

DIVISION 7 CONCRETE PAVEMENTS AND SHOULDERS

SECTION 700

GENERAL REQUIREMENTS FOR PORTLAND CEMENT CONCRETE PAVING

700-1 DESCRIPTION.

Perform the work covered by this section which includes but is not limited to the construction of a single course non-reinforced Portland cement concrete pavement on a prepared base in accordance with these specifications and with the lines, grades, thickness, and typical sections shown on the plans or as directed.

The Department accepts concrete paving with respect to strength and thickness on a lot by lot basis subject to adjusted unit prices as provided in Sections 710 and 720.

Use any combination of equipment that will effectively perform the necessary construction operations. Have the equipment at the job site sufficiently ahead of the start of construction operations for the Engineer to examine thoroughly and approve.

Maintain all equipment in a satisfactory operating condition while in use on the work.

700-2 CONCRETE PRODUCTION EQUIPMENT.

Use batch plants, central mix plants, and truck mixers which meet the requirements of Section 1000.

700-3 CONCRETE HAULING EQUIPMENT.

When central mixed concrete is used, non-agitating hauling equipment may be used to transport the concrete. Use equipment which have bodies that are smooth, water-tight, metal containers equipped with gates and vibrators that permit control of the discharge of the concrete.

Deliver the concrete to the site of the work in a thoroughly mixed and uniform mass and discharged with an acceptable degree of uniformity.

Delivery time is defined as the elapsed time from the time water is added to the mix until it is deposited on the grade. When using central mixed concrete, deliver the concrete within 30 minutes when hauled in non-agitating trucks. If transit mix (ready mix) concrete is used, Table 1000-2 applies.

700-4 PREPARATION OF SUBGRADE AND BASE.

Prepare the subgrade and base beneath Portland cement concrete pavement in accordance with the applicable sections of these specifications. Use approved automatically controlled grading and paving equipment to produce final subgrade and base surfaces meeting the lines, grades, and cross sections required by the plans or as directed. When in the judgment of the Engineer the use of such equipment is impractical, this requirement will be waived.

Dampen the surface of the base at the time the concrete is placed. Sprinkle the base when necessary to provide a damp surface. Satisfactorily correct all damaged areas in the subgrade or base prior to placing concrete.

Hauling over the base course will not be allowed except where specifically permitted by the special provisions or in writing. The Engineer may allow equipment dumping concrete to operate on the base to the extent and under the conditions deemed necessary to facilitate placing and spreading the concrete.

700-5 PLACING CONCRETE.**(A) General:**

Use a slip form paver to place concrete except where its use is impractical due to the presence of irregular areas or areas of existing pavement adjacent to the proposed pavement.

Place concrete only in the presence of the Engineer or his authorized representative.

Handle concrete in such a manner as to prevent segregation and keep free from mud, soil, or any other foreign matter.

Where finishing operations must be completed after dark, provide acceptable artificial light in accordance with Section 1412 of the Standard Specifications.

Do not begin paving operations or discontinue paving operations when any of the following conditions exist:

1. When a descending air temperature in the shade and away from artificial heat reaches 40°F (4.4°C), stop paving. Do not resume paving until an ascending air temperature in the shade and away from artificial heat reaches 35°F (1.7°C).
2. When the subgrade or base course is frozen.
3. When aggregates to be used in the mix contain frozen particles.
4. When air temperature in shade is 95°F (35.0°C) and rising or the concrete temperature is greater than 95°F (35.0°C).

Where additional pavement must be placed adjacent to new pavement by machine methods, do not place it until representative test beams of the concrete have attained a flexural strength of at least 600 psi (4.1 MPa)

Construction equipment or hauling equipment will not be allowed over the pavement until representative test beams of the concrete have attained a flexural strength of 600 psi (4.1 MPa).

(B) Slip Form Paver Method:

Where a slip form paver is to be used, provide concrete that has sufficient cohesion to prevent appreciable slumping of the pavement edges. When the original mix design produces concrete that will not meet these requirements, stop or slow production and immediately make corrections to the mix.

Use a slip form paver that is an approved self-propelled machine(s) designed to spread, consolidate, screed, and float finish the concrete in one complete pass of the machine in such a manner that requires a minimum of hand finishing to provide a smooth, dense, and homogeneous pavement. Use a slip form paver equipped with forms of sufficient length and rigidity to adequately support the edges of the slab so as to minimize hand finishing. Use slip form pavers equipped with both horizontal and vertical automatic controls. Check the automatic controls daily and make sure the slip form paver is working properly prior to beginning operations.

Operate the paver with a continuous forward movement and coordinate all operations of mixing, delivering, and spreading the concrete to provide uniform progress and minimize stopping and starting of the paver. If for any reason it is necessary to stop the forward movement of the paver, stop the vibratory and tamping elements immediately.

Produce concrete with surface smoothness and texture that meets the requirements of Article 710-6 and Article 710-7 except that a longitudinal straight edge tolerance of 1/4 inch (6.4 mm) in 10 feet (3.0 m) will apply to the area within 6 inches (152.4 mm) of the edge of pavement. Edge slump is limited to no more than 1/4 inch (6.4 mm).

Section 700

In addition to the requirements of Article 700-8, provide at all times materials for the protection of the edges of the unhardened concrete. Such protective materials can be either standard metal forms, or wood plank having a nominal thickness of not less than 2 inches (50.8 mm) and a depth equal to at least the thickness of the pavement. When rain appears imminent, stop all paving operations and use all available personnel to assist in protecting the unhardened concrete.

(C) Fixed Form Method:

Apply the requirements of this subarticle to all paving operations where a slip form paver is not being used.

Use forms made of metal and of such section and design that they will adequately support the concrete and the construction equipment.

Use forms that have a depth not less than the edge thickness of the pavement to be constructed and not more than 1 inch (25.4 mm) greater than the edge thickness of the pavement to be constructed. Use a form which has the base width at least equal to the height of the form.

Use a form in which the top face does not vary from a true plane more than 1/8 inch (3.2 mm) in 10 feet (3.0 m), and the upstanding leg does not vary more than 1/4 inch (6.4 mm).

Use straight forms that have at least 3 pin pockets per 10 feet (3.0 m) in length and at least 2 pin pockets per 5 feet (1.5 m) in length.

Use form pins that are metal and capable of holding the forms rigidly in place during construction operations. The Engineer may require pinholes in the base to be sealed prior to placing subsequent pavement.

Connect the form sections by a locking joint that will keep the forms free from vertical and horizontal movement.

Use straight forms 10 feet (3.0 m) in length on tangents and on curves having a radius of 200 feet (61.0 m) or more. For curves having a radius of between 200 feet (61.0 m) and 50 feet (15.2 m) use either straight forms 5 feet (1.5 m) in length or flexible forms. Use flexible forms for curves having a radius of less than 50 feet (15.2 m).

Thoroughly clean all forms before being setting and thoroughly oil all forms before placing concrete. Check the bearing of the forms and correct all areas of inadequate bearing.

Remove all rejected forms immediately from the project.

Set forms a sufficient distance in advance of the point where the concrete is being placed to provide for a continuous operation in placing the concrete and for proper inspection of line and grade.

All forms used for construction joints must meet the requirements of this subarticle except that provisions shall be made for inserting dowel bars where required.

700-6 SPREADING AND VIBRATING CONCRETE:

Spread the concrete uniformly over the entire area between the forms without segregation. Perform the spreading with a mechanical spreader except where hand methods are necessary due to pavement design, equipment breakdown, or other emergency.

Vibrate the concrete uniformly after it has been spread. Vibrators for full width vibration of concrete paving slabs may be either the surface pan type or 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 the separate carriage. Use vibrators so that they do not come in contact with the joint, load transfer devices, subgrade, or side forms. Stop

machine mounted vibrators or remove them from contact with the concrete whenever the forward motion of the machinery is stopped. Use surface vibrators with a frequency of not less than 3,500 impulses per minute and internal type vibrators with a frequency of not less than 5,000 impulses per minute for tube vibrators and not less than 7,000 impulses per minute for spud vibrators.

When spud type internal vibrators, either hand operated or attached to spreaders or finishing machines, are used adjacent to forms, use ones with a frequency of not less than 3,500 impulses per minute.

700-7 FINISHING.

Finish concrete pavement or concrete shoulders in accordance with Article 710-6 or Article 720-7, respectively.

700-8 PROTECTION FROM COLD WEATHER AND RAIN.

Adequately protect concrete from damage by freezing with insulating materials such as burlap, plastic sheets or other approved materials until it reaches an age of 72 hours. Remove and replace concrete damaged as a result of freezing at no cost to the Department. Protect concrete for at least 7 days when fly ash is used.

Have protective covering that will protect the surface of the freshly placed pavement from rain readily available each day at the location of each proposed day's operation prior to beginning work. Store an adequate quantity of these materials at the paving train. Repair or remove and replace concrete damaged as a result of rain as directed, at no cost to the Department.

700-9 CURING.

(A) General:

Immediately after finishing operations have been completed and surface water has disappeared, cure all exposed surfaces of the pavement by one of the methods covered by this article.

Apply the selected curing method to the edges of the pavement immediately after the forms are removed.

Use a curing period of 3 curing days for all methods. A curing day will be considered as any consecutive 24 hour period, beginning when the manipulation of each separate mass has been completed, during which the air temperature adjacent to the mass does not fall below 40°F (4.4° C).

(B) Membrane Curing Compound:

Use a minimum rate of application of 0.0067 gallons per square foot (0.27 liters per square meter) when the application equipment is mechanically operated or 0.01 gallons per square foot (0.41 liters per square meter) when the application equipment is hand operated.

Use mechanically operated application equipment designed to apply a uniformly agitated continuous flow of the curing compound at the prescribed rate to all concrete surfaces.

Protect the membrane curing compound film at all times during the curing period, and repair any damage immediately. Have available a sufficient amount of polyethylene film, burlap, or other approved material to provide for protection of the concrete during rain or when the application equipment fails to apply the curing compound uniformly to all surfaces.

(C) Polyethylene Film:

Spread the sections of the film in a manner that will not damage the finished pavement surface. Provide lap joints for the sections that are at least 12 inches (304.8 mm) wide, and take suitable precautions to prevent the circulation of air beneath the film.

Check the film for damage when it is spread and during the curing period. Repair or replace any damaged sections immediately.

(D) Burlap:

Spread the sections of burlap in a manner that will not damage the finished pavement surface. Provide lap joints that are at least 6 inches (152.4 mm) wide.

Use an amount of burlap that is not less than 12 ounces per running yard (372 g per running m) based on a 40 inch (1016 mm) width and may be either 1 layer of Class 4 burlap or 2 layers of Class 1, 2, or 3 burlap.

Saturate the burlap thoroughly prior to placing on the concrete and keep thoroughly wet throughout the curing period.

700-10 REMOVING FORMS.

Do not remove forms from freshly placed concrete until the concrete has hardened sufficiently to resist spalling, cracking, or any other damage, and at least 12 hours have elapsed after the concrete has been placed. Repair any honeycombed areas along the sides or edges of the slab by filling with mortar immediately after the forms have been removed. Use mortar consisting of 1 part of cement to 2 parts of fine aggregate.

700-11 JOINT CONSTRUCTION.**(A) General:**

Construct all joints in accordance with the requirements of these specifications and the details shown on the plans. Saw all joints and seal with joint sealer in accordance with the dimensions and details shown on the plans. Seal joints in accordance with the provisions of Article 700-12.

Perform sawing to the full depth required by the plans to control random cracking as soon as the concrete has hardened sufficiently to be sawed without spalling and raveling but not more than 24 hours after the concrete is placed.

Perform any additional sawing necessary to provide the full joint width required by the plans no earlier than 10 days prior to the sealing of the joint.

Deviations from the method of joint construction specified in the plans or specifications requires prior approval in writing. Such approval is conditional and is subject to obtaining satisfactory results.

The Engineer may order any concrete pavement or shoulder where uncontrolled cracking has occurred prior to final acceptance to be removed and replaced at no cost to the Department. Where permitted, the Contractor may be allowed to repair the cracking in a manner acceptable to the Engineer.

Prior to placing either concrete pavement or concrete shoulders adjacent to a previously placed pavement, cover the transverse joint opening on the edge of the existing slab with tape or other approved material to prevent intrusion of grout into the opening.

(B) Transverse Contraction Joints:

Construct transverse contraction joints in accordance with the details, dimensions and intervals as shown on the plans.

(C) Longitudinal Contraction Joints:

Construct longitudinal contraction joints in all pavements wider than 16 feet (4.9 m) in accordance with the details and dimensions shown on the plans.

(D) Transverse Construction Joints:**(1) General:**

Construct transverse construction joints by use of an approved form at the end of each day's operations (planned joint) or whenever the placing of concrete is suspended for more than 30 minutes (emergency joint).

(2) Planned Transverse Construction Joints:

Locate this type of joint at the same spacing required for contraction joints. Use dowel bars of the size and spacing shown on the plans.

(3) Emergency Transverse Construction Joints:

Use this type of joint when the placing of concrete is suspended for more than 30 minutes. Use tie bars of the size and spacing shown on the plans.

Do not change the spacing of contraction joints due to emergency construction joints. Locate the emergency construction joints at least 6 feet (1.8 m) from any contraction joint or planned construction joint.

(E) Longitudinal Construction Joints:

Construct longitudinal construction joints using tie bars in accordance with the details shown on the plans.

(F) Transverse Expansion Joints:

Construct transverse expansion joints in accordance with the details shown on the plans utilizing an approved joint assembly.

700-12 SEALING JOINTS.**(A) General:**

Seal all joints with low modulus silicone sealant in the presence of the Engineer.

Install backer rod and sealant in accordance with the details shown in the plans and the manufacturer's recommendations.

Any failure of the joint material will be cause for rejection. Repair the failed joint material as approved by the Engineer at no cost to the Department.

When requested, have a representative of the silicone sealant manufacturer present on the project during the sealing operation.

(B) Age of Pavement:

Do not seal the joints until the concrete is at least 14 calendar days old.

Do not perform final sawing and sealing of concrete pavement joints until after surface testing, correction of surface deficiencies, and all adjacent earth and paved shoulder construction have been completed.

(C) Temperature:

Do not place joint sealant when the air temperature near the joint is less than 45°F (7.2°C) or is 45°F (7.2°C) and falling.

(D) Sealing the Joint:

Immediately after sawing the joint to the dimensions as shown on the plans, completely remove the resulting slurry from the joint by flushing with a jet of water under

Section 700

pressure. Use sand blasting to clean joint faces before applying sealant. Make as many passes with a sand blaster as are necessary to provide a clean joint wall.

Blow all joints clear of deleterious materials with air using a nozzle pressure of at least 90 psi (0.6 MPa) before installing the backer rod. Use rotary screw compressors for this purpose that are equipped with traps capable of removing water and oil from the air. Maintain the traps in accordance with manufacturer's instructions.

Apply sealer only on thoroughly clean and dry joints. Place the sealer to closely conform to dimensions shown on the plans. Any unreasonable deviation will be cause for rejection.

(E) Cleaning Pavement:

After a joint has been sealed, remove surplus joint sealer on the pavement as soon as possible.

700-13 USE OF NEW PAVEMENT OR SHOULDER.

Traffic or other heavy equipment will not be allowed on the concrete pavement or shoulder until representative test samples have attained a flexural strength of at least 600 psi (4.1 MPa).

The Contractor is responsible for anticipating the need for early breaks on beams prior to the routine acceptance testing of beams at 14 calendar days. The Contractor is also responsible for making these additional beams. The minimum number of sample tests required when early use of the pavement is requested is 2 sets of 2 beams for each day's operation. The Engineer will test the beams as requested by the Contractor.

No permanent traffic will be allowed on the pavement until construction of the joints, including all sawing, sealing, and curing that is required, has been completed.

Construction traffic will be permitted on pavement that has reached the required strength. After the final sawing of the joint, no traffic will be permitted on the pavement within 3 days after the joints are sealed.

Take particular care to protect the exposed pavement edges and ends.

700-14 CONTRACTOR'S RESPONSIBILITY FOR PROCESS CONTROL.

Perform process control sampling and testing of concrete materials and operations in accordance with the provisions of Article 1000-3. The Contractor's roadway foreman and all personnel involved in the batching, sampling, testing, and acceptance of Portland cement concrete pavement must be NCDOT certified Portland Cement Concrete Pavement Technicians.

700-15 ACCEPTANCE TESTS FOR CONCRETE.

(A) Responsibility:

The Engineer will conduct acceptance sampling and testing of concrete. Provide access to all materials to be sampled and tested. The following tests will be performed on both concrete pavement and concrete shoulders to determine acceptance.

(B) Lot Definition:

A lot for acceptance purposes is defined and described in Article 710-4.

(C) Air Content:

The air content of the concrete will be determined on the roadway at a frequency established by the Engineer, and in accordance with Subarticle 1000-3(B). The sample taken for determination of air content will be obtained immediately after the concrete has been discharged on the road.

Concrete failing to meet specification requirements for air content will be subject to rejection.

(D) Slump:

The slump of the concrete will be determined in accordance with AASHTO T 119 at a frequency established by the Engineer. The sample taken for determination of slump will be obtained immediately after the concrete has been discharged on the road.

When the slump of the concrete is questionable by visual observation, do not place the concrete on the road until tested for slump by the Engineer.

Concrete failing to meet specification requirements for slump will be subject to rejection.

(E) Flexural Strength:

Determine the flexural strength of concrete by testing a minimum of one set of two 6" x 6" x 20" (152.4 mm x 152.4 mm x 508.0 mm) beams at 14 calendar days. Test beams for determining the flexural strength of the concrete will be made by the Engineer from the concrete as it comes from the mixer. The beams will be made and cured in accordance with AASHTO T 23 except that immersion in saturated lime water will not be required. Beams will be tested by the Engineer in accordance with AASHTO T 97. Furnish curing facilities for the test beams in accordance with Section 725.

(F) Thickness:

The thickness of the pavement will be determined by measurement of cores in accordance with AASHTO T 148 as modified by the Department. Copies of the modified test procedures are available upon request from the Construction Unit.

Take cores in the presence of the Engineer that are 4 inches (101.6 mm) in diameter. Take the cores when test beams have attained a flexural strength of at least 450 psi (3.1 MPa) and at least 72 hours have elapsed since placement of the pavement. If test beams have not attained a flexural strength of at least 600 psi, the gross vehicle weight rating of vehicles supporting the coring operation may not exceed 7,000 pounds (3,175.1 kg). Take cores no later than 30 days after the pavement has been placed. The core locations for each lot will be selected at random by the Engineer.

Patch all core holes within 72 hours of taking the core, using a NCDOT approved nonshrink grout compatible with the pavement or shoulder concrete.

(G) Surface Smoothness:

Perform acceptance testing for surface smoothness on concrete pavements in accordance with Article 710-7.

**SECTION 710
CONCRETE PAVEMENT**

710-1 DESCRIPTION.

Perform the work covered by this section including but not limited to designing the concrete mix; furnishing and placing concrete; furnishing of all admixtures and additives; the construction of all joints and the furnishing of all joint materials; marking the pavement; curing the pavement and furnishing all curing materials; the furnishing of all concrete necessary for making test beams; coring and patching the pavement; calibrating and checking the operation of any batching equipment; all actions necessary to prevent or to repair cracking; sawing and sealing joints; removal and replacement of defective pavement as well as the construction of Portland cement concrete pavement in accordance with these specifications and with the lines, grades and dimensions shown on the plans.

710-2 MATERIALS.

Refer to Division 10:

Portland cement concrete.....	Section 1000
Curing agents	Section 1026
Joint filler	Article 1028-1
Low modulus silicone sealant.....	Article 1028-4
Water	Article 1024-4
Dowels and tie bars	Article 1070-6

710-3 COMPOSITION OF CONCRETE.

Compose the concrete in accordance with Section 1000.

710-4 ACCEPTANCE OF CONCRETE.

Test the concrete pavement for acceptance with respect to flexural strength and thickness on a lot by lot basis in accordance with the provisions of Article 700-15 and the following requirements:

For all concrete pavement, including mainline, shoulders, ramps, tapers, intersections, entrances, crossovers, and irregular areas not otherwise defined, produce a lot consisting of 1,333.3 square yards (1,114.8 square meters) or fraction thereof placed within 14 calendar days. From each lot, make a minimum of one set of two 6" x 6" x 20" (152.4 mm x 152.4 mm x 508.0 mm) beams from a randomly selected batch of concrete. The average flexural strength of the two beams is considered one test. If Division of Highways personnel make and test additional sets of beams for a lot, these sets will be averaged with the original set to determine the flexural strength. In the case of low strength, the Engineer reserves the right to use beams made by certified Contractor personnel from the same sample of concrete and tested by Division of Highways personnel to evaluate the lot. If the Engineer elects to use these beams, the flexural strength of all additional beams tested will be averaged with the original two beam strengths to determine the flexural strength.

710-5 CONSTRUCTION METHODS.

Construct concrete pavement in accordance with Section 700.

Place concrete in 2 lane minimum widths in a single operation except as follows:

1. Where the total number of lanes is an odd number, one of the lanes may be placed in a separate operation.
2. Areas such as ramps or auxiliary lanes where the total width is less than 2 lanes.

710-6 FINISHING.

Finish the concrete with approved equipment. Screed and float finish the concrete to the required cross section by an approved float that minimizes or eliminates hand finishing. Normally, hand finishing will not be permitted except under the following conditions:

1. Narrow widths, or irregular areas, where operation of mechanical equipment is impractical.
2. In the event of breakdown of mechanical equipment, hand methods may be used to finish only that concrete deposited on the base when the breakdown occurred.
3. Abnormal circumstances of short duration subject to approval.

Produce a final finish on the pavement surface that is true to grade and uniform in appearance and free of irregular, rough, or porous areas.

Following the finishing of the pavement by screeding, floating, and checking with straightedges, further finish the surface of the pavement by burlap dragging, or other acceptable method which will produce an acceptable uniform surface texture. Operate the burlap drag in a longitudinal direction.

Section 710

Produce the final surface finish of all mainline pavement, auxiliary lanes, and ramps by mechanical equipment for grooving plastic concrete which utilizes spring steel tines. Hand finishing may be permitted when the use of mechanical equipment is impractical. Use mechanical equipment that produces transverse grooves that are spaced at random intervals of 1/2" (12.7 mm), 5/8" (15.9 mm), or 3/4" (19.1 mm) center to center. Do not overlap adjacent grooving. Produce grooves in the hardened surface which are 0.08 inches (2.0 mm) to 0.12 inches (3.0 mm) in width and 0.15 inches (3.8 mm) to 0.25 inches (6.4 mm) in depth.

After final finishing, hand finishing may be required on the edges of pavement and/or joints whenever irregularities in surface texture or alignment occur. Care should be taken in hand finishing pavement edges in order to avoid ridges or high places that will prevent water from draining out of the transverse grooves.

The use of excessive water during the finishing operations will not be permitted.

710-7 FINAL SURFACE TESTING.

Perform acceptance testing of the longitudinal profile of the finished pavement surface in the presence of the Engineer. Furnish and operate a Rainhart Profilograph (Model No. 860) to determine and record the longitudinal profile on a continuous graph (profilogram) for acceptance testing of the pavement. Take profiles the day after the pavement has been placed except where impractical, but in no event later than 72 hours following placement of the pavement.

Operate the profilograph over the pavement at a speed not exceeding 2 miles per hour (3.2 kph). If a propulsion vehicle is used, it must be approved, and the gross vehicle weight must not exceed 1,000 pounds (453.6 kg). Take profiles with the recording wheel parallel to and approximately 3.5 feet (1.1 m) inside the two outer edges of the travel lanes and at the location of each longitudinal joint. Take profiles over the entire length of through lane and ramp pavement exclusive of structures and approach slabs. Take additional profiles only to define the limits of an out-of-tolerance surface variation. Upon completion of each day's testing, submit the profilograms to the Engineer for analysis. The Engineer will retain the profilograms.

At the beginning and end of each day's testing operations, and at such other times as determined necessary, operate the profilograph over a calibration strip so that correct operation can be verified by the Engineer. The Engineer will select the section of pavement used as the calibration strip. Furnish obstructions of known dimensions and temporarily install them in the path of the profilograph. Operate the profilograph in the same manner as it is operated over pavement outside of the calibration strip.

Plot the profilogram at a horizontal scale of 25 feet per inch (0.3 m per mm) with the vertical scale plotted at a true scale. Record station numbers and reference lines on the profilograms, and make sure that the distances between reference locations do not exceed 200 feet (61.0 m).

The Engineer will determine the profile index in accordance with the procedure titled "Determination of Profile Index". Copies of this procedure can be obtained from the Construction Unit.

Construct the concrete so that the completed concrete pavement surface has a profile index (PI) along any line tested not exceeding 4 inches per mile (63.1 mm per km), as determined with a 0.20 inch (5.1 mm) blanking band, over any 600 foot (182.9 m) section of pavement. Individual deviations must not exceed 0.3 inches (7.6 mm) over any 25 foot (7.6 m) length of the line tested. Correct areas found to exceed this tolerance by grinding and texturing or using other approved corrective measures that produce smooth and skid resistant surfaces.

Promptly repair membrane curing compound damaged during acceptance testing operations.

In the event the Contractor does not produce a pavement surface that meets the requirements of this article, the Engineer may suspend the Contractor's operations until such time as the Contractor satisfies the Engineer, by making necessary adjustments to equipment, methods, or personnel, that he can produce a pavement surface that will meet these surface requirements.

The use of excessive grinding to meet these requirements will not be permitted.

710-8 PAVEMENT MARKING.

Mark the pavement at locations as shown on the plans with station numbers. Mark the pavement by pressing beveled-face metal dies between 4 inches (101.6 mm) and 6 inches (152.4 mm) high into the plastic concrete.

At locations where shoulder drain outlets are placed, mark the edge of pavement nearest the outlet to indicate the presence of the outlet. Provide a mark consisting of the letters "OL". Use the same marking procedure as for station numbers.

710-9 THICKNESS TOLERANCES.

A lot for thickness acceptance testing is defined in Article 710-4.

For the purpose of establishing an adjusted unit price, if appropriate, for mainline pavement, take one core from each lot at a random location as directed. Core each location in the presence of the Engineer. Take cores with a diameter of 4 inches (101.6 mm) and deliver them to the Engineer for measurement.

Other areas such as intersections, entrances, crossovers, ramps, etc. will each be considered as one lot and the thickness of each of these lots will be determined separately. Small irregular areas may be included as part of another lot. Take one core for each 1,333.3 square yards (1,114.8 square meters) of pavement or fraction thereof in the lot

When the measurement of the core from a lot is not deficient more than 0.2 inch (5.1 mm) from the plan thickness, full payment will be made. When such measurement is deficient more than 0.2 inch (5.1 mm) and not more than 1.0 inch (25.4 mm) from the plan thickness, take 2 additional cores at intervals not less than 300 feet (91.4 m) apart within the lot and determine the average of the 3 cores. In determining the average thickness of the pavement, the Engineer will use all 3 core measurements with the exception that measurements which are in excess of the plan thickness by more than 0.2 inch (5.1 mm) will be considered as the plan thickness plus 0.2 inch (5.1 mm). If the average measurement of these 3 cores is not deficient more than 0.2 inch (5.1 mm) from the plan thickness, full payment will be made. If the average measurement of the 3 cores is deficient more than 0.2 inch (5.1 mm) but not more than 1.0 inch (25.4 mm) from the plan thickness, an adjusted unit price provided in Subarticle 710-11(B) will be paid for the lot represented.

When the measurement of any core is less than the plan thickness by more than 1.0 inch (25.4 mm), the actual thickness of the pavement in this area will be determined by taking additional cores at not less than 10 foot (3.0 m) intervals parallel to the center line in each direction from the affected location until in each direction a core is found which is not deficient by more than 1.0 inch (25.4 mm). Areas found deficient in thickness by more than 1.0 inch (25.4 mm) will be removed and replaced with concrete of the thickness shown on the plans. Exploratory cores for deficient thickness will not be used in averages for adjusted unit price. Patch all core holes within 72 hours of taking the core, using a NCDOT approved nonshrink grout compatible with the pavement concrete.

710-10 METHOD OF MEASUREMENT.

The quantity of Portland cement concrete pavement to be paid for will be the actual number of square yards (square meters) of concrete pavement that has been completed and accepted. In measuring this quantity, the width of the pavement will be as called for on the plans or as directed. The length will be the actual length constructed, measured along the centerline of the pavement.

Separate measurement will be made of pavement that is deficient in thickness by more than 0.2 inch (5.1 mm) and of pavement that is deficient in flexural strength.

710-11 BASIS OF PAYMENT.**(A) General:**

The quantities of Portland cement concrete pavement, measured as provided in Article 710-10, will be paid for at the contract unit price per square yard (square meter) for "___ Inch (mm) Portland Cement Concrete Pavement, Through Lanes,(with dowels)", "___ Inch (mm) Portland Cement Concrete Pavement, Ramps, (with dowels)", or "___ Inch (mm) Portland Cement Concrete Pavement, Miscellaneous,(without dowels)", or if applicable, at such contract unit prices adjusted in accordance with the provisions shown below. No unit price adjustments on lots will be made until a final determination of the lot strength and depth is made. Pavement will be classified as through lane, ramp, or miscellaneous pavement in accordance with the classification shown on the plans.

Payment for all work of surface testing will be made at the contract lump sum price for "Surface Testing Concrete Pavement". Partial payments for surface testing will be proportional to the percentage of pavement which has been surface tested at the time the partial estimate is prepared.

(B) Pavement Deficient In Thickness:

The quantities of Portland cement concrete pavement which are deficient in thickness by more than 0.2 inch (5.1 mm) but not deficient by more than 1.0 inch (25.4 mm), measured as provided in Article 710-10, will be paid for at an adjusted contract unit price per square yard (square meter) for "___ Inch (mm) Portland Cement Concrete Pavement, Through Lanes, (with dowels)", or "___ Inch (mm) Portland Cement Concrete Pavement, Ramps, (with dowels)", or "___ Inch (mm) Portland Cement Concrete Pavement, Miscellaneous, (without dowels)" completed in place and accepted. The adjusted contract unit price will be as follows:

<u>Deficiency, Inches (mm)</u>	<u>Pay Factor (%)</u>
0.00 to 0.20 (0.0 to 5.1 mm)	100
0.21 to 0.30 (5.3 to 7.6 mm)	80
0.31 to 0.40 (7.9 to 10.2 mm)	72
0.41 to 0.50 (10.4 to 12.7 mm)	68
0.51 to 0.75 (13.0 to 19.1 mm)	57
0.76 to 1.00 (19.3 to 25.4 mm)	50

Pavement areas deficient in thickness by more than 1.0 inch (25.4 mm), will be removed and replaced.

Where pavement deficient by more than 1.0 inch (25.4 mm) is removed and replaced, the replacement pavement will be paid for at the contract unit price per square yard (square meter) for "___ Inch (mm) Portland Cement Concrete Pavement, Through Lanes, (with dowels)", or "___ Inch (mm) Portland Cement Concrete Pavement, Ramps, (with dowels)", or "___ Inch (mm) Portland Cement Concrete Pavement, Miscellaneous, (without dowels)" which price and payment will be full compensation for all work of placement, removal, restoration of subgrade and base, and replacement.

(C) Concrete Pavement Varying In Flexural Strength:

The pay factor for pavement achieving a flexural strength in 14 days of 600 psi (4.1 MPa) or greater is 100%. The pay factor for pavement achieving a flexural strength in 14 days between 550 psi (3.8 MPa) and 600 psi (4.1 MPa) is determined by the following formula:

$$2100 \quad \text{Pay Factor (\%)} = 102.1 - \left[\frac{\text{—————}}{((\text{PSI}-500)/10)^3} \right]$$

(pay factor rounded to nearest tenth of one percent)

$$\text{Pay Factor (\%)} = 102.1 - \left[\frac{2100}{(((\text{MPa} \times 145.04)-500)/10)^3} \right]$$

(pay factor rounded to nearest tenth of one percent)

The quantities of Portland cement concrete pavement which meet these criteria, measured as provided in Article 710-10, will be paid for at an adjusted unit price per square yard (square meter) for "____ Inch (mm) Portland Cement Concrete Pavement, Through Lanes, (with dowels)", or "____ Inch (mm) Portland Cement Concrete Pavement, Ramps, (with dowels)", or "____ Inch (mm) Portland Cement Concrete Pavement, Miscellaneous, (without dowels)" completed in place and accepted. The adjusted contract unit price will be determined by multiplying the contract unit price by the pay factor level determined for the average strength of concrete in each lot and will be applicable to the total square yards (square meters) of concrete in each lot.

Any pavement which fails to attain 550 psi (3.8 MPa) is subject to removal. If allowed to remain in place, the pavement will be accepted at a reduced unit price based on a pay factor level of 50% as provided in Article 105-3.

Where pavement deficient in strength is removed and replaced, the replacement pavement, if acceptable, will be paid for at the contract unit price for "____ Inch (mm) Portland Cement Concrete Pavement, Through Lanes, (with dowels)", or "____ Inch (mm) Portland Cement Concrete Pavement, Ramps, (with dowels)", or "____ Inch (mm) Portland Cement Concrete Pavement, Miscellaneous, (without dowels)" which price and payment will be full compensation for all work including placement, removal, restoration of subgrade and base, and replacement.

(D) Multiple Adjustments in Price:

Pavement found deficient in both thickness and strength will be evaluated by the Engineer to determine if it may be permitted to remain in place. Pavement permitted to remain in place will be paid for at a reduced price determined by successively multiplying the contract price by the appropriate factor indicated for each deficiency.

(E) Compensation:

Payment at the contract unit prices for "____ Inch (mm) Portland Cement Concrete Pavement, Through Lanes, (with dowels)" and "____ Inch (mm) Portland Cement Concrete Pavement Ramps, (with dowels)" and "____ Inch (mm) Portland Cement Concrete Pavement, Miscellaneous, (without dowels)" will be full compensation for all work covered by this section.

Payment at the contract lump sum price for "Surface Testing Concrete Pavement" will be full compensation for all work of surface testing including but not limited to furnishing, maintaining, and operating the profilograph and any necessary towing equipment; for furnishing graph paper and any other materials and supplies necessary for performing the surface testing; and for repairing any membrane curing compound damaged during surface testing operations.

(F) Pay Items

Payment will be made under:

___" (mm) Portland Cement Concrete Pavement, Through Lanes(with dowels).....	Square Yard (Square Meter)
___" (mm) Portland Cement Concrete Pavement, Ramps (with dowels)	Square Yard (Square Meter)
___" (mm) Portland Cement Concrete Pavement, Miscellaneous(without dowels).....	Square Yard (Square Meter)
Surface Testing Concrete Pavement	Lump Sum

**SECTION 720
CONCRETE SHOULDERS**

720-1 DESCRIPTION.

Perform the work covered by this section including but not limited to the construction of Portland cement concrete shoulders in accordance with these specifications and with the lines, grades, and dimensions shown on the plans as well as designing the mix; furnishing and placing the concrete shoulders; furnishing all admixtures and additives; the construction of all joints and rumble strips and furnishing all joint materials; curing the shoulder and furnishing all curing materials; coring and patching core holes; all actions necessary to prevent or to repair cracking; and removal and replacement of any unsatisfactory shoulder.

720-2 MATERIALS.

Refer to Division 10:

Portland cement concrete	Section 1000
Curing agents	Section 1026
Joint filler	Article 1028-1
Low modulus silicone sealant.....	Article 1028-4
Water	Article 1024-4
Dowels and Tie bars.....	Article 1070-6

720-3 COMPOSITION OF CONCRETE.

Composition of concrete is in accordance with Section 1000.

720-4 ACCEPTANCE OF CONCRETE.

Concrete shoulders will be tested for acceptance with respect to flexural strength and thickness on a lot by lot basis. A lot is defined in Article 710-4.

720-5 EQUIPMENT.

Use equipment in the production and placement of the concrete shoulders in accordance with Section 700 and Section 1000.

720-6 CONSTRUCTION METHODS.

Place the concrete shoulders only in the presence of an authorized representative of the Engineer. Construct concrete shoulders in accordance with Section 700.

Place the full width of the shoulder in a single operation.

720-7 FINISHING.

Finish the shoulder surface with approved equipment. Hand finishing will be permitted when the use of mechanical finishing equipment is impractical.

Perform the final finishing of the shoulder surface by burlap dragging or brooming, or other acceptable methods that will produce a similar surface texture acceptable to the Engineer.

While the concrete shoulder is still plastic, construct rumble strips to conform to the spacing and dimensions shown in the plans.

720-8 JOINTS.

Construct and seal all joints in accordance with Article 700-11 and 700-12 except as provided in this article. Saw all joints in the concrete shoulder and seal with joint sealer as shown in the plans.

Dowels will not be required at the transverse joints in the concrete shoulder. Use tie bars between the concrete pavement and the concrete shoulder.

Match the transverse joints in the concrete shoulder with the transverse joints in the adjacent concrete pavement. Space the rumble strips so that they are a minimum of 3 feet (0.9 m) from the transverse joint.

720-9 THICKNESS TOLERANCES.

The thickness of the shoulder will be determined by measurement of cores tested in accordance with AASHTO T 148 as modified by the Department. Copies of the modified test procedures are available upon request from the Construction Unit.

A lot for thickness acceptance testing is defined in Article 710-4.

Take one core from each lot at a random location as directed. Core each location in the presence of the Engineer. Take cores with a diameter of 4 inches (101.6 mm) and deliver them to the Engineer for measurement. When the required thickness for the shoulder varies, each core will be measured and compared to the required thickness for the shoulder at the location of the core. The deviation of the measured core thickness from the required thickness will be recorded as a plus or minus value for each core. Thickness tolerances in Article 710-9 apply for concrete shoulders.

720-10 METHOD OF MEASUREMENT.

The quantity of concrete shoulders to be paid for will be the actual number of square yards (square meters) of shoulders that have been completed and accepted. In measuring this quantity, the width of the shoulders will be as called for on the plans or as directed by the Engineer. The length will be the actual length constructed, measured along the surface of the shoulders at the centerline of each shoulder.

720-11 BASIS OF PAYMENT.

(A) General:

The quantity of concrete shoulder, measured as provided for in Article 720-10, will be paid for at the contract unit price per square yard (square meter) for "Concrete Shoulders Adjacent to ____ Inch (mm) Pavement," or if applicable, at such contract unit prices adjusted in accordance with the provisions shown below:

(B) Shoulder Deficient in Thickness:

Pay factors are determined in accordance with Subarticle 710-11(B). When the shoulder is deficient in thickness by more than 1 inch (25.4 mm), the Engineer will determine if the shoulder can be left in place or be removed and replaced. Where the Engineer determines the shoulder can be left in place, the shoulder will be accepted at a reduced unit price not to exceed 50% as provided in Article 105-3. Where the shoulder deficient by more than 1 inch (25.4 mm) is removed and replaced, the replacement shoulder will be paid for at the contract unit price per square yard (square meter) for "Concrete Shoulders Adjacent to ____ Inch (mm) Pavement," which price and payment will be full compensation for all work or removal.

(C) Concrete Shoulder Varying In Flexural Strength:

Concrete shoulders must meet the strength requirements of Subarticle 710-11(C).

The quantities of concrete shoulder which fail to meet 600 psi (4.1 MPa), measured as provided in Article 710-10, will be paid for at an adjusted unit price per square yard (square meter) for "Concrete Shoulders Adjacent to ___ Inch (mm) Pavement," completed in place and accepted. The adjusted contract unit price will be determined by multiplying the contract unit price by the pay factor level determined for the average strength of concrete in each lot and will be applicable to the total square yards (square meters) of concrete in each lot.

Where concrete shoulder deficient in strength is removed and replaced, the replacement pavement, if acceptable, will be paid for at the contract unit price for "Concrete Shoulders Adjacent to ___ Inch (mm) Pavement," which price and payment will be full compensation for all work of placement, removal, and replacement.

(D) Multiple Adjustments in Price:

Concrete shoulder found deficient in both thickness and strength will be evaluated by the Engineer to determine if it may be permitted to remain in place. Concrete shoulder permitted to remain in place will be paid for at a reduced price determined by successively multiplying the contract price by the appropriate factor indicated for each deficiency.

(E) Pay Items:

Payment will be made under:

Concrete Shoulders Adjacent to ___" (mm) Pavement Square Yard (square meter)

**SECTION 725
FIELD LABORATORY FOR
PORTLAND CEMENT CONCRETE PAVEMENT**

725-1 DESCRIPTION

Perform the work covered by this section including but not limited to providing and maintaining the building or trailer and the curing shelter for the exclusive use of the Engineer at concrete plants producing Portland cement concrete for use in pavement to be constructed on the project; furnishing water, heat, electricity, and other utility services; and any other equipment that may be necessary.

725-2 GENERAL REQUIREMENTS.

Furnish and maintain for the exclusive use of the Engineer a field laboratory in which to house and use all testing equipment needed. Provide a laboratory that is dust and water tight, floored, and has an adequate foundation so as to prevent excessive floor movement. Provide a laboratory which contains 6 or more 110 volt electrical double outlets properly grounded and spaced; a telephone; at least 2 windows, satisfactory locks on all doors and windows; adequate lighting, heating, and air conditioning; sink; running water to sink; and satisfactory exhaust fan. Provide a laboratory that meets the following approximate minimum requirements: 200 square feet (18.6 square meters) of floor space; 10 feet (3.0 m) interior width; 6 feet 6 inches (2.0 m) interior height; 20 square feet (1.9 square meters) of counter space, 2.5 to 3 feet (0.8 to 0.9 m) high and 2 feet (0.6 m) deep with cabinets or drawers below the counter top; and 6 square feet (0.6 square meters) of desk space not enclosed with cabinets. Locate the laboratory in a position that will permit full view of the plant from the interior of the laboratory. At or near the laboratory, furnish toilet facilities, with waste disposal, available for use of the Department personnel. Maintain these toilets in a neat and clean condition.

Provide a curing shelter adjacent to the laboratory that is at least 200 square feet (18.6 square meters) in area, approximately 10 feet (3.0 m) wide, 20 feet (6.1 m) long, and 7 feet (2.1 m) in height. Provide a workbench that is approximately 10 feet long (3.0 m), 2 feet (0.6 m) wide, and 2 feet (0.6 m) high across the end of the shelter. Provide, in the

Section 725

shelter, a sand bed at least 1 foot (0.3 m) deep, and approximately 10 feet (3.0 m) wide and 14 feet (4.3 m) long, which is enclosed on all 4 sides by timbers. Equip the shelter with curtains made of burlap, canvas, or other suitable materials, that may be raised or lowered to protect the sand bed and workbench from the sun. Furnish a wooden mixing board at least 3/4 inch (19 mm) thick and approximately 4 feet (1.2 m) wide and 4 feet (1.2 m) long, which is covered on one side with sheet metal of at least 22 gage (0.759 mm thickness), at the shelter. Provide a water supply to maintain the sand bed in a moist condition. Provide facilities to maintain the test beams at temperature between 60°F (15.6°C) and 80°F (26.7°C) during curing.

In lieu of equipping the curing shelter with a sand bed as required above, the Contractor may provide a similar facility meeting all of the above requirements except equipped with water storage tanks. Construct the water storage tanks of non-corroding materials and have provisions for automatic control of the water temperature. Maintain the water in the tank at a temperature of 73°F ±3°F (22.8°C ±1.7°C). Equip each tank with a recording thermometer with its bulb located in the water. Provide sufficient tank volume to maintain all beams, stored with the long axis vertical, in a fully submerged condition for the duration of the required curing period.

725-3 COMPENSATION.

Payment at the contract lump sum price for "Field Laboratory Rental, Portland Cement Concrete Pavement" will be made for furnishing and maintaining all field laboratories which have been made available for use by the Engineer at any concrete plant producing Portland cement concrete for use in pavement to be constructed on the project. Partial payments for field laboratory rental will be made with the first and last partial pay estimates which include concrete pavement and/or concrete shoulders. Payments will be made at the rate of 50 percent of the lump sum price for "Field Laboratory Rental, Portland Cement Concrete Pavement" on each of these partial pay estimates.

Payment will be made under:

Field Laboratory Rental, Portland Cement Concrete Pavement.....Lump Sum

NOTES

