 mile (200 m) in length, excluding approach slabs and bridges, and before any corrective work; however, grinding will be allowed to achieve full payment. Ramps, acceleration/deceleration lanes, shoulders, islands, tapers, or other incidentals shall not be considered for price adjustments. If grinding is required due to failure to meet the required profile index, the pavement will be ground to a level which qualifies for 100% payment.

Price adjustments shall be made as follows:

PROFILE INDEX		PRICE ADJUSTMENT % of payment of Unit Bid Price
In/Mi./0.1 Mi. section	mm/km/200 m section	
2 or less	30 or less	+ 6.0%
Over 2 to 3	Over 30 to 45	+ 4.0%
Over 3 to 4	Over 45 to 60	+ 2.0%
Over 4 to 5	Over 60 to 75	0
Over 5 to 6	Over 75 to 90	- 2.0%
Over 6 to 7	Over 90 to 110	- 4.0%
Over 7	Over 110	CORRECTIVE WORK REQUIRED

**501.13 Method of Measurement.** (a) Portland Cement Concrete Pavement and High Early Strength Concrete Pavement will be measured by the square yard (square meter). The width for measurement will be the width as constructed according to the plans and typical cross sections or as directed by the Engineer.

(b) Reinforcing steel, other than steel for joints, will be measured according to Section 502.

**501.14 Basis of Payment.** (a) Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per square yard (square meter) for Portland Cement Concrete Pavement or for High Early Strength Concrete Pavement, as the case may be, of the thickness and type specified, which price shall be full compensation for preparing the subgrade or base and shaping the shoulders unless otherwise specified; for furnishing, transporting, and placing materials, including steel bars for joints and all other joint materials; for the preparation and processing of

materials; for mixing, spreading, vibrating, finishing, and curing; for performing mix designs and quality control and acceptance sampling and testing; for sawing, cleaning, filling, and sealing joints; for half width construction; for furnishing the profilograph; taking all required profiles, performing all necessary computations; and for all labor, equipment, tools, and incidentals necessary to complete the work; provided, that for such area as is deficient in thickness, only the adjusted price will be paid as specified in Subsection 501.10. No payment will be made for pavement deficient in thickness in excess of 1/2" (12 mm), even though the deficient pavement may be allowed to remain in place, nor for repair as specified in Subsection 501.09.

(b) Reinforcing steel, when specified, other than the steel for joints mentioned above, will be paid for as provided under Section 502. Steel for joints will not be paid for separately, but full compensation therefor will be considered included in the contract unit prices bid for Portland Cement Concrete Pavement and High Early Strength Concrete Pavement.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Portland Cement Concrete Pavement (__" [__ mm] Uniform Thickness)	Square Yard (Square Meter)
High Early Strength Concrete Pavement (__" [__ mm] Uniform Thickness)	Square Yard (Square Meter)

**SECTION 502  
REINFORCING STEEL FOR PAVEMENT**

**502.01 Description.** This item shall consist of furnishing and placing reinforcing steel of the type and size designated on the plans and conforming to the details shown on the plans for Portland Cement Concrete Pavement.

**502.02 Materials.** Reinforcing steel, dowel bars, and other steel reinforcement shall comply with the requirements of the following specifications:

Dowel bars shall comply with AASHTO M 31. Dowel bars and tie bars shall be epoxy coated according to the provisions of AASHTO M 284 using a coating material meeting Annex A1. The Contractor shall certify the epoxy coating in accordance with Subsection 804.02(d) and that all materials used, the preparation of the bars, the coating and curing were done according to these specifications. Damage to epoxy coated bars shall be repaired according to the epoxy powder manufacturer's recommendations and Subsection 804.05. All repairs shall be made at no cost to the Department. No coating repairs will be required for uncoated cut or sheared ends of dowel bars or tie bars.

Reinforcing Steel shall comply with AASHTO M 31, M 42, or M 53.

Welded Wire Fabric shall comply with AASHTO M 55 or M 221.

Tie bars that are bent and later straightened to facilitate construction shall comply with AASHTO M 31, Grade 40 (Grade 300).

Reinforcing Steel used for longitudinal members in continuously reinforced concrete pavement shall be AASHTO M 31, Grade 60 (Grade 400).

**502.03 Construction Requirements.** Reinforcing steel for pavement shall be placed according to Section 501 or Section 503, as applicable. Shipping, handling, and placement of epoxy coated bars shall be in accordance with Subsection 804.05.

**502.04 Method of Measurement.** Reinforcing steel placed and accepted will be measured by the pound (kilogram), complete in place, making no allowance for laps or splices. The weight for reinforcing steel will be computed by multiplying the gross area of the pavement by the quantity in lbs./sq. yard (kg/sq m) specified on the plans.

**502.05 Basis of Payment.** Work performed and accepted and measured as provided above will be paid for at the contract unit price bid per pound (kilogram) for Reinforcing Steel for Pavement of the type used, Bars or Mesh Fabric, as the case may be, which price shall be full compensation for furnishing and placing materials and for all labor, equipment, tools, and incidentals necessary to complete the work.



Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Reinforcing Steel for Pavement (Bars)	Pound (Kilogram)
Reinforcing Steel for Pavement (Mesh Fabric Type___)	Pound (Kilogram)

### **SECTION 503 CONTINUOUSLY REINFORCED CONCRETE PAVEMENT**

**503.01 Description.** This item shall consist of a continuously reinforced concrete pavement, constructed on a prepared subgrade or on a completed and accepted base course according to these specifications, and conforming to the lines, grades, thickness, and typical cross section shown on the plans or established by the Engineer.

**503.02 Proportions.** The concrete shall be proportioned according to Section 501.

**503.03 Materials.** Materials used under this item of work shall comply with the applicable requirements of Sections 501 and 502.

**503.04 Construction Requirements.** Except as modified below, the construction of continuously reinforced concrete pavement shall be performed according to the requirements of Sections 501 and 502. In the event a portland cement stabilized base material is used under the pavement, the specified bond breaker shall be in place and undamaged when pavement is placed. If the base, curing agent, or bond breaker has been damaged in any manner, repairs shall be made before pavement is placed.

**(a) Placement of Reinforcement.** Reinforcement may be installed by one of the following methods: 1) Preset on chairs, or 2) Placed by mechanical means.

Regardless of the method of placement used, the horizontal spacing tolerances shall be  $\pm 1/2"$  ( $\pm 12$  mm) for longitudinal steel and  $\pm 2"$  ( $\pm 50$  mm) for transverse steel. The spacing and vertical

position of the longitudinal and transverse steel shall be as shown on the plans.

At the time concrete is placed, the reinforcement shall be free from loose, flaky rust, mud, oil, or other coatings that will materially reduce the bond and shall be handled with such care that the bars or mesh fabric sheets will remain reasonably flat and free from distortion. Loose bars shall be free from such kinks or bends as may prevent them from being properly assembled or installed.

**(1) Reinforcement Preset on Chairs.** The reinforcement shall be supported on chairs approved by the Engineer.

The arrangement and spacing of chairs shall be such that the reinforcement will be supported in proper position without permanent deflection or displacement during placing and consolidation of concrete. The tolerances specified herein shall not be exceeded. Chairs shall have sufficient bearing at the base to prevent overturning and penetration into the subbase, and shall be designed so as not to impede the placing and consolidation of concrete. Welding of chairs to transverse bars will be permitted.

If the support system does not maintain the reinforcement in the position required by these specifications during the placing and finishing of the concrete, the Contractor will be required to increase the number of chairs or take such other steps as necessary to assure proper position of the steel.

When the reinforcement consists of individual bars, the longitudinal bars shall be secured to the transverse bars by wire ties or clips at alternate intersections or more frequently if necessary to maintain their position within the horizontal and vertical tolerances specified herein.

**(2) Reinforcement Placed by Mechanical Means.** The reinforcement shall be incorporated into the concrete at its proper position by methods and/or equipment approved by the Engineer. When individual deformed bars are used, tying the intersection between longitudinal and transverse bars may be omitted if it can be demonstrated conclusively to the Engineer that the equipment and method used will assure proper placement of the reinforcement. The method of placement used shall maintain the splice pattern shown on the plans.

Embedment of the reinforcing steel shall be performed in such a manner that the concrete, after final finishing, shall show no segregation attributable to the placing operation.

**(b) Splices in Reinforcing Steel.** Reinforcing bars, bar mats, or welded wire fabric used as continuous reinforcement shall be lapped in the longitudinal direction in a staggered pattern as shown on the plans. All laps shall be securely tied or clipped. In lieu of lapped splices, the Contractor may use welded or mechanical splices according to Section 804.07.

**(c) Placement of Concrete.** The concrete shall be placed in a single course to the full depth.

**(d) Transverse Construction Joints.** At the end of each day's run, or at any time that the paving operation is delayed for more than 30 minutes, a transverse construction joint shall be formed as shown on the plans. The time may be adjusted, due to weather conditions, as directed by the Engineer. The joint shall be formed by placing the concrete against a header approved by the Engineer. The longitudinal reinforcing steel shall extend through the header for a sufficient length to provide a proper lap and be supported from the subgrade beyond the header to prevent undue deflections during paving operations. Hand vibrators shall be used to supplement mechanical vibrators at all construction joints.

**(e) Transverse Expansion Joints.** Expansion joints shall be provided where specified and according to the details shown on the plans.

**(f) Longitudinal Joints.** Longitudinal joints shall be constructed as specified in Subsection 501.05(j).

**(g) Temporary Pavement Crossings.** Where necessary to allow the passage of traffic across continuously reinforced concrete pavement at sites shown on the plans, or as directed, the Contractor shall construct and maintain suitable and substantial crossings to bridge the pavement. Such crossings shall be adequate for two-way traffic and satisfactory to the Engineer.

Pavement damaged before it is accepted shall be repaired or replaced at no cost to the Department.

Gaps in the pavement for temporary crossings will not be permitted.

**503.05 Method of Measurement.** (a) Continuously Reinforced Concrete Pavement and High Early Strength Continuously Reinforced Concrete Pavement will be measured by the square yard (square meter). The width for measurement will be the width as constructed according to the plans and typical cross sections.

(b) Reinforcing steel will be measured and paid for under Section 502.

(c) Temporary pavement crossings will not be measured for payment.

**503.06 Basis of Payment.** (a) Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per square yard (square meter) for Continuously Reinforced Concrete Pavement or for High Early Strength Continuously Reinforced Concrete Pavement, as the case may be, of the thickness and type specified, which price shall constitute full compensation for furnishing and preparation of materials including transverse and longitudinal joints, joint filler, and dowels or load transfer devices as required on the plans; for placing, finishing, and curing; for performing mix designs and quality control and acceptance sampling and testing; for furnishing the profilograph; taking all required profiles, performing all necessary computations; and for all labor, equipment, tools, and incidentals necessary to complete the work. For such area as is deficient in thickness, only the adjusted price will be paid as specified in Subsection 501.10. No payment will be made for pavement deficient in thickness in excess of 1/2" (12 mm), even though the deficient pavement may be allowed to remain in place, nor for repair as specified in Subsection 501.09.

(b) Reinforcing steel will be paid for under Section 502.

(c) Mix Design and Quality Control according to Section 501 will not be paid for separately, but full compensation therefor will be considered included in the contract unit price bid for Continuously Reinforced Concrete Pavement.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Continuously Reinforced Concrete Pavement ( _ " [ _ mm] Uniform Thickness)	Square Yard

(Square Meter)

High Early Strength Continuously Reinforced Concrete Pavement (\_\_\_" [\_\_\_ mm] Uniform Thickness)

Square Yard (Square Meter)

**SECTION 504  
APPROACH SLABS AND GUTTERS**

**504.01 Description.** This item shall consist of the construction of approach pavement slabs and gutters for structures, and furnishing and placing base material, according to these specifications and conforming to the location, type, dimensions, lines, and grades shown on the plans.

**504.02 Materials.** Materials used under this item of work shall comply with the applicable requirements of the following sections of the specifications, except as otherwise provided:

- Base Material                                Sections 303, 307, 308, or 405 as designated on the plans. As an alternate to Section 303 base material, the Contractor may substitute an equal depth of material complying with Sections 307, 308, 405, 406, or 407.
- Corrugated Metal Pipe                    Section 606.
- Reinforcing Steel                         Section 804.
- Concrete                                    Section 501 for Portland Cement Concrete Pavement, or High Early Strength Portland Cement Concrete Pavement, or Section 802 for Class S Concrete. The Contractor shall furnish the mix design in accordance with Subsection 501.03 or 802.05 and perform Quality Control and Acceptance sampling and testing in accordance with Subsection 501.04

or 802.06, as applicable to the class of concrete used.

Joint Filler Section 501.

Membrane Curing Compound Section 501.

**504.03 Construction Requirements.** Except as otherwise provided, the methods employed in performing the work shall comply with the applicable requirements of the specification sections as listed:

Subgrade Section 212.

Corrugated Metal Pipe Section 606.

Base Course Section 303, 307, 308, or 405 as designated on the plans, or the Sections applicable to the alternate materials.

Reinforcing Steel Section 502.

Concrete Section 501.

Joints Section 501.

Approach slabs shall be given a Class 5 surface finish according to Subsection 802.19 unless a Class 7 finish is specified.

The curing of the concrete in the approach slabs and gutters shall be by one of the methods specified in Subsection 501.05(l).

**504.04 Method of Measurement.** (a) Approach Slabs will be measured by the cubic yard (cubic meter).

(b) Approach Gutters will be measured by the cubic yard (cubic meter).

(c) Base material will be measured as provided in Sections 303, 307, 308, or 405 for the material designated on the plans.

(d) Reinforcing Steel will be measured as provided in Section 804.

(e) Class 7 surface finish will be measured as provided in Section 802.

(f) Corrugated metal pipe will be measured as provided in Section 606.

Quantities shown on the plans for Approach Slabs, Approach Gutters, and Reinforcing Steel will be considered as the final quantities and no further measurement will be made unless, in the opinion of the Engineer or upon evidence furnished by the Contractor, substantial variations exist between quantities shown on the plans and actual quantities due to changes in alignment or dimensions or to apparent errors.

**504.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per cubic yard (cubic meter) for Approach Slabs or Approach Gutters of the type designated, which price shall be full compensation for excavation and backfill; for furnishing materials; for forming, mixing, placing, curing, and finishing concrete; for performing mix designs and quality control and acceptance sampling and testing; for Class 5 surface finish; for sawing, filling, and sealing joints; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Base material will be paid for under Sections 303, 307, 308, or 405, for the material designated on the plans.

Reinforcing steel will be paid for under Section 804.

When Class 7 surface finish is specified, payment will be made under Section 802.

Corrugated metal pipe will be paid for under Section 606.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Approach Slabs	Cubic Yard (Cubic Meter)
Approach Gutters (Type___)	Cubic Yard (Cubic Meter)

**SECTION 505**

**PORTLAND CEMENT CONCRETE DRIVEWAY**

**505.01 Description.** This item shall consist of portland cement concrete constructed in one course on the prepared subgrade or on a completed and accepted base course according to these

specifications and conforming to the lines, grades, thickness, and typical cross section shown on the plans.

**505.02 Materials. (a) Concrete.** Concrete for driveways shall comply with Section 802 for Class A Concrete or Class M Concrete, except that mixing on site, volumetric proportioning, and commercial bagged concrete mix will not be allowed. The Department will perform all acceptance sampling and testing at the frequencies shown for Contractor acceptance testing in Subsection 802.06.

**(b) Joint Filler.** Materials for joint filler shall comply with AASHTO M 213.

**(c) Curing Materials.** Curing materials shall comply with Subsection 501.02(i).

**505.03 Construction Requirements.** The methods employed in performing the work shall comply with Subsection 501.05. Transverse expansion joints shall be placed at 15' (4.5 m) intervals or as directed by the Engineer.

**505.04 Method of Measurement.** Portland Cement Concrete Driveway will be measured by the square yard (square meter).

**505.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per square yard (square meter) for Portland Cement Concrete Driveway, which price shall be full compensation for furnishing, preparing, hauling, and placing materials, including joint materials; for excavation and preparation of subgrade; for shaping and finishing; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Portland Cement Concrete Driveway	Square Yard (Square Meter)



**SECTION 506**  
**PORTLAND CEMENT CONCRETE**  
**CORRUGATIONS**

**506.01 Description.** This item shall consist of the forming of a corrugated rumble strip in the plastic concrete. The corrugations shall be of the size, shape, and spacing shown on the plans or as directed by the Engineer.

**506.02 Construction Requirements.** The corrugations shall be formed in the plastic concrete at the optimum time to produce a neat and uniform finish. The corrugations shall be formed using methods approved by the Engineer.

**506.03 Method of Measurement.** Corrugations will be measured by the square yard (square meter).

**506.04 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per square yard (square meter) for Portland Cement Concrete Corrugations, which price shall be full compensation for the formation of the corrugations and for furnishing all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Portland Cement Concrete Corrugations	Square Yard (Square Meter)

**SECTION 507**  
**PORTLAND CEMENT CONCRETE PAVEMENT**  
**PATCHING**

**507.01 Description.** This item shall consist of removing and replacing portland cement concrete pavement at the locations designated on the plans or where directed by the Engineer.

**507.02 Materials.** The materials and proportions for concrete patching shall comply with the applicable requirements of Sections 501 and 502, except that the mixed concrete shall have a maximum slump of 4" (100 mm) and that epoxy coated tie bars and dowel bars are not required. Mix designs shall be performed by the Contractor

in accordance with Subsection 501.03. Quality control and acceptance testing shall be according to Subsection 501.04, except that compressive strength will be determined by cylinders obtained according to AASHTO T 23 and that coring will not be required to determine pavement thickness. Thickness will be determined immediately prior to placing the concrete for the pavement patch.

Each dowel bar shall be coated from one end for a minimum distance of 2" (50 mm) greater than half the length of the bar with a film of epoxy, plastic, epoxy paint, zinc chromate primer, zinc strontium phospho-silicate primer, red oxide primer, or tar paint. When bar coatings are found to be damaged prior to or during installation in the pavement, such bars shall be replaced with acceptable bars at no cost to the Department.

Materials for securing tie bars and dowel bars shall be listed on the QPL.

**507.03 Construction Requirements.** The construction requirements for Removal and Disposal of Concrete Pavement shall comply with Subsection 202.03 and the following:

The existing pavement to be removed shall be sawed the full depth of the slab as shown on the plans. If necessary and approved by the Engineer, one additional cut may be made to facilitate removal. Overcutting beyond the limits of the area to be removed shall be held to a minimum. All overcuts shall be thoroughly cleaned of saw slurry and other contaminants and completely filled with a low viscosity epoxy compound.

After sawing, the pavement to be removed shall be carefully lifted out in a manner that will not damage the existing pavement that is to remain or the existing base material. Any damage shall be repaired to the satisfaction of the Engineer at no cost to the Department. The material removed shall be placed in locations that will not cause a hazard to motorists and shall be removed from the project site by the end of each day's work.

Before placing the patch, any loose base material shall be removed. If the existing base material is granular, it shall be recompacted as necessary.

The Contractor shall take all precautions necessary to ensure that the base material remains dry until the new concrete is placed.

The construction methods for Portland Cement Concrete Pavement Patching shall comply with Subsections 501.05 and 503.04 and the following:

**(a) Installation of Dowel Bars and Tie Bars.** Dowel bars and tie bars shall be installed according to details included on the plans. Drills used to make holes shall be held in a rigid frame to assure proper horizontal and vertical alignment. The equipment shall be operated so as to prevent damage to the pavement being drilled. The drilling procedure shall be approved by the Engineer. When using the epoxy or polyester resin system, the bars shall be installed according to information provided by the manufacturer. To secure the bars, special care must be taken to ensure that the filling system completely surrounds the bars and fills the holes.

The filling system shall be an injection type system approved by the Engineer that will ensure that sufficient material is injected into the hole before the bar is inserted.

**(b) Joints.** Joints shall be constructed according to details shown on the plans. Joints that will require sawing and sealing shall be re-established as soon as possible to prevent random cracking.

**(c) Patches.** The initial areas to be patched will be marked by the Engineer. If there are subsequent pavement or patch failures in the initial patching phase, not due to the Contractor's negligence, they shall be repaired and will be paid for under the appropriate bid item. At this time, the item of patching will be considered to be completed.

Completed patches, and areas of the existing pavement adjacent to a completed patch, that are found to contain cracks or other damage due to Contractor negligence shall be removed and replaced at no cost to the Department.

Full depth side forms shall be used to form the shoulder edge of concrete patches.

Shoulder areas adjacent to completed pavement patches shall be repaired full depth with ACHM Surface Course meeting the requirements of Section 407 or Asphalt Concrete Cold Plant Mix meeting the requirements of Section 411 of the Specifications. Asphalt repairs shall be accomplished prior to opening the lane to traffic. All loose material and formwork shall be removed from the shoulder area prior to placing the asphalt material. The Asphalt

Concrete Mix shall be placed, compacted and finished to a uniform grade to eliminate any drop-off along the concrete pavement edge and to match the slope of the existing shoulder.

The completed patch shall show no deviation in excess of 1/8" (3 mm) when checked with a 10' (3m) straightedge, including overlapping half of the length of the straightedge on to the existing pavement. The patch will then be finished in accordance with Subsection 501.05(k)(5).

**(d) Equipment.** Hand methods of spreading, consolidating, and finishing will be permitted, provided that satisfactory results are obtained.

**(e) Measuring Materials and Mixing.** The Contractor may elect to use a mobile, continuous volumetric mixer at the patching location in lieu of a batch plant equipped with an automatic ticket printer as described in Subsection 501.05(c). A mobile, continuous volumetric mixer is defined as a truck mounted system where each component is automatically proportioned out for a selected batch size from on-board storage bins and automatically fed into a mixing unit to produce a mix complying with the requirements of Subsection 507.02. The unit shall be calibrated according to the manufacturer's recommendations by the Contractor in the presence of the Engineer before any placements are made on the project. Copies of all calibration forms/calculations shall be submitted to the Engineer.

A trial batch of at least 2 cubic yards shall be produced from the mobile, continuous volumetric mixer prior to placement of any patches on the project. The trial batch shall be accomplished by the Contractor under the observation of the Engineer. Trial batches will be sampled and tested by the Engineer to determine compliance with the specifications of the mix produced from the mobile, continuous volumetric mixer for slump, air content, and compressive strength.

**507.04 Method of Measurement.** Removal and Disposal of Concrete Pavement and Portland Cement Concrete Pavement Patching will be measured by the square yard (square meter).

**507.05 Basis of Payment. (a) Removal and Disposal of Concrete Pavement for Patching.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per square yard (square meter) for Removal and Disposal

of Concrete Pavement for Patching, which price shall be full compensation for sawing, removing, and satisfactorily disposing of the concrete pavement and any underlying base material as directed; for cleaning and filling all overcuts; and for all labor, equipment, tools, and incidentals necessary to complete the work.

**(b) Portland Cement Concrete Pavement Patching.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per square yard (square meter) for Portland Cement Concrete Pavement Patching of the thickness specified, which price shall be full compensation for preparing the existing base material; for furnishing, transporting, and placing materials, including reinforcing steel for pavement, tie bars, dowel bars, and materials for anchoring tie bars and dowel bars; for preparation and processing of materials; for mixing, spreading, vibrating, finishing, and curing concrete; for performing mix designs and quality control and acceptance sampling and testing; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Adjustment for Additional Thickness. Where the thickness of Portland Cement Concrete Pavement Patching is in excess of the specified uniform thickness (U.T.) plus 1" (25 mm), payment will be made for the percentage in excess of this amount. Payment will be made as follows:

$$\frac{\text{Avg.Depth} - (\text{Spec. U.T.} + 1")}{\text{Specified U.T.}} \times \text{Normal S.Y.} = \text{Add'l. S.Y.}$$

**OR**

$$\frac{\text{Avg.Depth} - (\text{Spec. U.T.} + 25 \text{ mm})}{\text{Specified U.T.}} \times \text{Normal sq m} = \text{Add'l. sq m}$$

**(c) Joints.** When Joint Rehabilitation under Section 509 is included as a pay item in the Contract, joints in concrete pavement patches will be measured and paid for under Section 509. When Joint Rehabilitation under Section 509 is not included as a pay item in the Contract, sawing and sealing of joints in concrete pavement patches will not be paid for separately, but full compensation therefor will be considered included in the contract unit price bid for PCCP Patching.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Removal and Disposal of Concrete Pavement for Patching	Square Yard (Square Meter)
Portland Cement Concrete Pavement Patching ( ___" [ ___mm]Uniform Thickness)	Square Yard (Square Meter)

## **SECTION 508 - VACANT**

### **SECTION 509 JOINT REHABILITATION**

**509.01 Description.** This item shall consist of sawing and cleaning existing transverse and longitudinal joints in portland cement concrete pavement, patches, approach slabs, and bridge decks, and filling and sealing the prepared joints with approved material according to these specifications and the details shown on the plans.

**509.02 Materials.** Joint filler and joint sealer shall comply with Subsection 501.02(h).

**509.03 Construction Requirements.** Joint Rehabilitation shall comply with the construction requirements of Subsection 501.05(j) and the following:

Existing joints shall be sawed to expose a new concrete face, free of any joint sealer, and to provide a sealer reservoir. Joints shall be sawed to a sufficient depth to accommodate the joint sealer and backer rod as shown on the plans. Any existing joint inserts, regardless of type or material, that interfere with joint rehabilitation shall be removed. Any debris resulting from the removal of the inserts shall be disposed of according to Section 201.

No joints, except those for concrete pavement patches, shall be sawed after December 1 and before March 1, without written permission of the Engineer.

All joints, except those for concrete pavement patches, shall be sealed within 15 calendar days after sawing. All joints shall be sealed before opening the pavement to traffic.

Type A Joint Rehabilitation shall include contraction joints in existing concrete pavement, patches, approach slabs, and joints in the decks of concrete slab span bridges. Contraction joints shall be sawed a minimum width as shown on the plans and cleaned, filled, and sealed with Type 3 or 4 joint sealer. Contraction joints in patches shall be sawed according to the details shown on the plans and cleaned, filled, and sealed with Type 3 or 4 joint sealer. Bridge deck joints shall be sawed a minimum of the existing joint width plus 1/8" (3 mm) and cleaned, filled, and sealed with Type 3 or 4 joint sealer.

Type B Joint Rehabilitation shall include all warping and longitudinal joints in existing concrete pavement, patches, and approach slabs. Joints of this type in existing pavement shall be sawed a minimum of the existing joint width plus 1/8" (3 mm) and cleaned, filled, and sealed with Type 3, 4, 5 or 6 joint sealer. Joints of this type in patches shall be sawed according to the details shown on the plans and cleaned, filled, and sealed with Type 3, 4, 5, or 6 joint sealer.

Type C Joint Rehabilitation shall apply to expansion joints. Existing expansion joints that are 3½" (90 mm) or greater in width shall be thoroughly cleaned to remove all existing joint filler and sealer. Existing expansion joints that are less than 3½" (90 mm) in width shall be sawed full depth to a minimum width of 4" (100 mm) and thoroughly cleaned to remove all joint filler and sealer. Following cleaning and preparation, the expansion joints shall be filled with Type 1 joint filler.

Type D Joint Rehabilitation shall include the joints around the area of concrete pavement patches that are not bounded by normal longitudinal or transverse joints. These joints shall be sawed along the joint created by the concrete pavement patch. The joints shall be sawed to the details shown on the plans. These joints shall be cleaned and sealed with Type 3, 4, 5, or 6 joint sealer.

**509.04 Method of Measurement.** Joint Rehabilitation will be measured by the linear foot (meter).

**509.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per linear foot (meter) for Joint Rehabilitation of the type specified, which price shall be full compensation for sawing and cleaning joints; for removal and disposal of existing inserts; for furnishing and placing all materials; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Joint Rehabilitation (Type ___)	Linear Foot (Meter)

**SECTION 510  
GRINDING PORTLAND CEMENT CONCRETE  
PAVEMENT**

**510.01 Description.** This item shall consist of grinding portland cement concrete pavement to substantially eliminate vertical differentials and to restore drainage, riding characteristics, and skid resistance to the pavement surface.

**510.02 Equipment.** The grinding equipment shall be a power driven, self-propelled machine that is specifically designed to smooth and texture portland cement concrete pavement.

The equipment shall be capable of grinding the surface without causing spalls at cracks, joints, or at other locations.

**510.03 Construction Requirements.** The pavement will be initially profiled by the Contractor using an automated lightweight profilometer complying with ASTM E 950, Class 1 and calibrated to the California-style profilograph scale. The initial profilograph will be used to locate high and low areas for correction.

Areas representing high points having deviations in excess of 0.3" (7.5 mm) in 25' (7.5 m) as determined by the profilograph or 1/8" (3 mm) in 10' (3 m) as determined by the straightedge, shall be reduced by grinding until such deviations as indicated by retest do not exceed the above limits.

Areas showing low spots of more than 1/4" (6 mm) in 10' (3 m) in the longitudinal direction shall be corrected by grinding the adjacent



higher pavement to an elevation that will not show surface deviations in excess of 1/8" (3 mm) in 10' (3 m).

The construction operation shall produce a uniform finished surface without damaging the existing pavement that is to remain. Grinding shall be accomplished in a manner that eliminates joint or crack faults while providing positive lateral drainage by maintaining a constant cross-slope. Grinding shall transition as required to provide positive drainage and an acceptable riding surface. The pavement shall be ground in a direction opposite to normal traffic flow.

The entire area designated on the plans shall be ground until the pavement surfaces of adjacent sides of transverse joints and cracks are in the same plane. It is intended that the faulting at joints and cracks be eliminated and that substantially all of the pavement surface shown on the plans be textured. Extra depth grinding to eliminate minor depressions in order to provide texturing for 100% of the pavement surface will not be required.

The Contractor shall establish positive means for removal of grinding residue. Solid residue including joint material shall be immediately removed from the pavement surface. Residue shall not be permitted to flow across lanes used by traffic. Drainage facilities shall be kept free of accumulated residue.

**510.04 Final Surface Finish.** The grinding process shall produce a pavement surface that is true to grade and uniform in appearance with a longitudinal line type texture. The line type texture shall contain parallel longitudinal corrugations that present a narrow ridge corduroy type appearance. The peaks of the ridges shall be approximately 1/32" (0.8 mm) higher than the bottoms of the grooves with approximately 53 to 57 evenly spaced grooves per foot (170 to 190 evenly spaced grooves per meter).

The finished pavement surface will be measured for roughness by the Contractor. Roughness will be measured using an automated lightweight profilometer complying with ASTM E 950, Class 1 and calibrated to the International Roughness Indicator (IRI) scale. The IRI shall not exceed 100 inches per mile per 0.5 mile section (1.60 m per km per 0.8 km section). Bridges or any other non-ground sections will not be included in the calculation of the IRI.

The Engineer will verify the roughness indices by testing approximately 10% of the pavement. This testing will be performed by the Engineer, using either the lightweight profilometer furnished by the Contractor or one provided by the Department, at the option of the Engineer.

Vertical misalignment of the planes of the surfaces on adjacent sides of the joints or cracks that is in excess of 1/16" (2 mm) shall be ground until the surfaces are flush.

The transverse slope of the pavement shall be uniform to a degree that no depressions or misalignment of slope greater than 1/4" (6 mm) in 10' (3 m) are present when tested with a straightedge placed perpendicular to the centerline.

**510.05 Method of Measurement.** Grinding Portland Cement Concrete Pavement will be measured by the square yard (square meter).

**510.06 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per square yard (square meter) for Grinding Portland Cement Concrete Pavement, which price shall be full compensation for furnishing equipment; for grinding the existing concrete pavement; for removing residue and cleaning the pavement; for furnishing and operating the automated lightweight profilometer, for measuring the surface profile indices and the IRI; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Grinding Portland Cement Concrete Pavement	Square Yard (Square Meter)

**SECTION 511  
PORTLAND CEMENT CONCRETE SHOULDER  
(ADD-ON)**

**511.01 Description.** This item shall consist of adding a portland cement concrete shoulder to an existing concrete pavement

according to these specifications and conforming to the lines, grades, thickness, and typical cross section shown on the plans.

**511.02 Materials. (a) Concrete.** Concrete shall comply with Section 501. The Contractor shall furnish the mix design in accordance with Subsection 501.03 and shall perform Quality Control and Acceptance sampling and testing in accordance with Subsection 501.04.

**(b) Joint Materials.** Joint materials shall comply with Subsection 501.02(h) Type 3, 4, or 5 for longitudinal joints and Type 3 or 4 for transverse joints.

**(c) Curing Materials.** Curing materials shall comply with Subsection 501.02(i).

**511.03 Construction Requirements.** The work shall comply with Subsection 501.05 with the following exceptions:

**(a)** Transverse joints shall match the transverse joints in the existing pavement.

**(b)** Longitudinal joints shall be constructed as shown on the plans.

**(c)** The longitudinal profile of the concrete shoulder shall match the longitudinal profile of the existing pavement edge.

**(d)** The transverse slope of the concrete shoulder shall be as specified on the plans. The slope shall vary no more than 1/8" per foot (10 mm/m) from the planned slope.

**(e)** The final surface finish shall be accomplished using a burlap drag or broom.

**511.04 Method of Measurement.** Portland Cement Concrete Shoulder (Add-On) will be measured by the square yard (square meter).

**511.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per square yard (square meter) for Portland Cement Concrete Shoulder (Add-On), which price shall be full compensation for excavation of existing shoulder and preparation of the subgrade; for furnishing, preparing, hauling, and placing materials, including tie bars, dowels, and joint materials; for mixing, spreading, vibrating, finishing, and curing; for performing mix

designs and quality control and acceptance sampling and testing; for sawing, filling, and sealing joints; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Portland Cement Concrete Shoulder (Add-On)	Square Yard (Square Meter)

**SECTION 512  
CLEANING AND FILLING JOINTS IN EXISTING  
CONCRETE PAVEMENT**

**512.01 Description.** This item shall consist of routing, cleaning, and filling existing transverse and longitudinal joints in portland cement concrete pavement in preparation for an asphalt overlay.

**512.02 Materials.** Materials to fill the joints shall be one of the following types:

Type 1. Type 1 joint filler complying with Subsection 501.02(h)(1)a.

Type 7. Type 7 joint sealer complying with Subsection 501.02(h)(2)f.

**512.03 Construction Requirements.** The Contractor shall remove all existing joint material and other foreign material from the longitudinal and transverse joints.

Before placement of joint material, the joints shall be dry and cleaned of all loose material. The material shall fill the joint to within 1/4" (6 mm) of the surface and shall be applied under pressure if necessary.

**512.04 Method of Measurement.** Cleaning and Filling Joints in Existing Concrete Pavement will be measured by the linear foot (meter).

**512.05 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per linear foot (meter) for Cleaning and Filling Joints in Existing Concrete Pavement for the type specified, which price shall

be full compensation for cleaning joints; furnishing and placing all materials; and for all labor, equipment, tools, and incidentals necessary to complete the work.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Cleaning and Filling Joints in Existing Concrete Pavement (Type___)	Linear Foot (Meter)

**SECTION 513  
RUBBLIZING PORTLAND CEMENT  
CONCRETE PAVEMENT**

**513.01 Description.** This item shall consist of rubblizing and compacting existing portland cement concrete pavement at the locations shown on the plans or where directed by the Engineer.

**513.02 Equipment.** The equipment used shall be subject to the approval of the Engineer and shall comply with the following:

(a) Rubblizing equipment shall be a self-contained, self-propelled resonant frequency breaker specifically designed for the purpose of rubblizing portland cement concrete pavement and capable of producing low amplitude 2000 pound (8900 N) force blows at a rate of not less than 44 cycles per second.

(b) Compacting equipment shall be a steel drum vibratory roller having a gross weight of 10 tons (9100 kg), operated in the vibrating mode.

Any other equipment needed for rubblizing shall have prior approval from the Engineer.

**513.03 Materials.** Stone Backfill shall meet the requirements of Section 207.

Aggregate base course shall meet the requirements of Section 303 for Aggregate Base Course (Class 7).

**513.04 Construction Requirements.** The rubblization shall be done in partial widths when necessary to maintain traffic. When rubblizing in a lane adjacent to a lane that is open to traffic,

measures shall be taken to prevent debris from entering the traffic lane. Rubblizing shall be scheduled and performed to minimize exposure to inclement weather and to provide sufficient time to place the base or binder course within one allowable lane closure period as set forth in plans or Contract.

A joint shall be saw cut full-depth at existing longitudinal joints between the main lanes and ramps and at transverse joints where rubblizing abuts pavement that is to remain in place.

The existing concrete pavement shall be broken into pieces ranging from sand size to pieces generally 6" (150 mm) or less in size. No individual pieces shall exceed 8" (200 mm) in any dimension. The majority of rubblized concrete volume shall be nominal 1" to 3" (25 mm to 75 mm) in size. At the beginning of the rubblizing operations, a 4' by 4' (1.2 m by 1.2 m) test pit shall be excavated in the middle of a lane at a location selected by the Engineer to determine if the breaker is producing pieces of the specified sizes. Additional test pits may be required if the Engineer determines that they are necessary.

The breaker shall be operated with a maximum amplitude of one inch (25 mm) to avoid damaging the base and underlying structures.

Existing asphalt overlays and thin asphalt patches shall be removed by cold milling or other approved methods prior to rubblization. Where directed by the Engineer, existing full-depth asphalt patches shall be removed and new patches placed according to the requirements of Section 415. All material resulting from the removal of existing overlay and patches shall be disposed of in accordance with Section 201.

Rubblizing shall begin at a free edge or previously broken edge and progress toward the opposite shoulder or longitudinal centerline of the road. In areas where the roadway is to be overlaid one lane at a time, rubblizing shall extend a minimum of 6" (150 mm) beyond the edge of pavement to be overlaid.

Reinforcement in the rubblized pavement shall be left in place. However, any reinforcement exposed at the surface during rubblizing or compacting operations shall be cut off below the surface and removed.

The rubblized pavement shall be compacted with a minimum of three passes up and back with a steel drum vibratory roller.

Additional passes may be required by the Engineer if necessary to satisfactorily compact the rubblized pavement. The roller shall be operated at a speed not to exceed 6 feet per second (2 meters per second).

At locations where the operations of rubblizing and compacting the existing pavement reveal soft spots or depressions in the surface, they shall be repaired by removing the rubblized pavement, base course and subgrade as necessary as unclassified excavation in accordance with Section 210 and placing and compacting stone backfill and/or aggregate base course as directed by the Engineer. Depressions in the surface that are deemed stable by the Engineer shall be corrected by adding aggregate base course and compacting as directed by the Engineer.

**513.05 Method of Measurement.** (a) Rubblizing portland cement concrete pavement will be measured by the square yard (square meter) in accordance with Section 109. No deduction will be made for minor non-rubblized areas such as catch basins or full-depth asphalt patches.

(b) Removal of existing asphalt overlays and asphalt surface patches will be measured by the square yard (square meter).

(c) Material for patching will be measured and paid for by the ton (metric ton) according to Section 415.

(d) Removal of existing rubblized portland cement concrete pavement and base course will be measured as unclassified excavation by the cubic yard (cubic meter). The volume will be determined by measuring the average length, width and depth.

(e) Stone Backfill will be measured by the ton (metric ton) according to Section 207.

(f) Aggregate base course will be measured by the ton (metric ton) according to Section 303.

**513.06 Basis of Payment.** Work completed and accepted and measured as provided above will be paid for as follows:

(a) **Rubblizing Portland Cement Concrete Pavement.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per square yard (square meter) for Rubblizing Portland Cement Concrete Pavement, which price shall be full compensation for sawing joints; for rubblizing the

existing pavement; for compacting the rubblized pavement; and for all equipment, tools, labor and incidentals necessary to complete the work.

**(b) Removal of Existing Asphalt Overlay and Surface Patches.** Work completed and accepted and measured as provided above will be paid for at the contract unit price bid per square yard (square meter) for Removal of Existing Asphalt Overlay, which price shall be full compensation for removal and satisfactory disposal of the existing asphalt overlay and asphalt surface patches; and for all equipment, tools, labor and incidentals necessary to complete the work.

**(c)** Removal of existing rubblized portland cement concrete pavement will be paid for as Unclassified Excavation under Section 210.

**(d)** Stone Backfill will be paid for according to Section 207.

**(e)** Aggregate Base Course will be paid for according to Section 303.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Rubblizing Portland Cement Concrete Pavement	Square Yard (Square Meter)
Removal of Existing Asphalt Overlay	Square Yard (Square Meter)