SECTION 603 -- CONCRETE PAVEMENT

603.01 -- Description

This work shall consist of furnishing all materials and constructing portland cement concrete pavements, approach slabs, and headers. They are to be constructed on a prepared subgrade or foundation course as prescribed in these *Specifications* and as shown in the plans.

603.02 -- Material Requirements

1. The concrete class for pavements and headers shall be as specified in the contract bid proposal Schedule of Items.

2. NDR Class 47BD-30 concrete is generally required for bridge approach slabs. Each contract's Schedule of Items will specify each bridge approach slab's concrete class and strength.

3. All materials shall be furnished by the Contractor and shall conform to the requirements in Table 603.01.

Table 603.01

Material Requirements	
Applicable Materials	**Section**
Fly Ash	1008
Admixtures	1007
Curing Materials	1010, 1011, 1012, 1013
Deformed Metal Joint Material	1027
Dowel Bars	1022
Joint Sealing Filler	1014
Portland Cement Concrete	1002
Preformed Joint Filler	1015
Preformed Polychloroprene Elastomeric Joint Seals	1016
Reinforcing Steel	1020, 1021, 1024
Tie Bars	1020
Water	1005

603.03 -- Construction Methods

1. Preparation:

   a. The Contractor shall prepare the subgrade as prescribed in Section 302.

   b. After the subgrade template or profiler has been drawn over the subgrade or foundation course, any irregularities found in lines or grades shall be corrected before concrete is placed.

c. The foundation course shall be constructed in accordance with the requirements of Section 307.

d. (1) The forms shall have a flat or rounded top at least 45 mm wide. When tested as a simple 3 m beam under a center load of 750 kg, the maximum deflection shall not exceed 3 mm. The forms shall be interlocking. Wood or metal forms of the proper radii shall be used for curves having radii of less than 30 m. Outside forms shall be ferrous metal, straight, and their depth equal to the pavement thickness. Additional form height for integral curb may be obtained by attaching form extensions to the main forms.

(2) Forms shall be tightly joined and securely pinned and staked to line and grade at least 60 m ahead of the concrete placing operation. Forms shall withstand the concrete pressure and the mass of supported equipment. The use of earth pedestals or other materials to support the forms above grade will not be allowed.

(3) Before placing the concrete, the Contractor shall clean, oil, and check the alignment and grade of the forms. Each joint of the forms shall be tested with a 3 m straightedge placed on the forms so that the mid-point of the straightedge is directly over the joint. Forms that do not make full contact along the full length of the straightedge shall be reset.

(4) Finished pavement and curbs may be used as forms.

2. Placing Concrete:

a. (1) The Contractor shall mix and place the concrete.

(2) Steel reinforcement shall not be disturbed.

(3) The concrete shall not be segregated.

(4) The concrete shall be spread to the required depth, consolidated, leveled, and finished.

(5) The foundation course shall not be damaged or mixed with the concrete.

b. The concrete shall be placed in the forms to make a uniform layer approximately 25 mm greater than the required finished thickness.

c. Concrete shall be consolidated for its full depth and width and along all joints.

d. After being consolidated with internal mechanical vibration, the concrete shall be struck off to a uniform height approximately 10 mm above the finished surface and then finished to the final elevation by means of a vibrating mechanical or vibrating hand operated screed.

e. Finished concrete shall be of uniform density with no segregation or honeycombing.

f. Portland cement concrete is sensitive to ambient air temperature and humidity. The following are maximum limits that do not cover all situations:

(1) Concrete shall be consolidated, leveled, and finished within 30 minutes of it being placed on the grade.

(2) Concrete shall not be kept in non-agitating trucks (i.e., dump trucks) more than 30 minutes.

(3) Concrete shall not be kept in an agitating truck more than 90 minutes.

(4) A transverse construction joint shall be installed whenever work stops for more than 30 minutes. However, no section's length shall be less than 3 m.

g. A set-retarding admixture conforming to Section 1007 may be incorporated into the concrete mixture.

h. Operations will not be started until the ascending ambient air temperature reaches 5°C. Mixing and placing operations shall be discontinued when the descending ambient air temperature reaches 5°C.

i. In no case shall concrete be placed upon an unstable or frozen subgrade or foundation course.

j. Placement authorized for ambient air temperatures below 5°C shall be as prescribed in Subsection 704.03, Paragraph 14. Any concrete damaged by freezing shall be rejected.

k. If the rate of evaporation approaches 1.0 kg/m²/hr., the Contractor must notify the Engineer regarding the additional actions that will be taken to prevent plastic shrinkage cracking. The rate of evaporation shall be obtained by using the nomograph at Figure 710.01.

l. To place concrete at night, the Contractor must request permission from the Engineer 24 hours in advance of placement.

m. Concrete headers extending the full depth and width of the pavement shall be constructed as shown in the plans.

n. The Contractor shall construct pavement approach slabs as shown in the plans.

3. Slip-Form Construction:

a. Slip-form equipment may be used to construct the pavement. Formed construction may be required on irregular or variable width sections which are not adaptable to slip-form construction.

b. (1) The subgrade profiler must provide trackways and a subgrade for the paver that will insure the finished surfaces will meet the specification requirements.

(2) A reference line shall be erected and maintained by the Contractor true to line and grade to assure vertical and horizontal control during the subgrade and foundation course operations. The reference line shall be maintained until passage of the paving machines.

c. The slip-form paving equipment shall be able to spread, consolidate, strike off, shape, and float-finish the freshly placed concrete to the desired line, grade, and thickness. Work shall be done in one continuous pass so that minimum hand finishing is required. All equipment shall be designed to span the full width of the lane or shoulder.

d. (1) The concrete shall be distributed uniformly into final position by the paver immediately following its placement on the prepared base.

(2) The forward speed of the paver shall be adjusted to the concrete production so that the operations are continuous and uninterrupted.

(3) All concrete shall be consolidated by internal vibration with transverse vibrating units or a series of longitudinal vibrating units.

(4) The paver extrusion plate or screed shall extrude the concrete under load, properly shaping and compacting the concrete into a dense, stable mass.

(5) Excess edge slumping resulting in profiles that do not match those in the plans will not be allowed.

e. The concrete float finisher shall be directly attached to the paver.

f. A wet burlap, carpet, or canvas drag will be drawn over the entire surface in a longitudinal direction for a final finish.

g. The straightedging operation may be required on any part of the pavement that the Engineer suspects is not smooth. This is in addition to the straightedging that is required at the beginning and end of the daily concrete placement and in those sections immediately following a breakdown or work interruption.

4. Placing Reinforcing Steel:

a. The Contractor shall place reinforcement as shown in the plans.

b. All reinforcement metal must be kept clean and free from foreign material.

c. Welded steel wire fabric shall be kept in flat sheets.

d. (1) Welded steel wire fabric shall be installed on a level and consolidated layer of concrete whose top surface is at the elevation specified for the reinforcing metal.

(2) (i) Welded steel wire fabric shall be lapped at least 300 mm.

(ii) The welded steel wire fabric shall be tied together at all laps.

(iii) The spacing between the ties of longitudinal laps shall not exceed 600 mm.

(iv) The transverse laps shall be tied with a minimum of three ties per lane width.

(3) The welded wire shall be covered immediately with a layer of concrete placed to the pavement's required thickness and crown. Any portion of the bottom layer of concrete that has been placed more than 30 minutes without being covered with the top layer shall be rejected.

e. (1) The Contractor may use mechanical means for placing the welded steel wire fabric. The placement machine shall be specifically designed for this purpose.

(2) When the welded steel wire fabric is placed by mechanical methods, the Contractor may elect to place the concrete in one operation to the full depth and width shown in the plans.

(3) Alternate methods of installing welded steel wire fabric may be approved when paving small or irregular sections.

f. (1) The Contractor will be required to furnish and install suitable supports approved by the Engineer for all reinforcing steel and dowel bars.

(2) All steel reinforcing bars must be tied securely in place at all points where these bars cross other reinforcing bars.

(3) Epoxy coated reinforcing steel shall be tied with plastic coated ties.

g. The Contractor shall coat dowel bars with a lubricant as shown in the plans. The lubricant shall be a petroleum oil or grease that meets the following requirements:

(1) The lubricant shall adhere to the dowel to form a complete and continuous film over the portion of the dowel being coated.

(2) The coating shall be sufficient to break the bond between the dowel bars and the concrete.

(3) The lubricant shall have sufficient contrast with the bar to be easily seen.

h. Dowel bars shall be placed at mid-depth of the slab, parallel to the finished surface of the slab, and parallel to the centerline of the roadway.

i. Dowel bars may be placed by use of either baskets or mechanical inserters. Mechanical inserters must be approved before being used on a project.

j. If baskets or mechanical inserters are not used, then the free end of the dowels must be supported in a frame to keep the dowels properly aligned.

k. (1) The Contractor may use a machine to place the longitudinal tie bars in lieu of tie bar pins shown in the plans.

(2) (i) The tie bar placement machine shall be designed to place the tie bars as shown in the plans.

(ii) The tie bar placement machine shall be operated only when the machine to which it is attached is moving.

(iii) Devices or jigs that call for manual placement of the tie bars will not be allowed except in emergencies to complete the day's concrete placement.

(3) (I) When adjacent pavement lanes are constructed separately, tie bars placed at key-type longitudinal joints may have a 90 degree bend at the center of the bar to facilitate placement.

(ii) Before placing the adjacent lane, the tie bars shall be bent to a position of 45 degrees to the longitudinal joint.

(iii) All bars that crack or break off shall be replaced by installing tie bars as prescribed in Section 909.

(iv) Cracked or broken bars shall be replaced at no additional cost to the Department.

5. Finishing Concrete Pavement:

a. The Contractor shall keep the concrete manipulation to a minimum when bringing the concrete to a proper finish.

b. (1) Machine finishing. After the concrete has been deposited and spread, it shall be struck off 6 mm higher than the specified crown elevation. The concrete shall then be consolidated and finished with a power-driven machine.

(2) The forward speed of the finishing machines shall be adjusted so the operations are continuous and uninterrupted.

(3) The top of the forms and the surfaces of the wheels of the finishing machine shall be kept free from concrete and earth.

(4) The addition of water to the surface of the concrete to assist in finishing operations is not allowed except as follows:

(i) Unavoidable delays or unusual drying conditions may require fogging the concrete surface to aid finishing. The fog shall be applied as a mist by means of an approved "orchard" sprayer.

(ii) If it becomes necessary to fog the surface to complete the concrete finishing, all placing operations shall be immediately stopped until the finishers catch up to a point where fogging for finishing is no longer required.

(iii) An evaporization retardant may be used in addition to fogging.

(5) Laitance and surplus water shall be removed after completion of the mechanical finishing and while the concrete is still plastic.

(6) (I) The surface shall be made smooth and true to the profile of a 3 m straightedge.

(ii) Straightedges shall be set parallel to centerline and shall be lapped one-half their length in each successive position. High areas shall be removed, depressions filled with fresh concrete, and the concrete consolidated with hand floats.

(iii) Straightedge testing shall be continued as necessary until all irregularities have been satisfactorily corrected.

(7) (I) The concrete shall be textured by dragging a wet burlap, carpet, or canvas belt over the full width of the surface in a longitudinal direction.

(ii) The drag shall be suspended from a mandrel, or similar device, to insure a uniform texture.

(iii) The drag shall be lifted from the surface of the concrete pavement when the paving train is not in motion for 30 minutes or more and carefully reset before resuming the dragging operations.

(iv) Drags shall be rinsed or washed as necessary to obtain a uniform surface. Drags that cannot be cleaned shall be replaced.

(8) After the final drag finish, hand-formed or machine-formed joints shall be prepared and the concrete over the joints carefully removed. The edges of the pavement along the side forms and joints shall be rounded with an edging tool.

(9) Hand methods may be used to finish concrete already placed when equipment breakdowns occur.

c. (1) (I) Unless otherwise provided in the special provisions, hand-finishing as prescribed herein may be employed only in cases of emergency and on narrow or variable width sections where mechanical methods are impractical. After the concrete has been deposited and spread, it shall be vibrated with a tamping device or vibrator, then struck-

off to a uniform height above the specified finished grade. It shall then be consolidated, shaped, and tamped with heavy templates, floats, or hand screeds until the concrete is thoroughly consolidated to the prescribed cross section.

(ii) When a non-vibrating hand screed is used, the concrete shall be consolidated with an approved tamping device or vibrator before the concrete is struck off.

(iii) Strike off shall account for consolidation and not allow the final surface elevation to be other than as shown in the plans.

(iv) Non-vibrating screeds and templates shall be at least 600 mm wider than the pavement.

(v) Screeds shall be of steel or steel-shod wood and shall have sufficient strength and stiffness to retain their shape under all working conditions.

(vi) The working edge shall have excess concrete in front of it to prevent voids in the concrete surface.

(2) (I) The screed or template shall be in contact with the forms. It shall be moved on the side forms.

(ii) When using non-vibrating screeds or templates, a crosswise motion shall be combined with the longitudinal advance.

(3) After the concrete has been consolidated, leveled, and tested with a straightedge, it shall be given a texture finish.

(4) (I) The concrete shall be textured by dragging a wet burlap, carpet, or canvas belt over the full width of the surface in a longitudinal direction.

(ii) The drag shall be suspended from a mandrel, or similar device, to insure a uniform texture.

(iii) Drags shall be rinsed or washed as necessary to obtain a uniform surface. Drags that cannot be cleaned shall be replaced.

(5) After the final drag finish, hand-formed or machine-formed joints shall be prepared and the concrete over the joints carefully removed. The edges of the pavement along the side forms and joints shall be rounded with an edging tool.

d. Tined Finish. When required by the plans or special provisions, the Contractor shall tine texture the concrete pavement surface using the following methods:

(1) The surface of the concrete pavement, after being dragged with a wet burlap, carpet, or canvas belt, shall be tined with a metal device not less than 3 m in length with a single row of tines.

(2) The tines shall be of such dimensions as to produce grooves approximately 3 mm wide and 3 mm deep. The tines shall be equally spaced at 10 mm to

20 mm on centers and securely mounted in a rigid head with the width of each tine parallel to the longitudinal centerline of the head.

(3) The tining device shall be mechanically operated and shall cover the full pavement width in a single pass at a uniform speed and depth.

(4) Hand tining is only allowed in areas inaccessible to the tining machine. The hand textured surface shall match that produced mechanically.

(5) When authorized, pavement texture damaged by rain and pavements not grooved to the specified requirements shall only be regrooved after the concrete has attained its designed strength. The transverse grooving shall be done with blades mounted on a multi-arbor machine built expressly for grooving pavements. The cut lines shall be equally spaced approximately 20 mm on center, 3 mm deep, and 3 mm wide. (Flailing type grooving machines will not be allowed.)

6. Protection and Curing:

The Contractor shall cure concrete pavement by one of the following methods:

a. Curing with liquid membrane-forming compounds:

1. After the final finishing operations, the concrete pavement surface, curbs, and edges shall be covered with a continuous uniform coating of white-pigmented curing compound as prescribed in Section 1012.

2. Curing compounds shall not be placed on any surface that will be bonded to another concrete surface.

3. (I) The curing-compound may be applied in either 1 or 2 applications in accordance with the manufacturer's directions.

(ii) If applied in 2 coatings, the second shall be applied not later than 30 minutes after the first.

(iii) The rate of application shall be determined from the results of moisture retention tests, except that the rate of application shall never be less than 0.3 L/m² of surface area for tined surfaces or 0.2 L/m² of surface area for all other finishes.

4. With form paving, the sides of the pavement slab shall be covered with the curing-compound within 30 minutes after removal of the forms.

5. (I) An approved self-propelled mechanical power sprayer shall be used to apply the curing-compound to the concrete pavement. Hand-powered spraying equipment may be employed in an emergency and on narrow or variable width sections where the use of a mechanical power sprayer is impractical.

(ii) The mechanical power sprayer shall not ride on the pavement surface.

(iii) The power sprayer shall be able to cover the entire lane width and thoroughly atomize the curing compound.

(iv) If the mechanical power sprayer produces an unsatisfactory result, such as puddling, dripping, or non-uniform application, the paving operation shall be suspended until appropriate changes have been made.

(v) The sprayer shall be equipped with a hood to prevent uncontrolled dispersal by the wind.

6. Damaged curing compound coatings, such as may result during the joint sawing operations, shall be recoated without delay using the same application rate originally prescribed.

7. (i) When concrete is being placed and the ambient air temperature may be expected to drop below 2°C, then straw, hay, or other suitable blanketing material shall be spread over the pavement to a sufficient depth to keep the concrete from freezing.

(ii) Any hay, straw, or similar material used to protect the concrete shall be covered with a layer of burlap or plastic sheeting. The cover shall have an adequate mass placed on it or be anchored to prevent the wind from displacing the insulation.

(iii) The protection shall be maintained not less than 10 days.

(iv) The Contractor shall replace any concrete damaged by freezing at no additional cost to the Department.

b. Curing with white opaque polyethylene film or white burlap-polyethylene sheets:

1. As soon as practical after the final finishing operations, the top surface of the pavement shall be covered with a white opaque polyethylene film or white burlap-polyethylene sheeting conforming to the requirements of Section 1010. Placement of the film or sheeting shall be done to avoid damaging the concrete surface.

2. The film or sheeting shall be placed on the concrete pavement in conformance with the following:

(i) The mass of the rolls of film or sheeting shall be kept off the concrete while placing the material.

(ii) The material shall cover all exposed horizontal and vertical pavement surfaces.

(iii) Film or sheeting shall be lapped at least 450 mm. The laps shall have a satisfactory anchor placed on them to form a closed joint.

(iv) The Contractor shall secure the sheeting and/or film so that moisture is held inside the covering to facilitate curing.

(v) Any tears or holes in the film or sheeting must be repaired immediately by cementing patches over the openings.

(vi) Film or sheeting may be used more than once, provided that it is kept in serviceable condition by proper repairs, and provided also that it will maintain a watertight covering during the curing period.

(vii) The concrete pavement must be kept covered with film or sheeting, properly sealed, for 72 consecutive hours following the placing of the concrete except that, while the pavement is uncovered, it shall be kept wet by sprinkling with water.

(3) If "hair-checking" develops before the film or sheeting can be applied, initial curing with wet burlap shall be required.

(4) Any joints or seams in a roll of burlap-polyethylene sheeting shall be double sewn.

(5) Joints and seams in polyethylene film or sheeting shall have a minimum lap of 450 mm, and sheeting shall be securely cemented together.

(6) All joints and seams shall be sufficiently durable to prevent separation during the curing period.

(c.) Curing with wet burlap:

(1) Immediately after the finish is complete, burlap shall be carefully placed on the concrete and kept moist in a manner which will not damage the pavement surface.

(2) The burlap shall conform to the requirements of Section 1011 and shall be of sufficient length to cover all exposed surfaces, including the vertical edges of the slab.

(3) At exposed vertical edges of the slabs, earth shall be banked so that the top width of the berm shall be at least 150 mm.

(4) The burlap shall be kept continuously saturated with water for at least 72 hours following the placing of the concrete, except that the burlap may be temporarily removed so that joints may be sawed and filled, the surface tested, and any grinding or rubbing necessary may be accomplished. While the pavement is uncovered, it shall be kept wet by sprinkling with water. Concreting operations shall be suspended when water is not available to cure the concrete.

7. Joint Construction Procedures:

a. (1) Joints shall be cut with a 4 mm thick saw blade to the width and depth shown in the plans.

(2) Initial sawing shall begin when the concrete can support the mass of the saw and sawing does not create raveling. Sawing must be completed before random cracking occurs.

(3) Doweled contraction joints shall not deviate more than 25 mm from the center of the dowel's length.

(4) Joints with or without dowels shall not deviate from their intended location by more than 5 percent of the prescribed spacing.

(5) Each transverse joint shall be cut to the prescribed depth in one continuous pass.

(6) Joint sawing shall be discontinued if a crack occurs at or near the joint location before sawing or if a crack develops ahead of the saw. These cracks shall be routed to a 40 mm depth and 10 to 15 mm width and sealed with joint sealant.

(7) Joints at gutters or integral curbs must be cut to the proper depths to prevent erratic cracking.

(8) Some joints shall require a second cutting to obtain the shape shown in the plans.

b. Immediately after the joints have been sawed or the premature cracks routed, they shall be cleaned with water to remove all dirt and loose material.

c. (1) Any spalls over 6 mm wide and over 12 mm below the surface of the pavement or over 6 mm wide and over 50 mm in length regardless of the depth below the surface shall be patched with epoxy mortar as prescribed in Section 1018 or the manufacturer's recommendations.

(2) Spall patching shall be done only when the air and pavement temperatures are above 10°C and rising. The concrete shall be clean and dry at the time of placing the epoxy mortar.

(3) All loose concrete shall be removed from the spalled area using pneumatic chisels. The spalled concrete surface shall be sandblasted and blown clean with compressed air.

(4) A suitable insert shall be placed in the joint or against the pavement edge to form the face of the patch. Polyethylene, polyvinylchloride, or other material that will not bond to the epoxy shall be used.

(5) After cleaning, the spalled surface shall be primed with a brush application of freshly mixed epoxy binder.

(6) Immediately after priming, epoxy mortar of troweling consistency shall be placed in the spalled area and finished to the level of the original pavement surface.

(7) Dry sand shall be sprinkled onto the fresh epoxy mortar surface to eliminate any gloss. After the epoxy mortar has cured sufficiently to prevent damage, the plastic insert shall be carefully removed.

d. (1) The Contractor shall prepare joints for sealing or filling according to the manufacturer's recommendations.

(2) Joints shall be sealed according to the manufacturer's recommendations.

(3) If a joint is not sealed immediately, a curing membrane must be applied to the joint surfaces.

(4) The curing membrane shall be completely removed from the joint surfaces by sandblasting.

(5) (i) The top surface of the joint material shall be approximately 6 mm below the pavement surface.

(ii) All overflow material shall be removed from the surface of the pavement.

(iii) Overfilled joints shall be repaired by reinstalling the joint filler.

(iv) If adhesion is not satisfactory, the material shall be rejected.

(6) The Contractor shall give the Engineer one copy of the manufacturer's sealing and filling recommendations.

8. Surface Tests:

a. The Contractor shall check all concrete pavement for smoothness as prescribed in Section 602.

b. The Contractor will test the hardened concrete for surface irregularities with a 3 m straightedge or other device for measuring deviations from a plane. Areas showing high spots in excess of 3 mm in the 3 m span will be plainly marked and ground to the required profile. The grinding or rubbing shall be performed so that the cement-aggregate bond will not be broken.

9. Integral Curb:

a. Original Method:

The Contractor shall construct integral curbs as shown in the plans. This curb shall be placed within 30 minutes after the slab has been placed and finished. That part of the pavement that will be covered by the integral curb shall be cleaned of all laitance and roughened to assure a good bond.

b. Alternate Method:

(1) The Contractor may install dowel bars of the size and at the spacing shown in the plans and then place the curb as a separate operation. The surface area upon which the curb is to be placed shall be finished with a rough texture.

(2) The part of the pavement that is to be covered by the integral curb shall be cleaned of all laitance and debris.

(3) A membrane curing compound shall not be used on the area where the curb will be placed.

c. The concrete for the integral curb shall be of the same class as that used in the concrete slab. All contraction or expansion joints in the pavement shall be continuous through the integral curb.

10. Opening Pavement to Traffic:

a. No section of concrete pavement shall be opened to traffic until approval has been given by the Engineer.

b. The time for opening pavement will be based on the length of time the pavement is in place and on the compressive strength of the concrete as determined from a 150 mm diameter cylinder or 100 mm diameter cores taken from the pavement.

c. The Contractor's forces may be allowed on the pavement when the concrete has reached a minimum age of 14 days or when the concrete has reached an age of 7 days and developed a compressive strength of 25 MPa when tested in accordance with AASHTO T 22.

d. If the Contractor elects to increase the early strength of the concrete by adding cement and/or reducing the water/cement ratio, then the pavement may be opened to traffic after 48 hours provided it has attained a compressive strength of 25 MPa.

603.04 -- Method of Measurement

1. Concrete pavement is measured by the square meter.

2. Concrete for pavement approaches is measured by the cubic meter.

3. Reinforcing steel for concrete pavement approaches is measured by the kilogram.

4. "Portland Cement Concrete Pavement Smoothness Testing" is measured according to the procedure in Section 602.

5. Headers are measured by the cubic meter of concrete used.

603.05 -- Basis of Payment

1.

Pay Item	Pay Unit
_____ mm Concrete Pavement _____	Square Meter (m^2)
_____ mm Reinforced Concrete Pavement _____	Square Meter (m^2)
Concrete for Pavement Approaches _____	Cubic Meter (m^3)
Epoxy Coated Reinforcing Steel for Pavement Approaches	Kilogram (kg)
Portland Cement Concrete Smoothness Testing	Lump Sum (LS)
Concrete for Headers, Class _____	Cubic Meter (m^3)

2. Payment will be based on the quantities shown in the plans unless changes are approved by the Engineer.

3. a. A pay factor will be applied to each unit based on the compressive strength of 1 core per unit tested in accordance with AASHTO T 24.

b. A unit is 2000 m^2, and it is determined based on the paved width times a paved length that will yield 2000 m^2.

c. The unit (2000 m2)for compressive strength is the same as the unit for thickness measurement.

d. The pay factors are shown in Table 603.02.

e. The pay factors for blockouts, intersections, and pavements not covered by coring shall be determined from the compressive strengths of their cylinders.

Table 603.02

Concrete Strength Pay Factor	
Percent of Design Concrete Compressive Strength	**Pay Factor**
Greater than 99.9	100
Greater than 98.5 to 99.9	99.75
Greater than 97.5 to 98.5	99.50
Greater than 96.0 to 97.5	99.00
Greater than 94.0 to 96.0	98.00
Greater than 92.0 to 94.0	97
Greater than 90.0 to 92.0	94
Greater than 88.0 to 90.0	90
Greater than 86.0 to 88.0	86
Greater than 84.0 to 86.0	81
Greater than 82.0 to 84.0	76
Greater than 80.0 to 82.0	70
Less than 80.00	See Paragraph 3.g. of this Subsection

f. If the concrete cylinders' compressive strengths are less than 15 MPa at 7 days, then the Engineer may require the concrete to be removed and replaced.

g. The Engineer will evaluate the concrete's expected use and may allow concrete with a compressive strength of less than 80 percent of the design strength (after 28 days) to be left in place and paid for at 40 percent of the bid price or may require the unit to be removed and replaced.

4. Pavement shall be constructed to the exact thickness shown in the plans. Determination of pavement thickness shall be based on pavement cores. The method of measuring the cores shall be in accordance with NDR T 148. Determination of thickness and requirements relative to deficient thickness shall be as specified herein:

a. (1) The paved area shall be divided into units. Each unit will be considered separately. Units are 2000 m^2 of pavement for each separately placed width.

(2) The last unit for the width under consideration shall be 2000 m^2 plus any fractional part of 2000 m^2 remaining.

(3) When the total area of a separately placed width is less than 2000 m^2, the area of the unit shall be the actual area.

(4) A separately placed width is the width between field constructed longitudinal joints, between a longitudinal construction joint and the edge, or between two pavement edges.

(5) Bridges and approach slabs shall be considered as exceptions to the unit's length.

(6) In cases of separately placed intersections or blockouts, the normal width of pavement on either side shall be considered as continuing through in the same manner as would be applicable if the section under consideration had been placed continuously through the section.

(7) At the option of the Engineer, cores may not be required from irregular areas, from a lane less than 2.4 m in width, or for an entire contract involving less than 4000 m^2 of pavement.

b. (1) At least 1 core shall be taken from within each unit of the pavement at random locations to be selected by the Engineer.

(2) If the core so taken is not deficient by more than 7.0 mm from the plan thickness, full payment will be made.

(3) Special cores may also be taken at any locations where the Engineer thinks deficiencies in materials or work quality may exist.

c. (1) The thickness of the pavement at the cored points shall be the average caliper measurement of the cores taken at 3 equi-distant points.

(2) If the unit core is deficient in thickness by more than 7.0 mm but not more than 12.0 mm, 2 additional cores will be taken within the unit. Where possible, the intervals between samples should approximately equal 33 percent of the unit's length.

(3) The average thickness of 3 cores will then be determined. If the average thickness of these 3 cores is not deficient by more than 7.0 mm, full payment will be made.

(4) If the average thickness of the 3 cores is deficient by more than 7.0 mm but not more than 12.0 mm, an adjusted unit price will be paid for the pavement unit in accordance with Table 603.03. Areas deficient more than 12.0 mm will be treated as prescribed in Paragraph 4.d. of this Subsection.

(5) In calculating the average thickness of the pavement in a unit, measurements that are greater than the plan thickness will be considered as the plan thickness and measurements which are less than the plan thickness by more than 12.0 mm will not be included in the average.

(6) Exploratory cores for determining limits of deficiencies of more than 12.0 mm or special cores will not be used in determining average thickness.

Table 603.03

Pavement Thickness Payment Deductions	
Average Thickness Deficiency	**Percent of Contract Unit Price**
0 - 7.0 mm	100
Greater than 7.0 to 8.0 mm	85
Greater than 8.0 to 9.0 mm	80
Greater than 9.0 to 10.0 mm	75
Greater than 10.0 to 11.0 mm	70
Greater than 11.0 to 12.0 mm	65
Greater than 12.0 mm	Reject

d. (1) When the measurement of any core is less than plan thickness by more than 12.0 mm, the actual thickness of the pavement in this area will be determined by taking exploratory cores.

(2) Cores shall be taken 2 m on either side of the deficient core's location and on a line parallel to the centerline of the pavement.

(3) If both cores are within the 12.0 mm tolerance, no additional cores will be taken for this individual zone of deficiency.

(4) If either one or both cores are not within the 12.0 mm tolerance, then additional cores will be cut on either side of the original deficient core on a line parallel to the centerline of the pavement. The first core will be at 7.5 m, and succeeding cores will be at 15.0 m intervals until a thickness within the 12.0 mm tolerance is found in both directions.

(5) On either side of the original short core, the procedure will then be to make a boring approximately one-half the distance between the first core which comes within the 12.0 mm tolerance and the core nearest it that is below the 12.0 mm tolerance.

(6) The preceding procedure shall be repeated within the unit until the location (plus or minus 2 m) at which the pavement comes within the 12.0 mm tolerance is located.

(7) When the thickness of the pavement is deficient by more than 12.0 mm and the Engineer determines that the area should not be removed, then the deficient area will be paid for at 40 percent of the bid price.

5. Cement Content Deduction:

a. Cement content as a percentage by mass of the specified concrete (regardless of its intended use) shall be determined as prescribed by ASTM C 138 or C 231.

b. (1) If the average of 10 consecutive cement content tests is less than 100 percent of the specified mass, then a deduction shall be made as prescribed in Table 603.04.

(2) The amount of placed concrete that is to have its payment adjusted by the cement content deduction pay factor shall include all concrete represented by the 10 consecutive tests.

c. (1) If the average cement content percentage for 10 consecutive tests is 100 percent or more of the specified mass and any individual test is less than 97 percent, then a deduction is made as prescribed in Table 603.05.

(2) The amount of placed concrete that is to have its payment adjusted by the cement content deduction pay factor shall include all concrete that is placed between the test just prior to the low percentage test and the first test following the low percentage test that is at or above 97 percent.

Table 603.04

PCC Concrete Deduction for Cement Content (Average of Ten Consecutive Tests)	
Average Cement Content - By Mass	**PCC Concrete Pay Factor**
100 or greater	1.00
Less than 100 to 99.7	0.98
Less than 99.7 to 99.5	0.95
Less than 99.5 to 99.2	0.85
Less than 99.2 to 99.0	0.85
Less than 99.0 to 98.5	0.700
Less than 98.5 to 98.0	0.625
Less than 98.0 to 97.5	0.550
Less than 97.5 to 97.0	0.475
Less than 97.0	Remove Concrete *
* The Engineer may elect to leave concrete in place and pay only 40 percent of bid price.	

Table 603.05

PCC Concrete Deduction for Cement Content (Individual Test)	
Cement Cement Percentage (by mass)	**PCC Concrete Pay Factor**
100 to 97	1.00
Less than 97.0 to 96.5	0.98
Less than 96.5 to 96.0	0.95
Less than 96.0 to 95.0	0.88
Less than 95.0 to 94.0	0.76
Less than 94.0 to 93.0	0.64
Less than 93.0 to 92.0	0.52
Less than 92	Remove Concrete *
* The Engineer may elect to leave concrete in place and pay only 40 percent of bid price.	

6. The payment formula for concrete pavement is:

Adjusted Unit Price = (smoothness pay factor) x (thickness pay factor) x (strength pay factor) x (cement content pay factor) x (bid price)

7. No additional payment over the contract unit bid price will be made for any pavement which has an average thickness greater than shown on the plans.

8. The preparation of the subgrade under the pavement approaches shall not be measured and paid for directly but shall be considered subsidiary to the concrete pavement.

9. Direct payment will not be made for integral curbs. They shall be considered as subsidiary to concrete pavement.

10. Furnishing and placing required reinforcement and dowel bars shall not be paid for directly but will be considered as subsidiary to concrete pavement.

11. Water incidental to the concrete placement shall be considered subsidiary to concrete pavement.

12. If varying types and thicknesses of concrete are required, the pay item will be subdivided so that the quantities of the various types and thicknesses will be identified.

13. Securing and tieing reinforcing bars will not be paid for directly but shall be considered subsidiary to the items of work for which direct payment is made.

14. Payment is full compensation for all work prescribed in this Section.