Florida Department of Transportation

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DENVER J. STUTLER, JR.
SECRETARY

July 13, 2005

Mr. Donald Davis
Program Operations Engineer
Federal Highway Administration
227 N. Bronough Street, Suite 2015
Tallahassee, Florida 32301

Re: Office of Design, Specifications
Section 350
Proposed Specification: 3500000 - Cement Concrete Pavement.

Dear Mr. Davis:

We are submitting, for your approval, two copies of a proposed Supplemental Specification for Cement Concrete Pavement.

This change was proposed by Emmanuel Uwaibi of the Pavement Management Office to ensure Section 370 is incorporated into the Specification package when Bridge Approach Expansion Joints are required.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via Email to SP965DB or duane.brautigam@dot.state.fl.us.

If you have any questions relating to this specification change, please call Duane F. Brautigam, State Specifications Engineer at 414-4110.

Sincerely,

Signature on file

Duane F. Brautigam, P.E.
State Specifications Engineer

DFB/jho
Attachment
cc: General Counsel
Florida Transportation Builders' Assoc.
State Construction Engineer

350 CEMENT CONCRETE PAVEMENT.

(REV ~~2-3-04~~*6-10-05*) ~~(FA 2-4-04) (7-04)~~

SECTION 350 (of the Supplemental Specifications) is deleted and the following substituted:

SECTION 350
CEMENT CONCRETE PAVEMENT

350-1 Description.

Construct Portland cement concrete pavement in one course, on a prepared subgrade. Use either the fixed-form or the slip-form method of construction. When reinforced cement concrete pavement is specified or required, use concrete reinforced with steel bars or steel fabric, in accordance with details shown in the plans. The Engineer may require a demonstration of equipment and paving operations.

If any uncontrolled cracks appear during the life of the Contract, remove and replace the cracked at no expense to the Department. Investigate and implement immediate effective solutions to eliminate further cracks, in consultation with, and subject to the approval of the Engineer.

Furnish the following information in the Quality Control Plan (QCP) as required in Section 105:

1. A detailed sequence and schedule of concrete placement operations including, but not limited to, width of pavement to be placed, proposed equipment, production rates, working hours, concrete hauling, and placement, curing, sawing, and sealing methods. Identify backup equipment and the procedures that will be followed in the case of a breakdown of equipment.
2. A method to ensure the proper placement of reinforcing steel, tie bars and dowel bars.
3. A traffic control plan that includes provisions for the placement and maintenance of barriers required to protect the pavement from traffic, for a minimum of 14 days after concrete placement.
4. Defined provisions for adequate lighting for all work done at night, including finishing, curing, and sawing joints.
5. A method for ensuring pavement thickness is met and a consolidation procedure is identified.
6. If forms are to be utilized define the material, dimensions, type, connections, and staking of the forms.
7. Define the procedure for the protection of the fresh concrete pavement from inclement weather.

350-2 Materials.

Meet the following requirements:

Concrete, Class I (Pavement).....Section 346
Grinding Concrete Pavement.....Section 352
Curing Materials .....Section 925
Embedded Items.....Section 931

Joint Seal.....Section 932

350-3 Equipment.

350-3.1 General: Ensure the equipment and tools that are to be used meet the following:

The capability of handling materials and performing all parts of the work.

To be of such capacity that the paver operates continuously and at a constant rate of production, with starting and stopping held to a minimum.

When equipment operates on the side forms, use scraping devices to clean accumulations from the top of the forms and wheels.

The forms will be a rigid material and mortar tight. Ensure that the alignment and grade of all forms are in accordance with the contract documents, prior to the placing of concrete.

350-3.2 Slip-Form Paver: Provide a slip-form paver that is self-propelled and equipped to spread, strike-off, consolidate, screed, and float-finish the freshly placed concrete in one complete pass of the equipment, in such a manner that a minimum amount of hand-finishing will be necessary to provide a dense and homogeneous pavement. Ensure that the equipment is of such dimensions and arrangement as to cover the full width of the pavement strip being placed. Use equipment that is adjustable as to crown and superelevation and that can shape and compact the concrete into a dense and stable mass, to the required cross-section. Ensure that the crown adjustment is readily controllable for accuracy in crown transitions.

Operate the paver on tracks having sufficient contact area to prevent track slippage under load. Ensure that the length of ground contact per track and the arrangement of tracks are adequate to meet the straightedge and other riding-quality requirements specified.

Accomplish screeding by either: (1) oscillating screeds, (2) an extrusion device, or (3) a combination of both.

If necessary, in order to produce a pavement of the required cross-section and meeting the surface requirements, equip the slip-form paver with traveling side forms of sufficient dimension and strength and of proper shape to support the concrete laterally for a sufficient length of time during placing and finishing.

If using trailing forms, provide forms that are rigidly supported laterally.

Equip the slip-form paver with automatic guidance and grade controls which operate by sensing from a taut line set true to line and grade. Erect and maintain the taut line.

Automatic grade controls are not required on the paver when the tracks of the slip-form paver are operating on previously placed concrete pavement. The Engineer may waive the use of automatic grade controls on the paver when the entire width of the tracks of the slip-form paver are operating on a subgrade which has been consistently trimmed to a tolerance of 1/8 inch [3 mm] above or below true grade as established by the taut line set for that purpose.

350-3.3 Vibratory Units: Consolidate the concrete for the full width of the strip being placed with either surface pan type or internal type vibrators. Use a vibration method with sufficient intensity and duration to ensure complete consolidation of the concrete without causing segregation of the materials.

For the surface vibrators, use a frequency of not less than 3,500 impulses per minute. For internal type vibrators, use 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 using spud-type internal vibrators adjacent to forms, either hand-operated or attached to spreaders or finishing machines, use a frequency of not less than 3,500 impulses per minute. Measure the

frequency of internal vibrators in plastic concrete. Mount spud vibrators such that the free tip trails, and space spud vibrators at a maximum interval of 30 inches [0.75 m].

Provide an amplitude of vibration with spud vibrators that is sufficient for the vibration to be perceptible on the surface of the concrete along the entire width of the strip being placed. Furnish a device for measuring and indicating the actual frequency of vibrations. Control all vibration by the forward movement of the spreader or finishing machine so that vibration automatically ceases when stopping the forward movement of the spreader.

350-3.4 Device for Application of Membrane Curing Compound: Provide equipment for applying membrane curing compound that is self-propelled and capable of uniformly applying the curing compound at the specified rate. Use equipment that continuously stirs the curing compound, by effective mechanical means, and that thoroughly atomizes the curing compound during the spraying operation so that the finished surface of the fresh concrete will not be marred. Cover the entire surface of the pavement and, with slip-form type paving, the vertical faces by a single pass of the machine. Only use spray nozzles that are equipped with appropriate wind guards to ensure uniform application.

Power-spray equipment may be used to apply curing compound to areas where it is impracticable to operate the self-propelled equipment.

350-3.5 Equipment for Paving Small or Narrow Areas: For variable width areas, other than mainline, ramps, and shoulders, the Engineer will not require the full paving train as specified for the standard run of paving. Use such equipment that is approved by the Engineer.

350-3.6 Hand Finishing Tools: Provide straightedges that have a blade length of 10 feet [3 m]. Use long-handled floats that have flat blades, approximately 4 feet [1.2 m] long by 5 to 8 inches [125 to 200 mm] wide, and that are designed so as to remain straight and true. Use a handle for both types of tool with a length that exceeds 1/2 the width of the strip being placed by 3 feet [1 m].

350-4 Subgrade Preparation.

Keep construction of the subgrade completed for a distance of at least 500 feet [150 m] ahead of the paving operation. Maintain the finished subgrade in a smooth, compact condition, and restore any areas which are disturbed prior to placing the concrete. Do not place concrete on a frozen subgrade.

Ensure that the subgrade is within 2 percent of the optimum moisture content while placing the concrete. Uniformly apply water ahead of the paving operations, as directed by the Engineer.

Do not allow vehicles to travel on the prepared subgrade between the subgrade trimming machine and the paving operations unless specifically authorized.

Accurately trim the subgrade to the required elevation. Trim high areas to proper elevation. Fill low areas with suitable material, compacted to the specified density, or with concrete placed integrally with the pavement. When slip-form paving, include in the width to be trimmed the areas on which the tracks of the paver will operate.

Remove material planed from the subgrade before placing any concrete. The Engineer may waive the use of the planer for small or isolated areas or any areas where its use would be impracticable.

350-5 Setting Forms.

350-5.1 General: Accurately set the forms to line and grade and such that they rest firmly, throughout their entire length, upon the subgrade surface. Join forms neatly and tightly, and brace them to resist the pressure of the equipment operating on the forms. Obtain the Engineer's approval of the alignment and grade of all forms before and immediately prior to the placing of concrete.

Fill any subgrade that is below the established grade at the form line to grade with granular material, in lifts of 1/2 inch [13 mm] or less, for a distance of 18 inches [0.5 m] on each side of the pavement edge, and thoroughly compact the material. As an exception, when placing forms on a cement-treated subgrade, the Contractor may use wedging, provided that the wedging system used adequately supports the forms without causing detrimental deflection under the weight of the paving equipment.

350-5.2 Tamping: When placing forms on other than a cement-treated subgrade, adequately tamp the materials below and adjacent to the forms with form-tamping machines.

350-5.3 Advance Preparation of Forms: Keep sufficient forms on hand at all times, and set forms so that at least 500 feet [150 m] of forms on each side of the roadway will be accurately set, and maintained true to line and grade, in advance of the point where concrete is being placed. Provide sufficient forms so that it is not necessary to remove them in less than 12 hours after placing the concrete.

350-5.4 Cleaning and Oiling Forms: Thoroughly clean and oil the forms after each use and before placing concrete against them.

350-6 Protection from Weather.

Inclement weather may include, but is not limited to, periods when the air temperature may fall below 35ºF [1ºC], periods when the air temperature may rise above 85ºF [29ºC], high winds, heavy rains and other conditions that might affect the final durability of the pavement. When rain appears imminent, stop all paving operations, and cover the surface of the unhardened concrete with the protective covering.

350-7 Placement of Reinforcement.

350-7.1 General: Where the plans call for reinforced concrete pavement, place the steel reinforcement in the pavement slab in accordance with the details shown in the plans. At the time of the concrete placement, ensure that the reinforcing steel is free from any of the following which could impair bonding of the steel with the concrete: dirt, oil, paint, grease, mill scale, and any loose or thick rust. Place the reinforcement as provided below.

350-7.2 Fabric: Place fabric reinforcement at right angles to the centerline of the pavement and accurately to the position and location shown in the plans. Lap adjacent sheets of fabric not less than 6 inches [150 mm]. Make the laps only in the longitudinal members.

350-7.3 Bars: Place bar reinforcement as shown in the plans. Securely wire together transverse and longitudinal bars at their intersections. Lap splices not less than 20 times the nominal diameter of the bar, and only in the longitudinal members.

350-8 Placing Concrete.

350-8.1 Distribution: Distribute the concrete on the subgrade to such depth that, when it is consolidated and finished, the slab thickness required by the plans will be obtained at all

points. The surface will at no point be below the grade specified for the finished surface. Place the concrete on the subgrade in a manner which will require as little rehandling as possible.

Place concrete as near to expansion and contraction joint assemblies as possible without disturbing them. Ensure that workers do not walk in the freshly placed concrete with their boots or shoes coated with earth or other deleterious substances.

350-8.2 Use of Spreader: Place concrete on the subgrade by an approved spreading device. Do not place concrete from the discharge bucket or hopper onto an assembly without centering the bucket or hopper directly over the assembly.

A spreader is not required in areas where the width of slab varies, intersections, and small or isolated areas where it would be impractical to use a spreader. Perform the necessary hand spreading with shovels (not with rakes or hoes).

350-8.3 Placement Widths: The Contractor may construct the pavement either in lanes as determined by the longitudinal joints shown in the plans, or for the full width in one operation. Construct the pavement to the full width of the lane or slab in a single construction operation. When constructing pavement in separate lanes, do not deviate the junction line from the true line shown on the plans by more than 1/2 inch [13 mm] at any point. Tool the edges of the junction to the radius shown in the plans.

When constructing pavement in separate lanes, place the lanes adjacent to the low edge of the pavement, as shown on the typical section, first.

350-8.4 Consolidation Along Forms and Joints: Thoroughly consolidate concrete against and along the faces of all forms, and along the full length on both sides of all joint assemblies, by means of hand-operated, spud-type vibrators. Do not allow vibrators to come in contact with a joint assembly, reinforcement, the subgrade or a side form.

350-8.5 Slip-Form Paver: When placing concrete with a slip-form paver, operate the paver with a continuous forward movement. If for any reason it is necessary to stop the forward movement of the paver, immediately stop operation of the vibrating or tamping elements. Do not apply tractive force to the paving machine except that which is controlled from the machine.

In case of an emergency, have available for use at the project site at least 100 feet [30 m] of forms.

Do not insert steel tie-bars into the unsupported side of the freshly formed slab. The Contractor may place tie-bars into position prior to extrusion from the paver by insertion through the forms, by insertion through a temporary support form placed against the form slab, or by other means approved by the Engineer. Use a method that results in placement of the tie-bars at the specified locations with no damage or disruption of the concrete.

350-9 Striking-off, Consolidating, and Finishing Concrete.

350-9.1 General Requirements: Immediately after placing the concrete, strike-off, consolidate, and finish it to produce a finished pavement in accordance with the cross-section, width, and surface finish required by the Contract Documents. Perform the sequence of operations as follows: strike-off; vibratory consolidation; screeding; floating; removal of laitance; straightedging; and final surface finish. Except as specified, perform strike-off, consolidation, screeding, and floating by the machine method.

Use equipment that is fully and accurately adjustable to produce a pavement meeting project requirements. Use equipment that is capable of operating in a consistent and smooth manner under all conditions of use.

Provide a concrete surface true to grade and crown, and free of irregularities. If the Engineer permits adding water to assist the finishing operations, apply water as a fog spray by means of approved spray equipment.

As soon as possible after screeding while the concrete is plastic, correct all flaws such as cavities, blemishes, marks, or scratches that will not be removed by planing. Apply moisture to the concrete surface only if required and only in the immediate vicinity of the irregularity. The quantity of moisture applied should not exceed what is needed to facilitate correction of the irregularity.

350-9.2 Machine Method: Operate the machine over each area of pavement as few times and at such intervals as is necessary to give proper consolidation and to leave a surface of uniform texture. Avoid excessive operation over a particular area.

Perform strike-off, consolidation, and finishing in a manner such as to avoid damage to, or misalignment of, joint assemblies, reinforcing steel, dowels, and other embedded items. Smooth the surface of the concrete and remove the excess mortar from the surface. Carry a small amount of mortar ahead of the float device as it moves on the surface of the concrete. Operate the machine over the surface of the concrete as many times as required to obtain an acceptable surface, meeting the requirements specified herein. Discard excess mortar beyond the edge of the slab.

350-9.3 Hand Methods:

350-9.3.1 Conditions under which Allowed: Use hand methods in areas of narrow width or irregular dimensions, where operation of mechanical equipment is impracticable.

350-9.3.2 Strike-off and Screeding: Use a portable screed of an approved design, constructed either of metal or of other suitable material shod with metal, to strike-off and screed the concrete. Use a screed that is sufficiently rigid to retain its shape and is at least 2 feet [0.6 m] longer than the maximum width of the strip to be screeded.

350-9.3.3 Consolidation: Use hand-operated spud-type vibrators to consolidate.

350-9.3.4 Floating: Use long-handled floats to float the concrete. Take the necessary care to avoid creating depressions or ridges during this operation.

350-9.4 Work Bridges: Provide work bridges or other devices necessary for access to the pavement surface for the purpose of inspection, finishing, straightedging, and performing corrective work.

350-10 Final Finish.

350-10.1 Finishing: As the water sheen disappears from the surface of the pavement and just before the concrete achieves its initial set, drag a seamless length of damp burlap that extends the full width of the strip of the constructed pavement, longitudinally along the surface to produce a uniform gritty texture.

Use a burlap drag that consists of two layers of medium weight burlap with the trailing edge of the lower layer extending approximately 2 inches [50 mm] behind the upper layer. Support the burlap drag in a manner so that a length of at least 3 feet [1 m] of burlap is in contact with the pavement.

Except in areas where using hand methods to construct the pavement, support the lead end of the burlap drag by a traveling bridge. Maintain the drag clean and free from encrusted mortar. Replace the burlap with new material as necessary.

350-10.2 Edging: After applying the final finish, but before the concrete has become nonplastic, carefully round the edges to a 1/4 inch [6 mm] radius on each side of transverse expansion joints and construction joints and along any structure extending into the pavement. Produce a well-defined and continuous radius, and obtain a smooth, dense mortar finish. Completely remove all concrete from the top of the joint filler.

Check all joints with a straightedge before the concrete has become nonplastic, and, if one side of the joint is higher than the other or the entire joint is higher or lower than the adjacent slabs, make corrections as necessary.

350-11 Curing.

350-11.1 General: After completing the finishing operations and as soon as the concrete has hardened sufficiently to not mar the surface, cover and cure the entire surface and, when the slip-form method is used, cover and cure the edges of the newly placed concrete in accordance with one or more of the methods described below. In cases where curing requires the use of water, ensure that curing has prior right to use all water supplies. If the Contractor fails to provide sufficient curing materials to adequately cure the concrete in place in a timely manner, that portion of the concrete pavement section addressed in the QCP will be suspended. Do not leave the concrete exposed for a period in excess of 30 minutes between stages of curing or during the curing period.

Continuously cure the freshly placed concrete for a period of 72 hours, exclusive of any periods when the temperature of the surface of the concrete falls below 50ºF [10ºC].

350-11.2 White-Pigmented Curing Compound: Under this method, uniformly apply white-pigmented curing compound to the surfaces to be cured, in a single coat, continuous film, at the minimum rate of 1 gallon to every 200 ft^2 [1 liter to every 5 m^2], by a mechanical sprayer.

At the time of use, thoroughly mix the compound in accordance with the manufacturer's recommendation.

Do not apply curing compound during periods of rainfall. Do not apply curing compound to the inside faces of joints to be sealed. Should the film become damaged from any cause within the required curing period, repair the damaged portions immediately with additional compound. If using side forms, upon their removal, immediately coat the sides of the slabs exposed to provide a curing treatment equal to that provided for the surface.

350-11.3 Burlap Mats: Thoroughly saturate the mats with water before placing them. Use mats of such dimensions that as laid they extend to at least 2 feet [0.6 m] beyond the edges of the strip of concrete placed. Place and weigh down the mats throughout the curing period to ensure contact with the surface being cured. Maintain the mats fully moist and in position for the entire portion of the required curing period.

350-11.4 Removal of Forms: Do not remove forms from freshly placed concrete for at least 12 hours after placement. Remove forms carefully so as to avoid damage to the pavement. After removing the forms, immediately cure the sides of the slab in the same manner as the surface of the pavement.

350-12 Joints.

350-12.1 General: Construct joints at the locations and in accordance with the details shown in the Design Standards, Index No*s*. 305 *and 306* and the Contract Documents.

350-12.2 Longitudinal Joints:

350-12.2.1 Longitudinal Construction Joints: Where the pavement is poured in strips less than the full width of the pavement, construct longitudinal construction joints in accordance with the details shown in the plans.

350-12.2.2 Longitudinal Lane-tie Joints: Construct longitudinal lane-tie joints within the limits of a strip of pavement, in accordance with the details shown in the plans. Construct the plane of weakness by sawing a groove in the hardened concrete. Complete sawing as soon as possible but in no case longer than 72 hours after placing the concrete.

350-12.2.3 Tie Bars and Bolt Assemblies: Place deformed steel tie bars or tie bolt assemblies at the required depth, parallel to the finished surface, at right angles to the joint and at the uniform spacing specified or required in the plans. Place them in the plastic concrete using approved equipment, or rigidly support them on the subgrade by approved devices capable of preventing displacement prior to placing of the concrete. Do not paint or coat the bars with any material before placing them in the concrete.

If placing tie bars along a longitudinal construction joint using the method of inserting bars with a 90 degree bend in the edge of the plastic concrete and after the concrete hardens straightening these bars, use Grade 40 [Grade 300] reinforcing steel for such tie bars. Replace any bar broken while being straightened in an approved manner.

350-12.3 Transverse Joints:

350-12.3.1 Transverse Construction Joints: Construct transverse construction joints at the end of all pours and at other locations where the paving operations are stopped for as long as 30 minutes. Do not place construction joints, however, within 10 feet [3 m] of any other transverse joint or within 10 feet [3 m] of either end of a section of pavement. If sufficient concrete has not been placed to form a slab at least 10 feet [3 m] long, remove the excess concrete, back to the last preceding joint. Form the joints by placing a wood or metal bulkhead accurately and securely in place, in a plane perpendicular to the profile and centerline of the pavement. Install dowel bars at the construction joints. Saw or form construction joints, in a manner similar to contraction joints, so that a groove will be formed for holding the joint sealing compound.

350-12.3.2 Transverse Contraction Joints: Construct transverse contraction joints at the interval indicated in the plans consisting of planes of weakness created by sawing a groove in the surface of the hardened concrete. Place the groove perpendicular to the surface of the pavement. Install load transfer devices in transverse contraction joints.

Ensure that the sawing equipment does not damage the pavement, and saw the transverse contraction joints as soon as the pavement has hardened to the degree that tearing and raveling are not excessive and before uncontrolled shrinkage cracking begins.

Accomplish the joint sawing in two steps. Make the initial cut 1/8 inch [3 mm] wide by a depth at least 1/3 of the pavement thickness and as soon as possible but in no case longer than 12 hours after placing the concrete. Make a second saw cut, to provide the joint dimensions indicated in the plans, just prior to sealing the load transfer device.

In cases where a strip of pavement is being placed immediately adjacent to a previously constructed strip of pavement, construct transverse contraction joints using extreme care to time sawing so as to prevent uncontrolled cracks.

Repair any uncontrolled cracks at no expense to the Department by removing and replacing the pavement across the full width of all affected lanes or shoulders and to the nearest transverse joint in each direction.

After the final sawing, clean the joint, install the bond breaker, and seal the joint.

350-12.3.3 Transverse Expansion Joints: Form transverse expansion joints using preformed joint filler, and provide them with dowel load transfer, in accordance with the details shown on the Design Standards, or in the plans.

Form the joints during the placing of the concrete, by securely staking a metal bulkhead accurately in place at the joint location or by other methods which will securely brace and support the joint filler. Where using approved devices to keep the expansion joint filler and dowels securely in place, the Engineer will not require a bulkhead. Protect all transverse expansion joints at the bottom and side edges by a sheet metal strip as specified in 931-2.1 and as shown in the Contract Documents.

Cut the filler to the crown and shape of the slab cross-section and extended it to the subgrade. After installation, ensure that the top is not less than 1 inch [25 mm], and not more than 1.25 inches [30 mm], below the finished surface. Furnish the joint filler in lengths not less than the lane widths being poured, except that the Engineer will not require lengths greater than 12 feet [3.5 m]. Where more than one section is allowed and used in a joint, securely lace or clip the sections together.

Place the filler normal to the pavement surface. Stake the assembly into position in such a way as to hold the assembly securely in position throughout construction. Ensure that the assembly is true to the line prescribed, subject to a tolerance of 1/4 inch [6 mm] in the width of the slab. Obtain the Engineer's approval of the assembly and its installation before placing any concrete against it. Obtain the Engineer's approval of the cross-section and length of the stakes.

When laying the pavement in partial width slabs, place transverse joints in the succeeding slab in line with the like joints in the first slab. In the case of widening existing pavement, place transverse joints in line with like joints in the existing pavement or as otherwise shown in the plans.

350-12.4 Load-Transfer Devices: Provide dowel load-transfer devices in all transverse joints. Firmly hold dowel bars in a position parallel to the surface and the centerline of the slab, by approved steel supports and spacers of a type shown in the plans. The Engineer may approve the use of dowel bar supports or assemblies other than those specifically detailed in the plans. Allow the dowels to be free to move in one slab as the concrete contracts and expands. Paint each dowel with one coat of approved zinc rich paint (listed on the Qualified Products List), and grease one end with an approved lubricant, to prevent the concrete from bonding to the dowel. Provide a cap for the free end of expansion joint dowels.

Position each dowel such that its final deviation from parallel to the surface of the pavement and parallel to the longitudinal centerline of the pavement does not exceed 1/2 inch [13 mm]. Position each dowel such that its final deviation from being centered on the joint does not exceed 2 inches [50 mm]. Position each dowel such that at no point in its length does it deviate from the surface of the pavement as shown in the plans in excess of 1 inch [25 mm]. Confirm the position of dowel bars by suitable means acceptable to the Engineer, which may include non-destructive testing methods.

350-12.5 Expansion Joints Around Structures:

350-12.5.1 Expansion Joints at Manholes, Meter Boxes and other Projections: Form expansion joints by placing premolded expansion joint material about all structures and

features projecting through, into or against the pavement. Ensure that such joints are 1/2 inch [13 mm] in width.

350-12.5.2 Bridge Approach Expansion Joints: *Construct in accordance with Design Standards, Index No. 306.*

350-12.6 Cleaning Joints and Cracks:

350-12.6.1 Cleaning Joints in New Pavement:

350-12.6.1.1 Sawed Joints: Immediately after sawing the joints which require sealing, completely remove the resulting slurry from the joint and the immediate area by flushing with a jet of water under pressure and by using other tools as necessary.

After flushing, blow out the joints with compressed air. After the flushed joints have dried, sandblast the joint faces to thoroughly remove all foreign material. Perform sandblasting in two passes, once for each face.

Patch all spalled edges with an epoxy compound.

Immediately prior to joint seal installation, clean the joints using compressed air to remove all traces of debris and dust within and on the joint surfaces.

350-12.6.1.2 Non-Sawed Joints: Thoroughly clean joints which require sealing of all foreign material for the full depth of the seal installation.

With the exception of slurry removal due to sawing, meet the cleaning requirements as specified for sawed joints.

350-12.6.2 Cleaning Joints in Existing Pavement: Remove all existing joint-sealing material and foreign material for the full depth of the new joint seal by sawing, wire brushing, sandblasting, or other methods approved by the Engineer.

Remove any existing sealant or parting strip material below the tape or backer rod bond breaker and replace it with additional bond breaker. When conditions require removal and replacement with additional bond breaker below the new joint seal, obtain the Engineer's approval of the type of bond breaker and its installation procedure. Perform cleaning by any method or combination of methods, as detailed in the plans.

Flush the joint with a pressurized jet of water, and use other tools as necessary, to remove loose remnants and debris.

After flushing, blow out the joints with compressed air. After the flushed joints have dried, sandblast the joint faces to thoroughly remove all foreign material. Perform sandblasting in two passes, once for each face.

Patch all spalled edges with an epoxy compound.

Immediately prior to joint seal installation, clean the joints using compressed air to remove all traces of debris and dust within and on the joint surfaces.

350-12.6.3 Cleaning Random Cracks in Existing Pavement: Do not begin cleaning random cracks in existing pavement until all other concrete pavement repairs have progressed to the point where those operations will not adversely affect the installation of the new seal.

Cut the random cracks to be repaired and sealed into grooved joints to the depth and width detailed in the plans. Clean the joints as specified in 350-12.6.2.

350-12.7 Sealing Joints and Cracks: Seal joints in new pavement before allowing any traffic or construction equipment on the pavement. Complete sealing within 72 hours (weather permitting) of sawing. If traffic is going to be on the pavement prior to any grinding, then seal the joints with a temporary material acceptable to the Engineer.

When using silicone and non-silicone sealants in the transverse and longitudinal joints, respectively, always use the silicone sealants first to prevent contamination at the intersection of the joint faces. Remove non-silicone sealant 1 foot [300 mm] in each direction from the transverse joints, and replace it with silicone sealant.

Use equipment equipped with nozzles that discharge the sealant at the bottom of the groove. Ensure that the apparatus develops sufficient pressure to extrude the joint sealer from the nozzles satisfactorily and to control the rate of application so as to completely fill the joint to within 1/4 inch [6 mm] of the surface of the pavement without spillage. Use an apparatus so constructed that it maintains the proper temperature of the sealing material within the manufacturer's recommendation.

350-12.7.1 Hot-Poured Type Sealant: When the plans require hot poured sealant for specific joints, fill the joint thoroughly, without trapping air, ensuring the sealant is recessed below the pavement surface as required, and control the pouring rate to avoid spilling of sealant onto the adjacent pavement surface. If any spilling of sealant occurs, immediately remove and clean the entire surplus amount from the pavement surface. Place poured material when the ambient air temperature is 50ºF [10ºC] or greater.

Use an indirect heating or double boiler type heating kettle that uses oil as a heat transfer medium, for hot poured sealer. Use a heating kettle that has a thermostatically controlled heat source, a built-in automatic agitator, and thermometers installed to indicate both the temperature of the melted sealing material and that of the oil bath.

350-12.7.2 Low Modulus Silicone Sealant: Use low modulus silicone sealant of either Type A (non-self-leveling silicone sealant), or Type B and/or Type C (self-leveling silicone sealant). Because Type A will not flow into the proper shape under its own weight, install and tool it so that the sealant is in firm contact with the joint faces and is formed into the appropriate shape as specified. Types B and C will normally flow into the proper shape without tooling. Exercise care to provide the required depth of recess above the sealant surface and below the pavement surface. Install the silicone sealant at temperatures above 40ºF [5ºC].

350-13 Surface Requirements.

Produce, by grinding in accordance with 352, a pavement surface that is true to grade and uniform in appearance with a longitudinal line type texture.

350-14 Thickness Determinations.

350-14.1 General: After completing the concrete pavement, including any corrective work to meet ride requirement, determine the thickness by one of following methods. The Engineer will select the locations for testing and make the determination of thickness. Sample locations will be taken at various points on the cross-section so that each test represents an area not exceeding 2,500 yd^2 [2,000 m^2]. Provide traffic control, non-destructive equipment, coring equipment, and operator to obtain the samples.

350-14.1.1 Core Borings: To determine the actual thickness, drill cores from the pavement and measure thickness in accordance with ASTM C 174. Replace the portions of the pavement removed by the borings at no expense to the Department.

350-14.1.2 Non-destructive Testing: For a determination using the impact-echo method, measure the thickness of the pavement in accordance with ASTM C 1383. The initial thickness measurement will be validated by having a core boring taken at that location in compliance with 350-14.1.1. If the results from the impact-echo test vary by ± 0.15 inches from

the core boring, then the non-destructive test method can not be used on the pavement. In such case, the core boring will be used for acceptance of that LOT. The Engineer has the option to verify the accuracy of the results at any time.

350-14.2 Method of Calculating Average Thickness: The Department will determine the average thickness of the pavement by using the following method of calculation:

(a) The Department will not take into account in the calculation, any areas of pavement which are left in place, but for which no payment will be made.

(b) When the thickness of the pavement is more than 1/2 inch [13 mm] greater than the specified thickness, the Department will consider it in the calculation as the specified thickness plus 1/2 inch [13 mm].

(c) The Department will calculate the average thickness for the entire job as a unit.

350-15 Deficient Thickness.

350-15.1 General: The Department will not pay for any pavement which is more than 1/2 inch [13 mm] less than the specified thickness. Any deficient pavement will be just cause for that portion of the concrete pavement addressed in the quality control plan to be suspended until the corrections are to the satisfaction of the Engineer. When the pavement contains no longitudinal construction joint, the Department will not pay for the area of such pavement that is the product of the full width of the strip placed as a unit times the sum of the distances each way from the short core or cores to the cores on each side which show measurements within the tolerance limits. When the pavement contains longitudinal construction joints, for the width, the Department will use the width between longitudinal construction joint and the edge of pavement.

350-15.2 Deficient Pavement Requiring Removal: The Engineer will evaluate areas of pavement found deficient in thickness by more than 1/2 inch [13 mm] and if, in his judgment, the deficiency is enough to seriously impair the anticipated service life of the pavement, remove such areas and replace them with concrete of the thickness shown in the plans. The Department will not pay for the area of pavement removed or for the materials or labor involved in its removal. When removing a section of pavement, remove the full length between transverse joints.

350-15.3 Deficient Pavement Left in Place: If the Engineer determines that the deficiency will not seriously impair the anticipated service life of the pavement, the pavement may be left in place, at no compensation.

350-15.4 Additional Borings: If the number of cores taken is not sufficient to indicate the thickness of the pavement, additional boring locations may be requested, with prior approval from the Engineer at no additional cost to the Department.

350-16 Opening Pavement to Traffic.

Construct an earth berm along each edge of the pavement within 36 hours of finishing any newly placed concrete pavement. Build the berm to the full height of the pavement and at least 18 inches [0.5 m] wide, and sufficiently compacted to prevent underwash of the pavement. Maintain the berm until the final shoulders are complete.

Except as provided below, keep the pavement closed to traffic for a minimum period (exclusive of days when surface temperature of the concrete falls below 50ºF [10ºC]) of 14 calendar days after placement of the concrete. As an exception to the above, when Type III cement is used, the Engineer will reduce this minimum required period to 48 hours. The

Engineer may permit opening of a section of pavement to traffic at an earlier time provided that representative test beams, made in accordance with ASTM C 31 and tested in accordance with ASTM C 78, indicate a flexural strength of at least 550 psi [3.75 MPa]. Cure these test beams in a manner identical to the corresponding section of pavement.

Protect the pavement from all traffic, including construction operations, until the specified period of time has elapsed in accordance with the current edition of the Design Standards.

350-17 Method of Measurement.

350-17.1 Concrete Pavement: The quantities to be paid for will be the plan quantity, in square yards [square meters], of Plain Cement Concrete Pavement and of Reinforced Cement Concrete Pavement, omitting any areas not allowed for payment under the provisions of 350-15.3 and adjusted for average thickness as provided herein.

For purposes of payment, the average thickness of pavement will determine the final pay quantities for this pavement as follows:

The area of pavement represented by the difference between the calculated average thickness and the specified thickness will be converted into equivalent square yards [square meters] of specified thickness pavement, and the quantity thereby obtained will be added to, or deducted from, the quantity of pavement to be paid for, subject to the limitation that the maximum average of over-thickness permitted in the adjustment of the quantity of pavement to be paid for will be 1/4 inch [6 mm].

Where the plans call for cement concrete pavement that is to be covered with asphalt concrete surface course, payment will be made for the total thickness of the combination as Plain Cement Concrete Pavement.

In such cases, price and payment will also include all costs of the asphalt concrete surface course constructed in accordance with Section 334. Reinforcing steel, placed and accepted, will be measured and paid for as provided in Section 415.

350-17.2 Joints and Cracks: Include the cost for Cleaning and Sealing Joints in the cost of the newly constructed pavement for: (1) transverse and longitudinal joint construction for new pavement; and (2) abutting joints between existing pavement and new pavement.

For replacing joint seals and sealing random cracks in existing portland cement concrete pavement, the quantity to be paid for will be as specified below:

(a) The length of pavement joint satisfactorily cleaned and sealed in existing portland cement concrete pavement, as determined by field measurement along the joints, will be paid for at the Contract unit price per foot [per meter] for Cleaning and Resealing Joints.

(b) The length of random cracks in existing portland cement concrete pavement that have been satisfactorily cut, cleaned, and sealed, as determined by field measurement along the joints, will be paid for at the Contract unit price per foot [per meter] for Cleaning and Sealing Random Cracks.

350-17.3 Bridge Approach Expansion Joint: *The quantity to be paid for will be plan quantity, in feet [meters]of bridge approach expansion joint installed in accordance with Design Standards, Index No. 306, calculated across the pavement at right angles to the centerline of the roadway pavement, completed and accepted.*

350-18 Basis of Payment.

Prices and payments will be full compensation for all work specified in this Section, including any preparation of the subgrade not included in the work to be paid for under another Contract item; all transverse and longitudinal joint construction, including tie-bars and dowel bars; the furnishing of test specimens; repair of core holes; and all incidentals necessary to complete the work.

Payment will be made under:

Item No. 350- 1-	Plain Cement Concrete Pavement - per square yard.
Item No. 2350- 1-	Plain Cement Concrete Pavement - per square meter.
Item No. 350- 2-	Reinforced Cement Concrete Pavement - per square yard.
Item No. 2350- 2-	Reinforced Cement Concrete Pavement - per square meter.
Item No. 350- 72-	Cleaning and Resealing Joints - per foot.
Item No. 2350- 72-	Cleaning and Resealing Joints - per meter.
Item No. 350- 78-	Cleaning and Sealing Random Cracks - per foot.
Item No. 2350- 78-	Cleaning and Sealing Random Cracks - per meter.
Item No. 370- 1-	*Bridge Approach Expansion Joint - per foot.*
Item No. 2370- 1-	*Bridge Approach Expansion Joint - per meter.*

350 CEMENT CONCRETE PAVEMENT.
(REV 6-10-05)

SECTION 350 (of the Supplemental Specifications) is deleted and the following substituted:

SECTION 350
CEMENT CONCRETE PAVEMENT

350-1 Description.

Construct Portland cement concrete pavement in one course, on a prepared subgrade. Use either the fixed-form or the slip-form method of construction. When reinforced cement concrete pavement is specified or required, use concrete reinforced with steel bars or steel fabric, in accordance with details shown in the plans. The Engineer may require a demonstration of equipment and paving operations.

If any uncontrolled cracks appear during the life of the Contract, remove and replace the cracked at no expense to the Department. Investigate and implement immediate effective solutions to eliminate further cracks, in consultation with, and subject to the approval of the Engineer.

Furnish the following information in the Quality Control Plan (QCP) as required in Section 105:

1. A detailed sequence and schedule of concrete placement operations including, but not limited to, width of pavement to be placed, proposed equipment, production rates, working hours, concrete hauling, and placement, curing, sawing, and sealing methods. Identify backup equipment and the procedures that will be followed in the case of a breakdown of equipment.

2. A method to ensure the proper placement of reinforcing steel, tie bars and dowel bars.

3. A traffic control plan that includes provisions for the placement and maintenance of barriers required to protect the pavement from traffic, for a minimum of 14 days after concrete placement.

4. Defined provisions for adequate lighting for all work done at night, including finishing, curing, and sawing joints.

5. A method for ensuring pavement thickness is met and a consolidation procedure is identified.

6. If forms are to be utilized define the material, dimensions, type, connections, and staking of the forms.

7. Define the procedure for the protection of the fresh concrete pavement from inclement weather.

350-2 Materials.

Meet the following requirements:

Concrete, Class I (Pavement)	Section 346
Grinding Concrete Pavement	Section 352
Curing Materials	Section 925
Embedded Items	Section 931

Joint Seal.....Section 932

350-3 Equipment.

350-3.1 General: Ensure the equipment and tools that are to be used meet the following:

The capability of handling materials and performing all parts of the work.

To be of such capacity that the paver operates continuously and at a constant rate of production, with starting and stopping held to a minimum.

When equipment operates on the side forms, use scraping devices to clean accumulations from the top of the forms and wheels.

The forms will be a rigid material and mortar tight. Ensure that the alignment and grade of all forms are in accordance with the contract documents, prior to the placing of concrete.

350-3.2 Slip-Form Paver: Provide a slip-form paver that is self-propelled and equipped to spread, strike-off, consolidate, screed, and float-finish the freshly placed concrete in one complete pass of the equipment, in such a manner that a minimum amount of hand-finishing will be necessary to provide a dense and homogeneous pavement. Ensure that the equipment is of such dimensions and arrangement as to cover the full width of the pavement strip being placed. Use equipment that is adjustable as to crown and superelevation and that can shape and compact the concrete into a dense and stable mass, to the required cross-section. Ensure that the crown adjustment is readily controllable for accuracy in crown transitions.

Operate the paver on tracks having sufficient contact area to prevent track slippage under load. Ensure that the length of ground contact per track and the arrangement of tracks are adequate to meet the straightedge and other riding-quality requirements specified.

Accomplish screeding by either: (1) oscillating screeds, (2) an extrusion device, or (3) a combination of both.

If necessary, in order to produce a pavement of the required cross-section and meeting the surface requirements, equip the slip-form paver with traveling side forms of sufficient dimension and strength and of proper shape to support the concrete laterally for a sufficient length of time during placing and finishing.

If using trailing forms, provide forms that are rigidly supported laterally.

Equip the slip-form paver with automatic guidance and grade controls which operate by sensing from a taut line set true to line and grade. Erect and maintain the taut line.

Automatic grade controls are not required on the paver when the tracks of the slip-form paver are operating on previously placed concrete pavement. The Engineer may waive the use of automatic grade controls on the paver when the entire width of the tracks of the slip-form paver are operating on a subgrade which has been consistently trimmed to a tolerance of 1/8 inch [3 mm] above or below true grade as established by the taut line set for that purpose.

350-3.3 Vibratory Units: Consolidate the concrete for the full width of the strip being placed with either surface pan type or internal type vibrators. Use a vibration method with sufficient intensity and duration to ensure complete consolidation of the concrete without causing segregation of the materials.

For the surface vibrators, use a frequency of not less than 3,500 impulses per minute. For internal type vibrators, use 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 using spud-type internal vibrators adjacent to forms, either hand-operated or attached to spreaders or finishing machines, use a frequency of not less than 3,500 impulses per minute. Measure the

frequency of internal vibrators in plastic concrete. Mount spud vibrators such that the free tip trails, and space spud vibrators at a maximum interval of 30 inches [0.75 m].

Provide an amplitude of vibration with spud vibrators that is sufficient for the vibration to be perceptible on the surface of the concrete along the entire width of the strip being placed. Furnish a device for measuring and indicating the actual frequency of vibrations. Control all vibration by the forward movement of the spreader or finishing machine so that vibration automatically ceases when stopping the forward movement of the spreader.

350-3.4 Device for Application of Membrane Curing Compound: Provide equipment for applying membrane curing compound that is self-propelled and capable of uniformly applying the curing compound at the specified rate. Use equipment that continuously stirs the curing compound, by effective mechanical means, and that thoroughly atomizes the curing compound during the spraying operation so that the finished surface of the fresh concrete will not be marred. Cover the entire surface of the pavement and, with slip-form type paving, the vertical faces by a single pass of the machine. Only use spray nozzles that are equipped with appropriate wind guards to ensure uniform application.

Power-spray equipment may be used to apply curing compound to areas where it is impracticable to operate the self-propelled equipment.

350-3.5 Equipment for Paving Small or Narrow Areas: For variable width areas, other than mainline, ramps, and shoulders, the Engineer will not require the full paving train as specified for the standard run of paving. Use such equipment that is approved by the Engineer.

350-3.6 Hand Finishing Tools: Provide straightedges that have a blade length of 10 feet [3 m]. Use long-handled floats that have flat blades, approximately 4 feet [1.2 m] long by 5 to 8 inches [125 to 200 mm] wide, and that are designed so as to remain straight and true. Use a handle for both types of tool with a length that exceeds 1/2 the width of the strip being placed by 3 feet [1 m].

350-4 Subgrade Preparation.

Keep construction of the subgrade completed for a distance of at least 500 feet [150 m] ahead of the paving operation. Maintain the finished subgrade in a smooth, compact condition, and restore any areas which are disturbed prior to placing the concrete. Do not place concrete on a frozen subgrade.

Ensure that the subgrade is within 2 percent of the optimum moisture content while placing the concrete. Uniformly apply water ahead of the paving operations, as directed by the Engineer.

Do not allow vehicles to travel on the prepared subgrade between the subgrade trimming machine and the paving operations unless specifically authorized.

Accurately trim the subgrade to the required elevation. Trim high areas to proper elevation. Fill low areas with suitable material, compacted to the specified density, or with concrete placed integrally with the pavement. When slip-form paving, include in the width to be trimmed the areas on which the tracks of the paver will operate.

Remove material planed from the subgrade before placing any concrete. The Engineer may waive the use of the planer for small or isolated areas or any areas where its use would be impracticable.

350-5 Setting Forms.

350-5.1 General: Accurately set the forms to line and grade and such that they rest firmly, throughout their entire length, upon the subgrade surface. Join forms neatly and tightly, and brace them to resist the pressure of the equipment operating on the forms. Obtain the Engineer's approval of the alignment and grade of all forms before and immediately prior to the placing of concrete.

Fill any subgrade that is below the established grade at the form line to grade with granular material, in lifts of 1/2 inch [13 mm] or less, for a distance of 18 inches [0.5 m] on each side of the pavement edge, and thoroughly compact the material. As an exception, when placing forms on a cement-treated subgrade, the Contractor may use wedging, provided that the wedging system used adequately supports the forms without causing detrimental deflection under the weight of the paving equipment.

350-5.2 Tamping: When placing forms on other than a cement-treated subgrade, adequately tamp the materials below and adjacent to the forms with form-tamping machines.

350-5.3 Advance Preparation of Forms: Keep sufficient forms on hand at all times, and set forms so that at least 500 feet [150 m] of forms on each side of the roadway will be accurately set, and maintained true to line and grade, in advance of the point where concrete is being placed. Provide sufficient forms so that it is not necessary to remove them in less than 12 hours after placing the concrete.

350-5.4 Cleaning and Oiling Forms: Thoroughly clean and oil the forms after each use and before placing concrete against them.

350-6 Protection from Weather.

Inclement weather may include, but is not limited to, periods when the air temperature may fall below 35ºF [1ºC], periods when the air temperature may rise above 85ºF [29ºC], high winds, heavy rains and other conditions that might affect the final durability of the pavement. When rain appears imminent, stop all paving operations, and cover the surface of the unhardened concrete with the protective covering.

350-7 Placement of Reinforcement.

350-7.1 General: Where the plans call for reinforced concrete pavement, place the steel reinforcement in the pavement slab in accordance with the details shown in the plans. At the time of the concrete placement, ensure that the reinforcing steel is free from any of the following which could impair bonding of the steel with the concrete: dirt, oil, paint, grease, mill scale, and any loose or thick rust. Place the reinforcement as provided below.

350-7.2 Fabric: Place fabric reinforcement at right angles to the centerline of the pavement and accurately to the position and location shown in the plans. Lap adjacent sheets of fabric not less than 6 inches [150 mm]. Make the laps only in the longitudinal members.

350-7.3 Bars: Place bar reinforcement as shown in the plans. Securely wire together transverse and longitudinal bars at their intersections. Lap splices not less than 20 times the nominal diameter of the bar, and only in the longitudinal members.

350-8 Placing Concrete.

350-8.1 Distribution: Distribute the concrete on the subgrade to such depth that, when it is consolidated and finished, the slab thickness required by the plans will be obtained at all

points. The surface will at no point be below the grade specified for the finished surface. Place the concrete on the subgrade in a manner which will require as little rehandling as possible.

Place concrete as near to expansion and contraction joint assemblies as possible without disturbing them. Ensure that workers do not walk in the freshly placed concrete with their boots or shoes coated with earth or other deleterious substances.

350-8.2 Use of Spreader: Place concrete on the subgrade by an approved spreading device. Do not place concrete from the discharge bucket or hopper onto an assembly without centering the bucket or hopper directly over the assembly.

A spreader is not required in areas where the width of slab varies, intersections, and small or isolated areas where it would be impractical to use a spreader. Perform the necessary hand spreading with shovels (not with rakes or hoes).

350-8.3 Placement Widths: The Contractor may construct the pavement either in lanes as determined by the longitudinal joints shown in the plans, or for the full width in one operation. Construct the pavement to the full width of the lane or slab in a single construction operation. When constructing pavement in separate lanes, do not deviate the junction line from the true line shown on the plans by more than 1/2 inch [13 mm] at any point. Tool the edges of the junction to the radius shown in the plans.

When constructing pavement in separate lanes, place the lanes adjacent to the low edge of the pavement, as shown on the typical section, first.

350-8.4 Consolidation Along Forms and Joints: Thoroughly consolidate concrete against and along the faces of all forms, and along the full length on both sides of all joint assemblies, by means of hand-operated, spud-type vibrators. Do not allow vibrators to come in contact with a joint assembly, reinforcement, the subgrade or a side form.

350-8.5 Slip-Form Paver: When placing concrete with a slip-form paver, operate the paver with a continuous forward movement. If for any reason it is necessary to stop the forward movement of the paver, immediately stop operation of the vibrating or tamping elements. Do not apply tractive force to the paving machine except that which is controlled from the machine.

In case of an emergency, have available for use at the project site at least 100 feet [30 m] of forms.

Do not insert steel tie-bars into the unsupported side of the freshly formed slab. The Contractor may place tie-bars into position prior to extrusion from the paver by insertion through the forms, by insertion through a temporary support form placed against the form slab, or by other means approved by the Engineer. Use a method that results in placement of the tie-bars at the specified locations with no damage or disruption of the concrete.

350-9 Striking-off, Consolidating, and Finishing Concrete.

350-9.1 General Requirements: Immediately after placing the concrete, strike-off, consolidate, and finish it to produce a finished pavement in accordance with the cross-section, width, and surface finish required by the Contract Documents. Perform the sequence of operations as follows: strike-off; vibratory consolidation; screeding; floating; removal of laitance; straightedging; and final surface finish. Except as specified, perform strike-off, consolidation, screeding, and floating by the machine method.

Use equipment that is fully and accurately adjustable to produce a pavement meeting project requirements. Use equipment that is capable of operating in a consistent and smooth manner under all conditions of use.

Provide a concrete surface true to grade and crown, and free of irregularities. If the Engineer permits adding water to assist the finishing operations, apply water as a fog spray by means of approved spray equipment.

As soon as possible after screeding while the concrete is plastic, correct all flaws such as cavities, blemishes, marks, or scratches that will not be removed by planing. Apply moisture to the concrete surface only if required and only in the immediate vicinity of the irregularity. The quantity of moisture applied should not exceed what is needed to facilitate correction of the irregularity.

350-9.2 Machine Method: Operate the machine over each area of pavement as few times and at such intervals as is necessary to give proper consolidation and to leave a surface of uniform texture. Avoid excessive operation over a particular area.

Perform strike-off, consolidation, and finishing in a manner such as to avoid damage to, or misalignment of, joint assemblies, reinforcing steel, dowels, and other embedded items. Smooth the surface of the concrete and remove the excess mortar from the surface. Carry a small amount of mortar ahead of the float device as it moves on the surface of the concrete. Operate the machine over the surface of the concrete as many times as required to obtain an acceptable surface, meeting the requirements specified herein. Discard excess mortar beyond the edge of the slab.

350-9.3 Hand Methods:

350-9.3.1 Conditions under which Allowed: Use hand methods in areas of narrow width or irregular dimensions, where operation of mechanical equipment is impracticable.

350-9.3.2 Strike-off and Screeding: Use a portable screed of an approved design, constructed either of metal or of other suitable material shod with metal, to strike-off and screed the concrete. Use a screed that is sufficiently rigid to retain its shape and is at least 2 feet [0.6 m] longer than the maximum width of the strip to be screeded.

350-9.3.3 Consolidation: Use hand-operated spud-type vibrators to consolidate.

350-9.3.4 Floating: Use long-handled floats to float the concrete. Take the necessary care to avoid creating depressions or ridges during this operation.

350-9.4 Work Bridges: Provide work bridges or other devices necessary for access to the pavement surface for the purpose of inspection, finishing, straightedging, and performing corrective work.

350-10 Final Finish.

350-10.1 Finishing: As the water sheen disappears from the surface of the pavement and just before the concrete achieves its initial set, drag a seamless length of damp burlap that extends the full width of the strip of the constructed pavement, longitudinally along the surface to produce a uniform gritty texture.

Use a burlap drag that consists of two layers of medium weight burlap with the trailing edge of the lower layer extending approximately 2 inches [50 mm] behind the upper layer. Support the burlap drag in a manner so that a length of at least 3 feet [1 m] of burlap is in contact with the pavement.

Except in areas where using hand methods to construct the pavement, support the lead end of the burlap drag by a traveling bridge. Maintain the drag clean and free from encrusted mortar. Replace the burlap with new material as necessary.

350-10.2 Edging: After applying the final finish, but before the concrete has become nonplastic, carefully round the edges to a 1/4 inch [6 mm] radius on each side of transverse expansion joints and construction joints and along any structure extending into the pavement. Produce a well-defined and continuous radius, and obtain a smooth, dense mortar finish. Completely remove all concrete from the top of the joint filler.

Check all joints with a straightedge before the concrete has become nonplastic, and, if one side of the joint is higher than the other or the entire joint is higher or lower than the adjacent slabs, make corrections as necessary.

350-11 Curing.

350-11.1 General: After completing the finishing operations and as soon as the concrete has hardened sufficiently to not mar the surface, cover and cure the entire surface and, when the slip-form method is used, cover and cure the edges of the newly placed concrete in accordance with one or more of the methods described below. In cases where curing requires the use of water, ensure that curing has prior right to use all water supplies. If the Contractor fails to provide sufficient curing materials to adequately cure the concrete in place in a timely manner, that portion of the concrete pavement section addressed in the QCP will be suspended. Do not leave the concrete exposed for a period in excess of 30 minutes between stages of curing or during the curing period.

Continuously cure the freshly placed concrete for a period of 72 hours, exclusive of any periods when the temperature of the surface of the concrete falls below 50ºF [10ºC].

350-11.2 White-Pigmented Curing Compound: Under this method, uniformly apply white-pigmented curing compound to the surfaces to be cured, in a single coat, continuous film, at the minimum rate of 1 gallon to every 200 ft^2 [1 liter to every 5 m^2], by a mechanical sprayer.

At the time of use, thoroughly mix the compound in accordance with the manufacturer's recommendation.

Do not apply curing compound during periods of rainfall. Do not apply curing compound to the inside faces of joints to be sealed. Should the film become damaged from any cause within the required curing period, repair the damaged portions immediately with additional compound. If using side forms, upon their removal, immediately coat the sides of the slabs exposed to provide a curing treatment equal to that provided for the surface.

350-11.3 Burlap Mats: Thoroughly saturate the mats with water before placing them. Use mats of such dimensions that as laid they extend to at least 2 feet [0.6 m] beyond the edges of the strip of concrete placed. Place and weigh down the mats throughout the curing period to ensure contact with the surface being cured. Maintain the mats fully moist and in position for the entire portion of the required curing period.

350-11.4 Removal of Forms: Do not remove forms from freshly placed concrete for at least 12 hours after placement. Remove forms carefully so as to avoid damage to the pavement. After removing the forms, immediately cure the sides of the slab in the same manner as the surface of the pavement.

350-12 Joints.

350-12.1 General: Construct joints at the locations and in accordance with the details shown in the Design Standards, Index Nos. 305 and 306 and the Contract Documents.

350-12.2 Longitudinal Joints:

350-12.2.1 Longitudinal Construction Joints: Where the pavement is poured in strips less than the full width of the pavement, construct longitudinal construction joints in accordance with the details shown in the plans.

350-12.2.2 Longitudinal Lane-tie Joints: Construct longitudinal lane-tie joints within the limits of a strip of pavement, in accordance with the details shown in the plans. Construct the plane of weakness by sawing a groove in the hardened concrete. Complete sawing as soon as possible but in no case longer than 72 hours after placing the concrete.

350-12.2.3 Tie Bars and Bolt Assemblies: Place deformed steel tie bars or tie bolt assemblies at the required depth, parallel to the finished surface, at right angles to the joint and at the uniform spacing specified or required in the plans. Place them in the plastic concrete using approved equipment, or rigidly support them on the subgrade by approved devices capable of preventing displacement prior to placing of the concrete. Do not paint or coat the bars with any material before placing them in the concrete.

If placing tie bars along a longitudinal construction joint using the method of inserting bars with a 90 degree bend in the edge of the plastic concrete and after the concrete hardens straightening these bars, use Grade 40 [Grade 300] reinforcing steel for such tie bars. Replace any bar broken while being straightened in an approved manner.

350-12.3 Transverse Joints:

350-12.3.1 Transverse Construction Joints: Construct transverse construction joints at the end of all pours and at other locations where the paving operations are stopped for as long as 30 minutes. Do not place construction joints, however, within 10 feet [3 m] of any other transverse joint or within 10 feet [3 m] of either end of a section of pavement. If sufficient concrete has not been placed to form a slab at least 10 feet [3 m] long, remove the excess concrete, back to the last preceding joint. Form the joints by placing a wood or metal bulkhead accurately and securely in place, in a plane perpendicular to the profile and centerline of the pavement. Install dowel bars at the construction joints. Saw or form construction joints, in a manner similar to contraction joints, so that a groove will be formed for holding the joint sealing compound.

350-12.3.2 Transverse Contraction Joints: Construct transverse contraction joints at the interval indicated in the plans consisting of planes of weakness created by sawing a groove in the surface of the hardened concrete. Place the groove perpendicular to the surface of the pavement. Install load transfer devices in transverse contraction joints.

Ensure that the sawing equipment does not damage the pavement, and saw the transverse contraction joints as soon as the pavement has hardened to the degree that tearing and raveling are not excessive and before uncontrolled shrinkage cracking begins.

Accomplish the joint sawing in two steps. Make the initial cut 1/8 inch [3 mm] wide by a depth at least 1/3 of the pavement thickness and as soon as possible but in no case longer than 12 hours after placing the concrete. Make a second saw cut, to provide the joint dimensions indicated in the plans, just prior to sealing the load transfer device.

In cases where a strip of pavement is being placed immediately adjacent to a previously constructed strip of pavement, construct transverse contraction joints using extreme care to time sawing so as to prevent uncontrolled cracks.

Repair any uncontrolled cracks at no expense to the Department by removing and replacing the pavement across the full width of all affected lanes or shoulders and to the nearest transverse joint in each direction.

After the final sawing, clean the joint, install the bond breaker, and seal the joint.

350-12.3.3 Transverse Expansion Joints: Form transverse expansion joints using preformed joint filler, and provide them with dowel load transfer, in accordance with the details shown on the Design Standards, or in the plans.

Form the joints during the placing of the concrete, by securely staking a metal bulkhead accurately in place at the joint location or by other methods which will securely brace and support the joint filler. Where using approved devices to keep the expansion joint filler and dowels securely in place, the Engineer will not require a bulkhead. Protect all transverse expansion joints at the bottom and side edges by a sheet metal strip as specified in 931-2.1 and as shown in the Contract Documents.

Cut the filler to the crown and shape of the slab cross-section and extended it to the subgrade. After installation, ensure that the top is not less than 1 inch [25 mm], and not more than 1.25 inches [30 mm], below the finished surface. Furnish the joint filler in lengths not less than the lane widths being poured, except that the Engineer will not require lengths greater than 12 feet [3.5 m]. Where more than one section is allowed and used in a joint, securely lace or clip the sections together.

Place the filler normal to the pavement surface. Stake the assembly into position in such a way as to hold the assembly securely in position throughout construction. Ensure that the assembly is true to the line prescribed, subject to a tolerance of 1/4 inch [6 mm] in the width of the slab. Obtain the Engineer's approval of the assembly and its installation before placing any concrete against it. Obtain the Engineer's approval of the cross-section and length of the stakes.

When laying the pavement in partial width slabs, place transverse joints in the succeeding slab in line with the like joints in the first slab. In the case of widening existing pavement, place transverse joints in line with like joints in the existing pavement or as otherwise shown in the plans.

350-12.4 Load-Transfer Devices: Provide dowel load-transfer devices in all transverse joints. Firmly hold dowel bars in a position parallel to the surface and the centerline of the slab, by approved steel supports and spacers of a type shown in the plans. The Engineer may approve the use of dowel bar supports or assemblies other than those specifically detailed in the plans. Allow the dowels to be free to move in one slab as the concrete contracts and expands. Paint each dowel with one coat of approved zinc rich paint (listed on the Qualified Products List), and grease one end with an approved lubricant, to prevent the concrete from bonding to the dowel. Provide a cap for the free end of expansion joint dowels.

Position each dowel such that its final deviation from parallel to the surface of the pavement and parallel to the longitudinal centerline of the pavement does not exceed 1/2 inch [13 mm]. Position each dowel such that its final deviation from being centered on the joint does not exceed 2 inches [50 mm]. Position each dowel such that at no point in its length does it deviate from the surface of the pavement as shown in the plans in excess of 1 inch [25 mm]. Confirm the position of dowel bars by suitable means acceptable to the Engineer, which may include non-destructive testing methods.

350-12.5 Expansion Joints Around Structures:

350-12.5.1 Expansion Joints at Manholes, Meter Boxes and other Projections: Form expansion joints by placing premolded expansion joint material about all

structures and features projecting through, into or against the pavement. Ensure that such joints are 1/2 inch [13 mm] in width.

350-12.5.2 Bridge Approach Expansion Joints: Construct in accordance with Design Standards, Index No. 306.

350-12.6 Cleaning Joints and Cracks:

350-12.6.1 Cleaning Joints in New Pavement:

350-12.6.1.1 Sawed Joints: Immediately after sawing the joints which require sealing, completely remove the resulting slurry from the joint and the immediate area by flushing with a jet of water under pressure and by using other tools as necessary.

After flushing, blow out the joints with compressed air. After the flushed joints have dried, sandblast the joint faces to thoroughly remove all foreign material. Perform sandblasting in two passes, once for each face.

Patch all spalled edges with an epoxy compound.

Immediately prior to joint seal installation, clean the joints using compressed air to remove all traces of debris and dust within and on the joint surfaces.

350-12.6.1.2 Non-Sawed Joints: Thoroughly clean joints which require sealing of all foreign material for the full depth of the seal installation.

With the exception of slurry removal due to sawing, meet the cleaning requirements as specified for sawed joints.

350-12.6.2 Cleaning Joints in Existing Pavement: Remove all existing joint-sealing material and foreign material for the full depth of the new joint seal by sawing, wire brushing, sandblasting, or other methods approved by the Engineer.

Remove any existing sealant or parting strip material below the tape or backer rod bond breaker and replace it with additional bond breaker. When conditions require removal and replacement with additional bond breaker below the new joint seal, obtain the Engineer's approval of the type of bond breaker and its installation procedure. Perform cleaning by any method or combination of methods, as detailed in the plans.

Flush the joint with a pressurized jet of water, and use other tools as necessary, to remove loose remnants and debris.

After flushing, blow out the joints with compressed air. After the flushed joints have dried, sandblast the joint faces to thoroughly remove all foreign material. Perform sandblasting in two passes, once for each face.

Patch all spalled edges with an epoxy compound.

Immediately prior to joint seal installation, clean the joints using compressed air to remove all traces of debris and dust within and on the joint surfaces.

350-12.6.3 Cleaning Random Cracks in Existing Pavement: Do not begin cleaning random cracks in existing pavement until all other concrete pavement repairs have progressed to the point where those operations will not adversely affect the installation of the new seal.

Cut the random cracks to be repaired and sealed into grooved joints to the depth and width detailed in the plans. Clean the joints as specified in 350-12.6.2.

350-12.7 Sealing Joints and Cracks: Seal joints in new pavement before allowing any traffic or construction equipment on the pavement. Complete sealing within 72 hours (weather permitting) of sawing. If traffic is going to be on the pavement prior to any grinding, then seal the joints with a temporary material acceptable to the Engineer.

When using silicone and non-silicone sealants in the transverse and longitudinal joints, respectively, always use the silicone sealants first to prevent contamination at the intersection of the joint faces. Remove non-silicone sealant 1 foot [300 mm] in each direction from the transverse joints, and replace it with silicone sealant.

Use equipment equipped with nozzles that discharge the sealant at the bottom of the groove. Ensure that the apparatus develops sufficient pressure to extrude the joint sealer from the nozzles satisfactorily and to control the rate of application so as to completely fill the joint to within 1/4 inch [6 mm] of the surface of the pavement without spillage. Use an apparatus so constructed that it maintains the proper temperature of the sealing material within the manufacturer's recommendation.

350-12.7.1 Hot-Poured Type Sealant: When the plans require hot poured sealant for specific joints, fill the joint thoroughly, without trapping air, ensuring the sealant is recessed below the pavement surface as required, and control the pouring rate to avoid spilling of sealant onto the adjacent pavement surface. If any spilling of sealant occurs, immediately remove and clean the entire surplus amount from the pavement surface. Place poured material when the ambient air temperature is 50ºF [10ºC] or greater.

Use an indirect heating or double boiler type heating kettle that uses oil as a heat transfer medium, for hot poured sealer. Use a heating kettle that has a thermostatically controlled heat source, a built-in automatic agitator, and thermometers installed to indicate both the temperature of the melted sealing material and that of the oil bath.

350-12.7.2 Low Modulus Silicone Sealant: Use low modulus silicone sealant of either Type A (non-self-leveling silicone sealant), or Type B and/or Type C (self-leveling silicone sealant). Because Type A will not flow into the proper shape under its own weight, install and tool it so that the sealant is in firm contact with the joint faces and is formed into the appropriate shape as specified. Types B and C will normally flow into the proper shape without tooling. Exercise care to provide the required depth of recess above the sealant surface and below the pavement surface. Install the silicone sealant at temperatures above 40ºF [5ºC].

350-13 Surface Requirements.

Produce, by grinding in accordance with 352, a pavement surface that is true to grade and uniform in appearance with a longitudinal line type texture.

350-14 Thickness Determinations.

350-14.1 General: After completing the concrete pavement, including any corrective work to meet ride requirement, determine the thickness by one of following methods. The Engineer will select the locations for testing and make the determination of thickness. Sample locations will be taken at various points on the cross-section so that each test represents an area not exceeding 2,500 yd^2 [2,000 m^2]. Provide traffic control, non-destructive equipment, coring equipment, and operator to obtain the samples.

350-14.1.1 Core Borings: To determine the actual thickness, drill cores from the pavement and measure thickness in accordance with ASTM C 174. Replace the portions of the pavement removed by the borings at no expense to the Department.

350-14.1.2 Non-destructive Testing: For a determination using the impact-echo method, measure the thickness of the pavement in accordance with ASTM C 1383. The initial thickness measurement will be validated by having a core boring taken at that location in compliance with 350-14.1.1. If the results from the impact-echo test vary by ± 0.15 inches from

the core boring, then the non-destructive test method can not be used on the pavement. In such case, the core boring will be used for acceptance of that LOT. The Engineer has the option to verify the accuracy of the results at any time.

350-14.2 Method of Calculating Average Thickness: The Department will determine the average thickness of the pavement by using the following method of calculation:

(a) The Department will not take into account in the calculation, any areas of pavement which are left in place, but for which no payment will be made.

(b) When the thickness of the pavement is more than 1/2 inch [13 mm] greater than the specified thickness, the Department will consider it in the calculation as the specified thickness plus 1/2 inch [13 mm].

(c) The Department will calculate the average thickness for the entire job as a unit.

350-15 Deficient Thickness.

350-15.1 General: The Department will not pay for any pavement which is more than 1/2 inch [13 mm] less than the specified thickness. Any deficient pavement will be just cause for that portion of the concrete pavement addressed in the quality control plan to be suspended until the corrections are to the satisfaction of the Engineer. When the pavement contains no longitudinal construction joint, the Department will not pay for the area of such pavement that is the product of the full width of the strip placed as a unit times the sum of the distances each way from the short core or cores to the cores on each side which show measurements within the tolerance limits. When the pavement contains longitudinal construction joints, for the width, the Department will use the width between longitudinal construction joint and the edge of pavement.

350-15.2 Deficient Pavement Requiring Removal: The Engineer will evaluate areas of pavement found deficient in thickness by more than 1/2 inch [13 mm] and if, in his judgment, the deficiency is enough to seriously impair the anticipated service life of the pavement, remove such areas and replace them with concrete of the thickness shown in the plans. The Department will not pay for the area of pavement removed or for the materials or labor involved in its removal. When removing a section of pavement, remove the full length between transverse joints.

350-15.3 Deficient Pavement Left in Place: If the Engineer determines that the deficiency will not seriously impair the anticipated service life of the pavement, the pavement may be left in place, at no compensation.

350-15.4 Additional Borings: If the number of cores taken is not sufficient to indicate the thickness of the pavement, additional boring locations may be requested, with prior approval from the Engineer at no additional cost to the Department.

350-16 Opening Pavement to Traffic.

Construct an earth berm along each edge of the pavement within 36 hours of finishing any newly placed concrete pavement. Build the berm to the full height of the pavement and at least 18 inches [0.5 m] wide, and sufficiently compacted to prevent underwash of the pavement. Maintain the berm until the final shoulders are complete.

Except as provided below, keep the pavement closed to traffic for a minimum period (exclusive of days when surface temperature of the concrete falls below 50ºF [10ºC]) of 14 calendar days after placement of the concrete. As an exception to the above, when Type III cement is used, the Engineer will reduce this minimum required period to 48 hours. The

Engineer may permit opening of a section of pavement to traffic at an earlier time provided that representative test beams, made in accordance with ASTM C 31 and tested in accordance with ASTM C 78, indicate a flexural strength of at least 550 psi [3.75 MPa]. Cure these test beams in a manner identical to the corresponding section of pavement.

Protect the pavement from all traffic, including construction operations, until the specified period of time has elapsed in accordance with the current edition of the Design Standards.

350-17 Method of Measurement.

350-17.1 Concrete Pavement: The quantities to be paid for will be the plan quantity, in square yards [square meters], of Plain Cement Concrete Pavement and of Reinforced Cement Concrete Pavement, omitting any areas not allowed for payment under the provisions of 350-15.3 and adjusted for average thickness as provided herein.

For purposes of payment, the average thickness of pavement will determine the final pay quantities for this pavement as follows:

The area of pavement represented by the difference between the calculated average thickness and the specified thickness will be converted into equivalent square yards [square meters] of specified thickness pavement, and the quantity thereby obtained will be added to, or deducted from, the quantity of pavement to be paid for, subject to the limitation that the maximum average of over-thickness permitted in the adjustment of the quantity of pavement to be paid for will be 1/4 inch [6 mm].

Where the plans call for cement concrete pavement that is to be covered with asphalt concrete surface course, payment will be made for the total thickness of the combination as Plain Cement Concrete Pavement.

In such cases, price and payment will also include all costs of the asphalt concrete surface course constructed in accordance with Section 334. Reinforcing steel, placed and accepted, will be measured and paid for as provided in Section 415.

350-17.2 Joints and Cracks: Include the cost for Cleaning and Sealing Joints in the cost of the newly constructed pavement for: (1) transverse and longitudinal joint construction for new pavement; and (2) abutting joints between existing pavement and new pavement.

For replacing joint seals and sealing random cracks in existing portland cement concrete pavement, the quantity to be paid for will be as specified below:

(a) The length of pavement joint satisfactorily cleaned and sealed in existing portland cement concrete pavement, as determined by field measurement along the joints, will be paid for at the Contract unit price per foot [per meter] for Cleaning and Resealing Joints.

(b) The length of random cracks in existing portland cement concrete pavement that have been satisfactorily cut, cleaned, and sealed, as determined by field measurement along the joints, will be paid for at the Contract unit price per foot [per meter] for Cleaning and Sealing Random Cracks.

350-17.3 Bridge Approach Expansion Joint: The quantity to be paid for will be plan quantity, in feet [meters]of bridge approach expansion joint installed in accordance with Design Standards, Index No. 306, calculated across the pavement at right angles to the centerline of the roadway pavement, completed and accepted.

350-18 Basis of Payment.

Prices and payments will be full compensation for all work specified in this Section, including any preparation of the subgrade not included in the work to be paid for under another Contract item; all transverse and longitudinal joint construction, including tie-bars and dowel bars; the furnishing of test specimens; repair of core holes; and all incidentals necessary to complete the work.

Payment will be made under:

Item No. 350- 1-	Plain Cement Concrete Pavement - per square yard.
Item No. 2350- 1-	Plain Cement Concrete Pavement - per square meter.
Item No. 350- 2-	Reinforced Cement Concrete Pavement - per square yard.
Item No. 2350- 2-	Reinforced Cement Concrete Pavement - per square meter.
Item No. 350- 72-	Cleaning and Resealing Joints - per foot.
Item No. 2350- 72-	Cleaning and Resealing Joints - per meter.
Item No. 350- 78-	Cleaning and Sealing Random Cracks - per foot.
Item No. 2350- 78-	Cleaning and Sealing Random Cracks - per meter.
Item No. 370- 1-	Bridge Approach Expansion Joint - per foot.
Item No. 2370- 1-	Bridge Approach Expansion Joint - per meter.