WORKBOOK CHANGE(S)

Add D 3500000 SS
Rev Date 2-3-04
F.A. Date 2-4-04
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Federal Highway Administration
Florida Division
227 N. Bronough Street, Room 2015
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SPECIFICATIONS

To:	Organization:	Date:	Routing Symbol:
MR. DUANE BRAUTIGAM	FDOT, SPECIFICATIONS ENGINEER	Feb. 04, 2004	MS-75

- ☐ Per Your Request
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Remarks:

FLORIDA SPECIFICATIONS:

D0020000 - Supplemental Specification for Proposal Requirements and Conditions, Section 2.

D0070001.D02, for Laws to be Observed, Section 7.

D0080D16.D01, for "Bonus" Payment and Waiver of Contractor Claims, Section 8.

D3500000.D04, for Cement Concrete Pavement, Section 350.

D3520000.D03, for Grinding Concrete Pavement, Section 352.

D3530000.D03, for Concrete Pavement Slab Replacement, Section 353.

D9480044, for Pipe Liner-Machine Spiral Wound Pipe Liner, Section 948.

ATTACHMENTS

From:	Telephone Number:	FDOT MS:	Org/Rtg Symbol
By Ann Allshouse FOR: JAMES E. ST. JOHN, DIVISION ADMINISTRATOR	(850) 942-9650, EXT. 3034	# 29	

DON Davis: ANN to file in binders cc: 1 (w/specification)

Florida Department of Transportation

JEB BUSH
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JOSÉ ABREU
SECRETARY

February 3, 2004

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: D3500000.D04

Dear Mr. Davis:

We are resubmitting, for your approval, two copies of a proposed Supplemental Specification for Cement Concrete Pavement. This version incorporates the changes which you requested.

This change was proposed by Charles Ishee of the State Materials Office to bring the specification more in agreement with the Contractor Quality Control guidelines.

Please review and transmit your comments, if any as soon as possible so that we may include this in the July 2004 Workbook. 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/jf
Attachment
cc: General Counsel
Florida Transportation Builders' Assoc.
State Construction Engineer

350 CEMENT CONCRETE PAVEMENT.
(REV 2-3-04) (FA 00-00-00) (7-04)

SECTION 350 (Pages 304-322) 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 slab 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.

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Deleted: For aggregates, proportioning and mixing, and other provisions for the production of the concrete, meet the applicable provisions of Section 346.¶ Provide adequate lighting for all work done at night, including finishing, curing, and sawing joints. Unless lighting is provided for finishing, stop construction operations soon enough each day to permit finishing during daylight.
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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.

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Deleted: . **350-3.2 Equipment For Trimming of Subgrade:** For equipment operating on the subgrade, provide an automatically controlled subgrade trimmer. Use a machine that is capable of trimming the subgrade to proper elevation within the tolerances established herein. Provide grade controls that operate by sensing from a taut line, set true to line and grade. Erect and maintain the taut line.¶
350-3.3 Forms:¶
350-3.3.1 Form Material: Provide steel forms, except that on curves with a radius of 45 m or less, provide flexible forms, or wooden forms that bend to the required arc.¶
. . **350-3.3.2 Dimensions:** Use forms with a minimum length of 10 feet [3 m], except wherethey are used on curves having a radius between 150 and 300 feet [45 and 90 m], in which case use a form length of 5 feet [1.5 m]. Use forms with a height that is equal to the edge thickness of the pavement. Use forms with a height greater than the edge thickness, provided the outer portion of the slab is thickened to equal the depth of the form by tapering at the rate of 1 inch of the extra thickness per foot [80 mm of the extra thickness per meter] of width. In such case, the Department will make no allowance for additional concrete. Do not use built-up forms.¶
. **350-3.3.3 Steel Forms:** Use steel forms fabricated into an approved sectio... [3]

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. **350-3.8 Mechanical Floating Equipment:** Provide equipment that ... [5]

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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 35°F [1°C], periods when the air temperature may rise above 85°F [29°C], 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.

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. 350-3.10 **Equipment for Sealing Joints:** Provide equipment for sealing the joints for each section of pavement. Use a heating kettle for hot-poured sealer that is of the indirect heating or double-boiler type, using oil as a heat transfer medium. 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. Use pouring equipment equipped with nozzles that discharge the seal 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 for pouring, within 10°F [5°C]manufacturer's .
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Deleted: . 350-3.13 7 **Texturing Machine:** Provide a machine that consists of a supplementary machine capable of applying the final finish to the concrete pavement. Apply the finish by rectangular shaped spring steel tines rigidly mounted in a frame operating on an adjustable track mounted under the main frame of the machine. Use a machine that is constructed so as to provide for adjustment of the downward pressure on the tines as necessary fo... [6]
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. During periods when the air temperature may fall below 35°F [1°C] [8]
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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.

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Secure the reinforcement in position in advance of concrete placement or, with the Engineer's specific approval, place it in the plastic concrete by mechanical or vibratory means after spreading the concrete.

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. **350-8.4 Hours of Operation:** Stop placing concrete in time to complete... [9]

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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

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. . . In operation, move the screed forward on the forms with a combined longitudinal and transverse shearing motion, moving always in the direction in which the work is progressing, and manipulate it so that neither end is raised from the side forms during the striking-off process. If necessary, repeat this until the surface is of uniform texture, true to grade and cross-section, and free from porous areas.
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. In areas where performing machine strike-off, consolidation, and finishing, further 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. Waste excess mortar beyond the edge of the slab.
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. . After applying the burlap drag finish [1]
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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 50°F [10°C].

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. 305 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

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. After curing, remove the curing material (except for the impervious coating), and thoroughly test the surface for pavement surface smoothness in accordance with 352-4(c). Plainly mark all variations from the required tolerances. Where pavement surfaces do not meet the smoothness requirements, the Engineer will require corrective work and retesting to ensure conformity.¶
. Eliminate high spots exceeding 1/8 inch in 10 feet [3.2 mm in 3 m], but not in excess of 0.3 inch in 25 feet [7.6 mm in 7.6 m], by grinding either with an approved machine or with a carborundum brick and water. Do not use bush-hammering or other destructive means for removing irregularities. As directed by the Engineer, retexture corrected high areas to give skid resistance comparable to the surrounding area.¶
. Provide grinding equipment with a power driven self-propelled machine that is specifically designed to grind portland cement concrete pavement, with a ... [17]

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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

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. . . 350-15.2.4 Longitudinal Shoulder Joints (Concrete to Asphalt): Construct a continuous joint by sawing a groove into the asphalt pavement at the abutment with the concrete pavement. Produce a groove that is 3/4 inch [19 mm] wide and 3/4 inch [19 mm] deep, after sawing and cleaning.¶
. . . Seal the joint with hot-poured type sealant.

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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: 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.

350-12.6 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.

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Deleted: The Contractor shall confirm that the paving operation has not displaced the dowels from their required positions. Perform confirmation checks daily for the first two days of the paving operation and weekly thereafter.

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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 50°F [10°C] 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 40°F [5°C].

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.

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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 50°F [10°C]) 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.

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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.

350-18 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.

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350 CEMENT CONCRETE PAVEMENT.
(REV 2-3-04) (FA 00-00-00) (7-04)

SECTION 350 (Pages 304-322) 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 slab 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 35°F [1°C], periods when the air temperature may rise above 85°F [29°C], 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 50°F [10°C].

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. 305 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: 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.

350-12.6 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 50°F [10°C] 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 40°F [5°C].

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 50°F [10°C]) 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.

350-18 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.

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Obtain the Engineer's approval of the equipment and tools to be used for handling materials and performing all parts of the work, as to their design, capacity, and mechanical condition. Deliver the equipment to the job site sufficiently ahead of the start of construction operations to allow the Engineer to examine it thoroughly for approval.

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

Equip all equipment which operates on the side forms with scraping devices to clean accumulations from the top of the forms and wheels.

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

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350-3.2 Equipment For Trimming of Subgrade: For equipment operating on the subgrade, provide an automatically controlled subgrade trimmer. Use a machine that is capable of trimming the subgrade to proper elevation within the tolerances established herein. Provide grade controls that operate by sensing from a taut line, set true to line and grade. Erect and maintain the taut line.

350-3.3 Forms:

350-3.3.1 Form Material: Provide steel forms, except that on curves with a radius of 45 m or less, provide flexible forms, or wooden forms that bend to the required arc.

350-3.3.2 Dimensions: Use forms with a minimum length of 10 feet [3 m], except wherethey are used on curves having a radius between 150 and 300 feet [45 and 90 m], in which case use a form length of 5 feet [1.5 m]. Use forms with a height that is equal to the edge thickness of the pavement. Use forms with a height greater than the edge thickness, provided the outer portion of the slab is thickened to equal the depth of the form by tapering at the rate of 1 inch of the extra thickness per foot [80 mm of the extra thickness per meter] of width. In such case, the Department will make no allowance for additional concrete. Do not use built-up forms.

350-3.3.3 Steel Forms: Use steel forms fabricated into an approved section and sufficiently strong to ensure rigidity under the impact, thrust, and weight of the heaviest equipment to be carried over the forms. Make the width of the base of the forms which is in direct contact with the soil at least equal to the height of the forms, but not less than 8 inches [200 mm]. Extend the flange braces outward on the base not less than two-thirds the height dimension of the form. Use steel forms of a thickness that is not less than 7/32 inch [5.5 mm]. When tested with a 10 foot [3.048 m] straightedge, ensure that the forms have no vertical variation in a 10 foot [3 m] length that is greater than 1/8 inch [3 mm] from a true plane of the surface on the top of the form, and no lateral variation that is greater than 1/4 inch [6 mm] from a true plane surface on the vertical face of the form. Do not use steel forms if, when tested as a simple beam with a span of 9 feet 6 inches [2.9 m] and a load equal to that exerted by construction equipment placed upon them, the deflection is more than 1/4 inch [6 mm].

350-3.3.4 Form Connections: Provide connections between adjacent sections of the form, that form a lock joint, free from vertical movement in excess of

1/8 inch [3 mm] and from horizontal movement in excess of 1/4 inch [6 mm], under the impact, thrust, and weight of the heaviest machine carried on the forms.

350-3.3.5 Defective Forms: Remove bent, twisted, or broken forms, and forms with battered top surfaces, from the work. Do not use repaired forms until they are inspected and approved by the Engineer.

350-3.3.6 Form Stakes: Provide at least three steel stakes for each 10 foot [3 m] length of form. Use stakes that are of sufficient size to prevent undue lateral movement of the form during paving operations. Fasten each of the stakes to the form by means of a suitable socket attached to the form. Equip each stake socket with steel wedges for securely keying the forms to the stakes. Locate a stake not more than 12 inches [300 mm] from the end of each section. Do not use forms with broken or badly worn sockets.

350-3.3.7 Form Tampers: Use adequate mechanical form tampers, capable of thoroughly compacting the soil under the forms, except when the forms rest on a cement-treated subgrade.

350-3.4 Spreader: Provide a mechanical spreader that is independently powered and capable of spreading the mixed concrete on the subgrade over the entire width and depth of the strip being paved in a manner which will prevent segregation of the materials. Use a spreader designed and constructed to permit the concrete to be struck-off to a uniform thickness.

350-3.5 Strike-Off, Consolidation, and Finishing for Fixed-Form Construction: Provide equipment for these operations that consists of a self-propelled unit, or units, that perform the following functions by mechanical means, in the sequence indicated:

(1) Strike-off.
(2) Vibratory Consolidation.
(3) Screeding.
(4) Floating.

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

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The Engineer may allow variation from any specific feature of the slip-form paver as detailed above, provided the industry has generally accepted the proposed variation as an improved feature.

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350-3.8 Mechanical Floating Equipment: Provide equipment that consists of a supplementary self-propelled machine capable of further smoothing the concrete, removing excess mortar from the surface, and minimizing hand finishing.
Use a machine that leaves the surface of the concrete 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.

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350-3.13 7 Texturing Machine: Provide a machine that consists of a supplementary machine capable of applying the final finish to the concrete pavement. Apply the finish by rectangular shaped spring steel tines rigidly mounted in a frame operating on an adjustable track mounted under the main frame of the machine. Use a machine that is constructed so as to provide for adjustment of the downward pressure on the tines as necessary to produce the desired finish under varying conditions of the concrete surface.

The Engineer may allow variation from any specific feature of the Texturing Machine as detailed above, provided that the Contractor can produce an equivalent final finish.

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Have available at the site, at all times when concrete paving operations are underway, materials for the protection of the surface and edges of the unhardened concrete. For the protection of the pavement edges, use any covering material, such as burlap, paper, or plastic sheeting material, suitable for the protection of the pavement surface.

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During periods when the air temperature may fall below 35°F [1°C], ~~advise the Engineer of~~ plans for curing and protecting the fresh concrete shall be implemented as identified in the QCP before placing the concrete. ~~Do not place any concrete until the Engineer has approved the proposed methods~~.

The Contractor is fully responsible for the quality and strength of the concrete placed in cold weather even if the Engineer approves of the provisions the Contractor employs for protecting the concrete placed during cold weather.

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The Engineer will not require the Contractor to alter placement operations where superelevation reverses the pavement cross slope from that shown on the typical section.

350-8.4 Hours of Operation: Stop placing concrete in time to complete finishing operations during daylight hours, or provide adequate ~~approved~~ lighting as identified in the QCP.

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Do not continue vibration at any one location so long as to produce puddling or the accumulation of excessive grout on the surface.

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After applying the burlap drag finish, apply the final finish with the texturing machine. Control the time of applying this finish and the method of operating the texturing machine so as to minimize tearing of surface and unseating of aggregate particles.

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Provide a final finish that consists of transverse grooves which are 0.08 to 0.12 inch [2 to 3 mm] in width and 0.10 to 0.15 inch [2.5 to 4 mm] in depth, spaced at random intervals between 1/2 to 1 inch [13 to 25 mm]. Operate the texturing machine in a

manner that minimizes the overlapping of subsequent passes of the steel comb. Create short gaps in the grooved finish as necessary to avoid overlap between passes.

In areas of irregular dimensions or narrow widths, where operating the texturing machine is impracticable, the Contractor may apply the finish by approved hand methods that achieve the required finish with a minimum of surface tearing and unseating aggregate particles. Ensure that the surface resulting from this operation is uniform in appearance and free of irregular, rough, or porous areas.

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all		
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in which		
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Engineer will order an immediate suspension of concreting operations		
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0.005 gal/ft^2		
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0.2 L/m^2		
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Under this method, cover the surfaces to be cured with burlap mats.		
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so as to cause them to remain in intimate contact with the surface being cured,		
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until it has set		
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350-14 Surface Requirements.

After curing, remove the curing material (except for the impervious coating), and thoroughly test the surface for pavement surface smoothness in accordance with 352-4(c). Plainly mark all variations from the required tolerances. Where pavement surfaces do not meet the smoothness requirements, the Engineer will require corrective work and retesting to ensure conformity.

Eliminate high spots exceeding 1/8 inch in 10 feet [3.2 mm in 3 m], but not in excess of 0.3 inch in 25 feet [7.6 mm in 7.6 m], by grinding either with an approved machine or with a carborundum brick and water. Do not use bush-hammering or other destructive means for removing irregularities. As directed by the Engineer, retexture corrected high areas to give skid resistance comparable to the surrounding area.

Provide grinding equipment with a power driven self-propelled machine that is specifically designed to grind portland cement concrete pavement, with a minimum of a 3 foot [1 m] wide grinding head and diamond impregnated grinding blades. Produce, by grinding, a pavement surface that is true to grade and uniform in appearance with a longitudinal line type texture. Provide a line type texture that contains parallel longitudinal corrugations that present a narrow ridge corduroy type appearance. Ensure that the peaks of ridges are approximately 1/32 inch [0.8 mm] higher than the bottoms of the grooves with approximately 60 evenly spaced grooves per foot [300 mm].

Operate all milling, cutting, or grinding equipment to produce a reasonably uniform finished surface without spalling the pavement joints within corrected areas. The Engineer will not require extra grinding to eliminate minor depressions in order to provide 100% texturing of the pavement surface. Maintain the cross slope of the pavement as shown in the plans. Repair all joint seals destroyed by grinding at no expense to the Department.

Remove and replace any area of pavement which, after grinding, still shows a deviation in excess of the allowable tolerance. Ensure that the area removed and replaced is the full length between transverse joints and the full width of the lane involved.

Saw the area to be removed to a smooth vertical surface. Clean the face of the adjacent (hardened) concrete, and coat it with an epoxy bonding compound before placing the replacement concrete.

Bear the costs of all surface corrections required and of all required removal and replacement of defective surface concrete.

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Roadway and Traffic

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Where keyways are required, the Contractor may form them by placing an insert of the proper shape along the inside face of the side form or, when using the slip form method of paving, by an approved extrusion device. Use a method that produces a keyway of the shape and at the location indicated in the plans.

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within

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after the concrete is three days old or less than seven days old. Before opening the pavement to traffic, construct an earth berm along each edge

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after the concrete is three days old or less than seven days old.

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Before opening the pavement to traffic, construct an earth berm along each edge. Build the berm to the full height of the pavement and at least 18 inches [0.5 m] wide, and sufficiently compact

APPROVED: ~~DATE:~~ 2-04-04

For the Division Administrator

Florida Department of Transportation

JEB BUSH
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JOSÉ ABREU
SECRETARY

January 15, 2004

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: D3500000.D04

Dear Mr. Davis:

We are resubmitting, for your approval, two copies of a proposed Supplemental Specification for Cement Concrete Pavement. This version incorporates the changes which you requested.

This change was proposed by Charles Ishee of the State Materials Office to bring the specification more in agreement with the Contractor Quality Control guidelines.

Please review and transmit your comments, if any as soon as possible so that we may include this in the July 2004 Workbook. 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/jf
Attachment
cc: General Counsel
Florida Transportation Builders' Assoc.
State Construction Engineer

350 CEMENT CONCRETE PAVEMENT.
(REV ~~5-13-03~~*09-19-03*2-3-04) *(FA 00-00-00) (7-04)*

SECTION 350 (Pages 304-322) is deleted and the following substituted:

SECTION 350
CEMENT CONCRETE PAVEMENT

350-1 Description.

Construct ~~portland~~ *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 ~~that is unacceptable to the Engineer~~, remove and replace ~~any area~~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.

~~For aggregates, proportioning and mixing, and other provisions for the production of the concrete, meet the applicable provisions of Section 346.~~

~~Provide adequate lighting for all work done at night, including finishing, curing, and sawing joints. Unless lighting is provided for finishing, stop construction operations soon enough each day to permit finishing during daylight.~~

~~At least 20 days prior to paving, f~~Furnish the following information ~~for the Engineer's review for specification compliance~~*in the Quality Control Plan (QCP) as required in Section 105*:

1. A detailed sequence and schedule of concrete placement operations including, but not ~~necessarily~~ 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. ~~*MA detailed staking plan for subgrade controls including offset requirements*~~*A method to ensure the proper placement of reinforcing steel, tie bars and dowel bars.*

3. A traffic control plan ~~for pavement construction operations~~ *that* ~~which~~ 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. ~~Identify~~ Defined provisions for adequate lighting for all work done at night, including finishing, curing, and sawing joints.

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

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

7. ~~Identify~~ 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: ~~Obtain the Engineer's approval of the equipment and tools to be used for handling materials and performing all parts of the work, as to their design, capacity, and mechanical condition. Deliver the equipment to the job site sufficiently ahead of the start of construction operations to allow the Engineer to examine it thoroughly for approval.~~

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

~~Equip all equipment which operates on the side forms with scraping devices to clean accumulations from the top of the forms and wheels.~~*~~Provide~~ Ensure the equipment and tools that are to be used ~~that~~ meet the following:*

~~Capable~~ 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 ~~meet~~ are in accordance with the contract documents, prior to the placing of concrete.

~~**350-3.2 Equipment For Trimming of Subgrade:** For equipment operating on the subgrade, provide an automatically controlled subgrade trimmer. Use a machine that is capable of trimming the subgrade to proper elevation within the tolerances established herein. Provide grade controls that operate by sensing from a taut line, set true to line and grade. Erect and maintain the taut line.~~

~~**350-3.3 Forms:**~~

~~**350-3.3.1 Form Material:** Provide steel forms, except that on curves with a radius of 45 m or less, provide flexible forms, or wooden forms that bend to the required arc.~~

~~**350-3.3.2 Dimensions:** Use forms with a minimum length of 10 feet [3 m], except whereby are used on curves having a radius between 150 and 300 feet [45 and 90 m], in which case use a form length of 5 feet [1.5 m]. Use forms with a height that is equal to the edge thickness of the pavement. Use forms with a height greater than the edge thickness, provided the outer portion of the slab is thickened to equal the depth of the form by tapering at the rate of 1 inch of the extra thickness per foot [80 mm of the extra thickness per meter] of width. In such case, the Department will make no allowance for additional concrete. Do not use built up forms.~~

~~**350-3.3.3 Steel Forms:** Use steel forms fabricated into an approved section and sufficiently strong to ensure rigidity under the impact, thrust, and weight of the heaviest equipment to be carried over the forms. Make the width of the base of the forms which is in direct contact with the soil at least equal to the height of the forms, but not less than 8 inches [200 mm]. Extend the flange braces outward on the base not less than two thirds the height dimension of the form. Use steel forms of a thickness that is not less than 7/32 inch [5.5 mm]. When tested with a 10 foot [3.048 m] straightedge, ensure that the forms have no vertical variation in a 10 foot [3 m] length that is greater than 1/8 inch [3 mm] from a true plane of the surface on the top of the form, and no lateral variation that is greater than 1/4 inch [6 mm] from a true plane surface on the vertical face of the form. Do not use steel forms if, when tested as a simple beam with a span of 9 feet 6 inches [2.9 m] and a load equal to that exerted by construction equipment placed upon them, the deflection is more than 1/4 inch [6 mm].~~

~~**350-3.3.4 Form Connections:** Provide connections between adjacent sections of the form, that form a lock joint, free from vertical movement in excess of 1/8 inch [3 mm] and from horizontal movement in excess of 1/4 inch [6 mm], under the impact, thrust, and weight of the heaviest machine carried on the forms.~~

~~**350-3.3.5 Defective Forms:** Remove bent, twisted, or broken forms, and forms with battered top surfaces, from the work. Do not use repaired forms until they are inspected and approved by the Engineer.~~

~~**350-3.3.6 Form Stakes:** Provide at least three steel stakes for each 10 foot [3 m] length of form. Use stakes that are of sufficient size to prevent undue lateral movement of the form during paving operations. Fasten each of the stakes to the form by means of a suitable socket attached to the form. Equip each stake socket with steel wedges for securely keying the forms to the stakes. Locate a stake not more than 12 inches [300 mm] from the end of each section. Do not use forms with broken or badly worn sockets.~~

~~**350-3.3.7 Form Tampers:** Use adequate mechanical form tampers, capable of thoroughly compacting the soil under the forms, except when the forms rest on a cement treated subgrade.~~

~~**350-3.4 Spreader:** Provide a mechanical spreader that is independently powered and capable of spreading the mixed concrete on the subgrade over the entire width and depth of the strip being paved in a manner which will prevent segregation of the materials. Use a spreader designed and constructed to permit the concrete to be struck off to a uniform thickness.~~

~~**350-3.5 Strike-Off, Consolidation, and Finishing for Fixed-Form Construction:** Provide equipment for these operations that consists of a self-propelled unit, or units, that perform the following functions by mechanical means, in the sequence indicated:~~

~~(1) Strike-off.~~

~~(2) Vibratory Consolidation.~~

~~(3) Screeding.~~

~~(4) Floating.~~

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

350-3.6*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 ~~all of this~~*the* equipment is of such dimensions and arrangement as to cover the full width of the pavement strip being *placed*~~laid~~. 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.

~~Do not use a~~*A*utomatic grade controls *are not* ~~*allowed*~~*required* on the paver when the tracks of the slip-form paver are operating on ~~econocrete base or~~ 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. ~~The Engineer may allow variation from any specific feature of the slip-form paver as detailed above, provided the industry has generally accepted the proposed variation as an improved feature.~~

350-3.~~7~~ *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 ~~cause~~ 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.

~~**350-3.8 Mechanical Floating Equipment:** Provide equipment that consists of a supplementary self-propelled machine capable of further smoothing the concrete, removing excess mortar from the surface, and minimizing hand finishing.~~

~~Use a machine that leaves the surface of the concrete 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.~~

350-3.~~9~~ *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.

~~The Contractor may use hand-~~ p*P*ower-spray equipment ~~to~~ *may be used to* apply curing compound to areas where it is impracticable to operate the self-propelled equipment.

~~**350-3.10 Equipment for Sealing Joints:** Provide equipment for sealing the joints for each section of pavement. Use a heating kettle for hot-poured sealer that is of the indirect heating or double-boiler type, using oil as a heat transfer medium. 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. Use pouring equipment equipped with nozzles that discharge the seal 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 for pouring, within 10°F [5°C]*manufacturer's*.~~

350-3.~~11~~ *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. ~~The Contractor may u~~*U*se such equipment *that*~~as~~ *is approved by* the Engineer~~ may approve for such areas~~.

350-3.~~12~~ *6* Hand Finishing Tools: Provide straightedges that have a blade length of 10 feet [3.~~048~~ 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].

~~**350-3.13 *7* Texturing Machine:** Provide a machine that consists of a supplementary machine capable of applying the final finish to the concrete pavement. Apply the finish by rectangular shaped~~

~~spring steel tines rigidly mounted in a frame operating on an adjustable track mounted under the main frame of the machine. Use a machine that is constructed so as to provide for adjustment of the downward pressure on the tines as necessary to produce the desired finish under varying conditions of the concrete surface.~~

~~The Engineer may allow variation from any specific feature of the Texturing Machine as detailed above, provided that the Contractor can produce an equivalent final finish.~~

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* moist*ure 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 35°F [1°C], periods when the air temperature may rise above 85°F [29°C], high winds, heavy rains and other conditions that might affect the final durability of the pavement. ~~Have available at the site, at all times when concrete paving operations are underway, materials for the protection of the surface and edges of the unhardened concrete. For the protection of the pavement edges, use any covering material, such as burlap, paper, or plastic sheeting material, suitable for the protection of the pavement surface.~~

When rain appears imminent, stop all paving operations, and ~~have all available personnel~~ cover the surface of the unhardened concrete with the protective covering.

~~During periods when the air temperature may fall below 35°F [1°C], advise the Engineer of plans for curing and protecting the fresh concrete *shall be implemented as identified in the QCP* before placing the concrete. Do not place any concrete until the Engineer has approved the proposed methods. The Contractor is fully responsible for the quality and strength of the concrete placed in cold weather even if the Engineer approves of the provisions the Contractor employs for protecting the concrete placed during cold weather.~~

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. ~~Secure the reinforcement in position in advance of concrete placement or, with the Engineer's specific approval, place it in the plastic concrete by mechanical or vibratory means after spreading the concrete.~~ 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 ~~which could impair bonding of the steel with the concrete~~. 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. ~~and t~~*T*he surface will at no point be below the grade specified for the finished surface~~, after application of the allowable tolerance~~. ~~Deposit~~ *Place* the concrete on the subgrade in a manner which will require as little rehandling as possible. ~~Continuously place concrete between transverse joints without using intermediate bulkheads.~~

~~Deposit~~ *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.* ~~Do not dump concrete from the discharge bucket or hopper onto an assembly without centering the bucket or hopper directly over the assembly.~~

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.* ~~The Engineer will not require the Contractor to use a spreader for areas where the width of slab varies, for intersections, and for 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*). Ensure that workmen *workers* do not walk in the freshly deposited concrete with *their boots or shoes coated with* earth or other deleterious substances coated on their boots or shoes.~~

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. ~~The Engineer will not require the Contractor to~~

~~alter placement operations where superelevation reverses the pavement cross slope from that shown on the typical section.~~

~~**350-8.4 Hours of Operation:** Stop placing concrete in time to complete finishing operations during daylight hours, or provide adequate approved lighting *as identified in the QCP.*~~

350-8.*5*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. ~~Do not continue vibration at any one location so long as to produce puddling or the accumulation of excessive grout on the surface.~~

350-~~9~~8.*65* 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-~~10~~-*9* Striking-off, Consolidating, and Finishing Concrete.

350-~~10~~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 ~~planning~~ 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-~~10~~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-~~10~~9.3 Hand Methods:

350-~~9~~10.3.1 Conditions under which Allowed: ~~The Contractor may use~~ *Use* hand methods in areas of narrow width or irregular dimensions, where operation of mechanical equipment is

impracticable. ~~In the event that mechanical equipment breaks down, the Contractor may use hand methods to finish only that concrete already deposited on the subgrade when the breakdown occurred.~~

350-~~9~~10.3.2 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.

~~In operation, move the screed forward on the forms with a combined longitudinal and transverse shearing motion, moving always in the direction in which the work is progressing, and manipulate it so that neither end is raised from the side forms during the striking-off process. If necessary, repeat this until the surface is of uniform texture, true to grade and cross-section, and free from porous areas.~~

350-~~9~~10.3.3 Consolidation: Use hand-operated spud-type vibrators to consolidate.

350-~~9~~10.3.4 Floating: Use long-handled floats to float the concrete. Take the necessary care to avoid creating depressions or ridges during this operation.

350-~~9~~10.4 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.

~~350-11 Supplemental Floating.~~

~~In areas where performing machine strike-off, consolidation, and finishing, further 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. Waste excess mortar beyond the edge of the slab.~~

350-~~12~~ *10* Final Finish.

350-~~12~~*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.

~~After applying the burlap drag finish, apply the final finish with the texturing machine. Control the time of applying this finish and the method of operating the texturing machine so as to minimize tearing of surface and unseating of aggregate particles.~~

~~Provide a final finish that consists of transverse grooves which are 0.08 to 0.12 inch [2 to 3 mm] in width and 0.10 to 0.15 inch [2.5 to 4 mm] in depth, spaced at random intervals between 1/2 to 1 inch [13 to 25 mm]. Operate the texturing machine in a manner that minimizes the overlapping of subsequent passes of the steel comb. Create short gaps in the grooved finish as necessary to avoid overlap between passes.~~

~~In areas of irregular dimensions or narrow widths, where operating the texturing machine is impracticable, the Contractor may apply the finish by approved hand methods that achieve the required finish with a minimum of surface tearing and unseating aggregate particles. Ensure that the surface resulting from this operation is uniform in appearance and free of irregular, rough, or porous areas.~~

350-~~12~~*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-~~13~~-*11* Curing.

350-~~13~~*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 method*s* described below. In ~~all~~ cases *where*~~in which~~ 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*~~Engineer will order an immediate suspension of concreting operations~~. 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 50°F [10°C].

350-~~13~~*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}~~0.005 gal/ft^2~~ [~~0.2 L/m^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*~~until the pigment is uniformly dispersed throughout the vehicle~~.

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-~~13~~*11*.3 Burlap Mats: ~~Under this method, cover the surfaces to be cured with 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 ~~so as to cause them to remain in intimate contact with the surface being cured,~~ throughout the curing period *to ensure* ~~a~~ *contact with the surface being cured.* Maintain the mats fully moist and in position for the entire portion of the required ~~burlap~~ curing period.

350-~~13~~*11*.4 Removal of Forms: Do not remove forms from freshly placed concrete ~~until it has set~~ 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.

~~**350-14 Surface Requirements.**~~

~~After curing, remove the curing material (except for the impervious coating), and thoroughly test the surface for pavement surface smoothness in accordance with 352-4(e). Plainly mark all variations from the required tolerances. Where pavement surfaces do not meet the smoothness requirements, the Engineer will require corrective work and retesting to ensure conformity.~~

~~Eliminate high spots exceeding 1/8 inch in 10 feet [3.2 mm in 3 m], but not in excess of 0.3 inch in 25 feet [7.6 mm in 7.6 m], by grinding either with an approved machine or with a carborundum brick and water. Do not use bush-hammering or other destructive means for removing irregularities. As directed by the Engineer, retexture corrected high areas to give skid resistance comparable to the surrounding area.~~

~~Provide grinding equipment with a power driven self-propelled machine that is specifically designed to grind portland cement concrete pavement, with a minimum of a 3-foot [1-m] wide grinding head and diamond impregnated grinding blades. Produce, by grinding, a pavement surface that is true to grade and uniform in appearance with a longitudinal line type texture. Provide a line type texture that contains parallel longitudinal corrugations that present a narrow ridge corduroy type appearance. Ensure~~

~~that the peaks of ridges are approximately 1/32 inch [0.8 mm] higher than the bottoms of the grooves with approximately 60 evenly spaced grooves per foot [300 mm].~~

~~Operate all milling, cutting, or grinding equipment to produce a reasonably uniform finished surface without spalling the pavement joints within corrected areas. The Engineer will not require extra grinding to eliminate minor depressions in order to provide 100% texturing of the pavement surface. Maintain the cross slope of the pavement as shown in the plans. Repair all joint seals destroyed by grinding at no expense to the Department.~~

~~Remove and replace any area of pavement which, after grinding, still shows a deviation in excess of the allowable tolerance. Ensure that the area removed and replaced is the full length between transverse joints and the full width of the lane involved.~~

~~Saw the area to be removed to a smooth vertical surface. Clean the face of the adjacent (hardened) concrete, and coat it with an epoxy bonding compound before placing the replacement concrete.~~

~~Bear the costs of all surface corrections required and of all required removal and replacement of defective surface concrete.~~

350-~~15~~*12* Joints.

350-~~15~~*12*.1 General: Construct joints at the locations and in accordance with the details shown in the ~~Roadway and Traffic~~ Design Standards, Index No. 305 and the Contract Documents.

350-~~15~~*12*.2 Longitudinal Joints:

350-~~15~~*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. ~~Where keyways are required, the Contractor may form them by placing an insert of the proper shape along the inside face of the side form or, when using the slip form method of paving, by an approved extrusion device. Use a method that produces a keyway of the shape and at the location indicated in the plans.~~

350-~~15~~*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*~~within~~ 72 hours after placing the concrete.

350-~~15~~*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.

~~**350-15.2.4 Longitudinal Shoulder Joints (Concrete to Asphalt):** Construct a continuous joint by sawing a groove into the asphalt pavement at the abutment with the concrete pavement. Produce a groove that is 3/4 inch [19 mm] wide and 3/4 inch [19 mm] deep, after sawing and cleaning.~~

~~Seal the joint with hot-poured type sealant.~~

350-~~15~~*12*.3 Transverse Joints:

350-~~15~~*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-~~15~~*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* ~~in general when the concrete is between 4 and~~ 12 hours *after placing the concrete*~~old~~. Make a second saw cut, to provide the joint dimensions indicated in the plans, ~~as soon as there is no danger of further raveling~~*just prior to* ~~*installing*~~*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-~~15~~*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 ~~Roadway and Traffic~~ 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 ~~on the Roadway and Traffic Design Standards, *Index 306*~~ *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-~~15~~*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 ~~the free end of~~ each dowel with one coat of approved zinc rich paint (listed on the Qualified Products List), and grease *one end* ~~it~~ with an approved

lubricant, to prevent the concrete from bonding to the dowel. *Provide a cap for* ~~Provide~~ the free end of expansion joint dowels ~~with the closest fitting metal cap or sleeve, equipped with a stop to prevent closing during placement operations. Maintain a clearance of 1 inch [25 mm] between the closed end of the cap and the dowel to accommodate future slab movement.~~

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].

~~Provide the Engineer with c~~*C*onfirm~~ation of~~ the ~~location~~ *position* of ~~the~~ dowel bars *by suitable means acceptable to the Engineer, which may include non-destructive testing methods.* ~~The Contractor shall confirm that the paving operation has not displaced the dowels from their required positions. Perform confirmation checks daily for the first two days of the paving operation and weekly thereafter.~~

350-~~15~~*12*.5 Expansion Joints Around Structures: 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-~~15~~*12*.6 Cleaning Joints and Cracks:

350-~~15~~*12*.6.1 Cleaning Joints in New Pavement:

350-~~15~~*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-~~15~~*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-~~15~~*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-~~15~~*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*~~15~~.6.2.

350-~~15~~*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-~~15~~*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 50°F [10°C] or greater.

~~*Use a heating kettle for hot poured sealer that is of the indirect heating or double-boiler type, using oil as a heat transfer medium*~~*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-~~15~~*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 40°F [5°C].

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-~~16~~-*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 ~~**350-16.1**~~ **Core Borings:** ~~After completing the concrete pavement, including any corrective work to meet ride requirement,~~ *To determine the actual thickness,* drill cores from the pavement *and measure thickness in accordance with ASTM C 174* ~~to determine the actual thickness. When the Department is ready to core the finished pavement for thickness, provide traffic control, coring equipment, and operator to obtain the cores. The Engineer will select the coring locations and make the acceptance measurements *for thickness determination*. Take borings at random intervals and at various points on the cross-section so that each test boring represents an area not exceeding 2,500 yd^2 [2,000 m^2].~~

~~———————~~Replace the portions of the pavement removed by the borings at no expense to the Department.

350-14.1.2 Non-destructive Testing: ~~*To determine by*~~ *-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-~~16~~*14*.2 Method of Calculating Average Thickness: The Department will determine the average thickness of *the* pavement *by using the following method of calculation:* ~~from the length of all cores taken as indicated above and will calculate it as follows:~~

(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*~~as measured by the cores~~ 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-~~17~~*15* Deficient Thickness.

350-~~17~~*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-~~17~~*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 ~~deficient~~ *deficiency* ~~area~~ is ~~sufficient~~ *enough* to seriously impair the anticipated service life of the pavement, ~~the Contractor shall~~ 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-~~17~~*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 Contractor may elect to leave~~ the pavement *may be left* in place, ~~but shall receive~~ *at* no compensation ~~for the area of pavement~~.

350-~~17~~*15*.4 Additional Borings: If the ~~Contractor believes that the~~ number of cores taken is not sufficient to indicate the thickness of the pavement, ~~he may request that the Engineer select~~ additional boring locations *may be requested, with prior approval* ~~*by*~~ *from the Engineer* ~~*and bear all cost for these additional boring locations*~~*at no additional cost to the Department.* ~~The Department will deduct the cost of these additional borings from any sums due the Contractor, unless such borings indicate that the pavement within the questioned area is of specified or greater thickness.~~

350-~~18~~*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 ~~*after the concrete is three days old or less than seven days old. Before opening the pavement to traffic, construct an earth berm along each edge*~~*. Build the berm to the full height of the*

pavement and at least 18 inches [0.5 m] wide, and sufficiently compacted ~~it~~ to prevent underwash of the pavement. Maintain the berm until ~~completing~~ 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 50°F [10°C]) 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 ~~AASHTO T 23~~*ASTM C 31* and tested in accordance with ~~AASHTO T 97~~*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 ~~Department's Roadway and Traffic Design Standards for Design, Construction, Maintenance and Utility Operations on the State Highway System~~.* ~~Provide protection that includes the erection and maintenance of signs, lights, barricades, etc., the construction and removal of temporary pavement, bridges, crossovers, etc., and the use of flagmen as may be necessary. Arrange the protective measures so as not to interfere with traffic in lanes being utilized for required maintenance of traffic.~~

~~Before opening the pavement to traffic, construct an earth berm along each edge. Build the berm to the full height of the pavement and at least 18 inches [0.5 m] wide, and sufficiently compact it to prevent underwash of the pavement. Maintain the berm until completing the final shoulders.~~

350-~~19~~*17* Method of Measurement.

350-~~19~~*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 350-1~~5~~7.3 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~~ic~~ 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~~ic~~ concrete surface course constructed in accordance with Section 33~~1~~*4*. Reinforcing steel, placed and accepted, will be measured and paid for as provided in Section 415.

350-~~19~~*17*.2 Joints and Cracks: ~~The Contractor shall include~~*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 ~~that have been~~ 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-~~20~~-*198* 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.

350 CEMENT CONCRETE PAVEMENT. (REV 2-3-04) (FA 00-00-00) (7-04)

SECTION 350 (Pages 304-322) 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 35°F [1°C], periods when the air temperature may rise above 85°F [29°C], 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 50°F [10°C].

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. 305 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: 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.

350-12.6 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 50°F [10°C] 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 40°F [5°C].

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 50°F [10°C]) 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.

350-18 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.

meeting this week. Charles agreed to make the changes.

In section 350-1, a second paragraph is added to include "If any uncontrolled cracks appear during the life of the contract that is unacceptable to the Engineer, remove and replace any area 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."

In section 350-3.2 (last sentence) is changed to "Automatic grade controls are not allowed on the paver when the tracks of the slip-form paver are operating on previously placed concrete pavement. "

In section 350-3.7 is removed because grinding is now required and no tining is needed.

In section 350-12.3.2 (third paragraph) is changed to "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 installing the load transfer device."

In section 14.1.2, Greg was going to look and see if any other state was using the Impact Echo for pavement thickness and use similar wording. no change

In section 350-16 (first paragraph) is changed to "Construct an earth berm along each edge of the pavement after the concrete is 3 days old or less than 7 days old. "

354 - Delete as standard specification and make as a technical special provision only

Section 354 – 1 .....Second sentence should be eliminated and placed in 350, if it isn't already there. **Agree**

Section 354-3..... Partial depth repairs are no longer allowed by the Department, (the performance has been horrible even when done right). Need section rewritten accordingly

.....Also in the development of the PCC warranty spec agreement was reached that the defective area (in the wheel path) that can be filled with silicone is when the width is 1" or less (can be left in place). Suggests this spec read the same.

352

Need to address "What" the calibration will consists of and reference that in the specification. Also need to require the calibration to be observed by the Engineer

The methods described in this section is for the contractor to perform quality control testing on the pavement. The final acceptance (section 355) will be performed by the Department.

Section 352-6 .....need to establish the maximum area, or wheel path length, that the longitudinal grooves can be ground out to correct a bump or improve the ride before the area has to be re-grooved.

The minimum wheel path length that can be evaluated by the pavement evaluation skid vehicles is 100-feet. Since this is the minimum amount that can be evaluated for skid safety, this is the length that will be included in the specification. Add sentence to the end of the section to read "If the grinding operation removes more than a total length of 100 consecutive feet [30 M] of the grooves,

John H Owens
02/03/2004 12:41 PM

To: Judy F Frazier/CO/FDOT@FDOT, Shirley Harvey/CO/FDOT@FDOT
cc:
Subject: Re: Greg Schiess comments on Sections 350, 352, 353 and 354.

Duane said to make the changes Charles has in the attached file and get them ready to send back to FHWA.

Thank You, Have A Great Day,

John H. Owens

F.D.O.T. Specifications Office

(850) 414-4113 Fax (850) 413-7385

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----- Forwarded by John H Owens/CO/FDOT on 02/03/2004 12:39 PM -----

Charles A Ishee
02/03/2004 12:23 PM

To: Greg.Schiess@fhwa.dot.gov
cc: (bcc: John H Owens/CO/FDOT)
Subject: Re: Greg Schiess comments on Sections 350, 352, 353 and 354.

Mr. Schiess:

Sorry I didn't get this back to you sooner, but I was in meetings all day yesterday. Here are the answer to the questions we discussed earlier in blue. I will try to call you right after lunch to see if you have any additional comments or questions. Thanks =)

D3500000 (new).D03.do D3520000 (new).D02.do D3530000 (new).D02.do fm5-558.pdf

----- Forwarded by Duane F Brautigam/CO/FDOT on 02/02/2004 08:58 AM -----

"Schiess, Greg" <Greg.Schiess@fhwa.dot.gov>
01/30/2004 01:37 PM

To: <DUANE.BRAUTIGAM@DOT.STATE.FL.US>
cc:
Subject: DB 013004.doc

To: Mr. D. Brautigam

From: G Schiess

Subject: Spec Review

Date: 30-Jan-04

I have the following comments on these specifications: 354, 350, 352, and 353.

350 - There are numerous comments and these were discussed with Charles Ishee at the DME

350 CEMENT CONCRETE PAVEMENT.
(REV ~~5-13-03~~*09-19-03*~~*1-15-04*~~) *(FA 00-00-00) (7-04)*

SECTION 350 (Pages 304-322) is deleted and the following substituted:

SECTION 350
CEMENT CONCRETE PAVEMENT

350-1 Description.

Construct ~~portland~~ *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 that is unacceptable to the Engineer, remove and replace any area 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.

~~For aggregates, proportioning and mixing, and other provisions for the production of the concrete, meet the applicable provisions of Section 346.~~

~~Provide adequate lighting for all work done at night, including finishing, curing, and sawing joints. Unless lighting is provided for finishing, stop construction operations soon enough each day to permit finishing during daylight.~~

~~At least 20 days prior to paving, f~~*F*urnish the following information ~~for the Engineer's review for specification compliance~~*in the Quality Control Plan (QCP) as required in Section 105*:

1. A detailed sequence and schedule of concrete placement operations including, but not ~~necessarily~~ 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. ~~*M*A detailed staking plan for subgrade controls including offset requirements~~*A method to ensure the proper placement of reinforcing steel, tie bars and dowel bars.*

3. A traffic control plan ~~for pavement construction operations~~ *that* ~~which~~ 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. ~~Identify~~ Defined provisions for adequate lighting for all work done at night, including finishing, curing, and sawing joints.

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

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

7. ~~Identify~~ 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: ~~Obtain the Engineer's approval of the equipment and tools to be used for handling materials and performing all parts of the work, as to their design, capacity, and mechanical~~

~~condition. Deliver the equipment to the job site sufficiently ahead of the start of construction operations to allow the Engineer to examine it thoroughly for approval.~~

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

~~Equip all equipment which operates on the side forms with scraping devices to clean accumulations from the top of the forms and wheels.~~*Provide Ensure the equipment and tools that are to be used ~~that~~ meet the following:*

~~Capable~~ 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 ~~meet~~ are in accordance with the contract documents, prior to the placing of concrete.

~~**350-3.2 Equipment For Trimming of Subgrade:** For equipment operating on the subgrade, provide an automatically controlled subgrade trimmer. Use a machine that is capable of trimming the subgrade to proper elevation within the tolerances established herein. Provide grade controls that operate by sensing from a taut line, set true to line and grade. Erect and maintain the taut line.~~

~~**350-3.3 Forms:**~~

~~**350-3.3.1 Form Material:** Provide steel forms, except that on curves with a radius of 45 m or less, provide flexible forms, or wooden forms that bend to the required arc.~~

~~**350-3.3.2 Dimensions:** Use forms with a minimum length of 10 feet [3 m], except wherethey are used on curves having a radius between 150 and 300 feet [45 and 90 m], in which case use a form length of 5 feet [1.5 m]. Use forms with a height that is equal to the edge thickness of the pavement. Use forms with a height greater than the edge thickness, provided the outer portion of the slab is thickened to equal the depth of the form by tapering at the rate of 1 inch of the extra thickness per foot [80 mm of the extra thickness per meter] of width. In such case, the Department will make no allowance for additional concrete. Do not use built-up forms.~~

~~**350-3.3.3 Steel Forms:** Use steel forms fabricated into an approved section and sufficiently strong to ensure rigidity under the impact, thrust, and weight of the heaviest equipment to be carried over the forms. Make the width of the base of the forms which is in direct contact with the soil at least equal to the height of the forms, but not less than 8 inches [200 mm]. Extend the flange braces outward on the base not less than two-thirds the height dimension of the form. Use steel forms of a thickness that is not less than 7/32 inch [5.5 mm]. When tested with a 10 foot [3.048 m] straightedge, ensure that the forms have no vertical variation in a 10 foot [3 m] length that is greater than 1/8 inch [3 mm] from a true plane of the surface on the top of the form, and no lateral variation that is greater than 1/4 inch [6 mm] from a true plane surface on the vertical face of the form. Do not use steel forms if, when tested as a simple beam with a span of 9 feet 6 inches [2.9 m] and a load equal to that exerted by construction equipment placed upon them, the deflection is more than 1/4 inch [6 mm].~~

~~**350-3.3.4 Form Connections:** Provide connections between adjacent sections of the form, that form a lock joint, free from vertical movement in excess of 1/8 inch [3 mm] and from horizontal movement in excess of 1/4 inch [6 mm], under the impact, thrust, and weight of the heaviest machine carried on the forms.~~

~~**350-3.3.5 Defective Forms:** Remove bent, twisted, or broken forms, and forms with battered top surfaces, from the work. Do not use repaired forms until they are inspected and approved by the Engineer.~~

~~**350-3.3.6 Form Stakes:** Provide at least three steel stakes for each 10 foot [3 m] length of form. Use stakes that are of sufficient size to prevent undue lateral movement of the form during paving operations. Fasten each of the stakes to the form by means of a suitable socket attached to the form. Equip each stake socket with steel wedges for securely keying the forms to the stakes. Locate a~~

~~stake not more than 12 inches [300 mm] from the end of each section. Do not use forms with broken or badly worn sockets.~~

~~**350-3.3.7 Form Tampers:** Use adequate mechanical form tampers, capable of thoroughly compacting the soil under the forms, except when the forms rest on a cement-treated subgrade.~~

~~**350-3.4 Spreader:** Provide a mechanical spreader that is independently powered and capable of spreading the mixed concrete on the subgrade over the entire width and depth of the strip being paved in a manner which will prevent segregation of the materials. Use a spreader designed and constructed to permit the concrete to be struck-off to a uniform thickness.~~

~~**350-3.5 Strike-Off, Consolidation, and Finishing for Fixed-Form Construction:** Provide equipment for these operations that consists of a self-propelled unit, or units, that perform the following functions by mechanical means, in the sequence indicated:~~

~~(1) Strike-off.~~

~~(2) Vibratory Consolidation.~~

~~(3) Screeding.~~

~~(4) Floating.~~

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

350-3.6*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 ~~all of this~~*the* equipment is of such dimensions and arrangement as to cover the full width of the pavement strip being *placed*~~laid~~. 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.

~~1~~Do not use automatic grade controls *are not allowed* on the paver when the tracks of the slip-form paver are operating on ~~concrete base or~~ 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.

~~The Engineer may allow variation from any specific feature of the slip-form paver as detailed above, provided the industry has generally accepted the proposed variation as an improved feature.~~

350-3.7~~.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 ~~cause~~ 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.

~~**350-3.8 Mechanical Floating Equipment:** Provide equipment that consists of a supplementary self-propelled machine capable of further smoothing the concrete, removing excess mortar from the surface, and minimizing hand finishing.~~

~~Use a machine that leaves the surface of the concrete 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.~~

350-3.~~9~~ *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.

~~The Contractor may use hand p~~*P*ower-spray equipment ~~to~~ *may be used to* apply curing compound to areas where it is impracticable to operate the self-propelled equipment.

~~**350-3.10 Equipment for Sealing Joints:** Provide equipment for sealing the joints for each section of pavement. Use a heating kettle for hot-poured sealer that is of the indirect heating or double-boiler type, using oil as a heat transfer medium. 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. Use pouring equipment equipped with nozzles that discharge the seal 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 for pouring, within 10°F [5°C]*manufacturer's* .~~

350-3.~~11~~ *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. ~~The Contractor may u~~*U*se such equipment *that*~~as~~ *is approved by* the Engineer~~may approve for such areas~~.

350-3.~~12~~ *6* Hand Finishing Tools: Provide straightedges that have a blade length of 10 feet [3.~~048~~ 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].

~~**350-3.13 Texturing Machine:** Provide a machine that consists of a supplementary machine capable of applying the final finish to the concrete pavement. Apply the finish by rectangular shaped spring steel tines rigidly mounted in a frame operating on an adjustable track mounted under the main frame of the machine. Use a machine that is constructed so as to provide for adjustment of the downward pressure on the tines as necessary to produce the desired finish under varying conditions of the concrete surface.~~

~~The Engineer may allow variation from any specific feature of the Texturing Machine as detailed above, provided that the Contractor can produce an equivalent final finish.~~

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* moist*ure 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 35°F [1°C], periods when the air temperature may rise above 85°F [29°C], high winds, heavy rains and other conditions that might affect the final durability of the pavement. ~~Have available at the site, at all times when concrete paving operations are underway, materials for the protection of the surface and edges of the unhardened concrete. For the protection of the pavement edges, use any covering material, such as burlap, paper, or plastic sheeting material, suitable for the protection of the pavement surface.~~

~~When~~ When rain appears imminent, stop all paving operations, and ~~have all available personnel~~ cover the surface of the unhardened concrete with the protective covering.

~~During periods when the air temperature may fall below 35°F [1°C], advise the Engineer of plans for curing and protecting the fresh concrete *shall be implemented as identified in the QCP* before placing the concrete. Do not place any concrete until the Engineer has approved the proposed methods.~~

~~The Contractor is fully responsible for the quality and strength of the concrete placed in cold weather even if the Engineer approves of the provisions the Contractor employs for protecting the concrete placed during cold weather.~~

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. ~~Secure the reinforcement in position in advance of concrete placement or, with the Engineer's specific approval, place it in the plastic concrete by mechanical or vibratory means after spreading the concrete.~~ 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 ~~which could impair bonding of the steel with the concrete~~. 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. ~~and t~~*T*he surface will at no point be below the grade specified for the finished surface~~, after application of the allowable tolerance~~. ~~Deposit~~ *Place* the concrete on the subgrade in a manner which will require as little rehandling as possible. ~~Continuously place concrete between transverse joints without using intermediate bulkheads.~~

~~Deposit~~ *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.* ~~Do not dump concrete from the discharge bucket or hopper onto an assembly without centering the bucket or hopper directly over the assembly.~~

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.* ~~The Engineer will not require the Contractor to use a spreader for areas where the width of slab varies, for intersections, and for 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*). Ensure that workmen *workers* do not walk in the freshly deposited concrete with *their boots or shoes coated with* earth or other deleterious substances coated on their boots or shoes.~~

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. ~~The Engineer will not require the Contractor to alter placement operations where superelevation reverses the pavement cross slope from that shown on the typical section.~~

~~**350-8.4 Hours of Operation:** Stop placing concrete in time to complete finishing operations during daylight hours, or provide adequate approved lighting *as identified in the QCP.*~~

350-8.~~5~~*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. ~~Do not continue vibration at any one location so long as to produce puddling or the accumulation of excessive grout on the surface.~~

350-~~9~~*8.65* 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-~~1~~0-*9* Striking-off, Consolidating, and Finishing Concrete.

350-~~1~~09.1 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 ~~planning~~ 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-~~1~~09.2 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-~~1~~09.3 Hand Methods:

350-~~9~~10.3.1 Conditions under which Allowed: ~~The Contractor may use~~ *Use* hand methods in areas of narrow width or irregular dimensions, where operation of mechanical equipment is impracticable. ~~In the event that mechanical equipment breaks down, the Contractor may use hand methods to finish only that concrete already deposited on the subgrade when the breakdown occurred.~~

350-~~9~~10.3.2 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.

~~In operation, move the screed forward on the forms with a combined longitudinal and transverse shearing motion, moving always in the direction in which the work is progressing, and manipulate it so that neither end is raised from the side forms during the striking-off process. If necessary,~~

~~repeat this until the surface is of uniform texture, true to grade and cross-section, and free from porous areas.~~

350-~~9~~10.3.3 Consolidation: Use hand-operated spud-type vibrators to consolidate.

350-~~9~~10.3.4 Floating: Use long-handled floats to float the concrete. Take the necessary care to avoid creating depressions or ridges during this operation.

350-~~9~~10.4 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.

~~350-11 Supplemental Floating.~~

~~In areas where performing machine strike-off, consolidation, and finishing, further 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. Waste excess mortar beyond the edge of the slab.~~

350-~~12~~ *10* Final Finish.

350-~~12~~*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.

~~After applying the burlap drag finish, apply the final finish with the texturing machine. Control the time of applying this finish and the method of operating the texturing machine so as to minimize tearing of surface and unseating of aggregate particles.~~

~~Provide a final finish that consists of transverse grooves which are 0.08 to 0.12 inch [2 to 3 mm] in width and 0.10 to 0.15 inch [2.5 to 4 mm] in depth, spaced at random intervals between 1/2 to 1 inch [13 to 25 mm]. Operate the texturing machine in a manner that minimizes the overlapping of subsequent passes of the steel comb. Create short gaps in the grooved finish as necessary to avoid overlap between passes.~~

~~In areas of irregular dimensions or narrow widths, where operating the texturing machine is impracticable, the Contractor may apply the finish by approved hand methods that achieve the required finish with a minimum of surface tearing and unseating aggregate particles. Ensure that the surface resulting from this operation is uniform in appearance and free of irregular, rough, or porous areas.~~

350-~~12~~*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-~~13~~ *11* Curing.

350-~~13~~*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 ~~all~~ cases *where*~~in which~~ 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*~~Engineer will order an immediate suspension of concreting operations~~. 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 50°F [10°C].

350-~~13~~*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}~~0.005 gal/ft^2~~ [~~0.2 L/m^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* ~~until the pigment is uniformly dispersed throughout the vehicle~~.

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-~~13~~*11*.3 Burlap Mats: ~~Under this method, cover the surfaces to be cured with 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 ~~so as to cause them to remain in intimate contact with the surface being cured,~~ throughout the curing period *to ensure ~~a~~ contact with the surface being cured.* Maintain the mats fully moist and in position for the entire portion of the required ~~burlap~~ curing period.

350-~~13~~*11*.4 Removal of Forms: Do not remove forms from freshly placed concrete ~~until it has set~~ 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.

~~**350-14 Surface Requirements.**~~

~~After curing, remove the curing material (except for the impervious coating), and thoroughly test the surface for pavement surface smoothness in accordance with 352-4(c). Plainly mark all variations from the required tolerances. Where pavement surfaces do not meet the smoothness requirements, the Engineer will require corrective work and retesting to ensure conformity.~~

~~Eliminate high spots exceeding 1/8 inch in 10 feet [3.2 mm in 3 m], but not in excess of 0.3 inch in 25 feet [7.6 mm in 7.6 m], by grinding either with an approved machine or with a carborundum brick and water. Do not use bush-hammering or other destructive means for removing irregularities. As directed by the Engineer, retexture corrected high areas to give skid resistance comparable to the surrounding area.~~

~~Provide grinding equipment with a power driven self-propelled machine that is specifically designed to grind portland cement concrete pavement, with a minimum of a 3-foot [1-m] wide grinding head and diamond impregnated grinding blades. Produce, by grinding, a pavement surface that is true to grade and uniform in appearance with a longitudinal line type texture. Provide a line type texture that contains parallel longitudinal corrugations that present a narrow ridge corduroy type appearance. Ensure that the peaks of ridges are approximately 1/32 inch [0.8 mm] higher than the bottoms of the grooves with approximately 60 evenly spaced grooves per foot [300 mm].~~

~~Operate all milling, cutting, or grinding equipment to produce a reasonably uniform finished surface without spalling the pavement joints within corrected areas. The Engineer will not require extra grinding to eliminate minor depressions in order to provide 100% texturing of the pavement surface. Maintain the cross slope of the pavement as shown in the plans. Repair all joint seals destroyed by grinding at no expense to the Department.~~

~~Remove and replace any area of pavement which, after grinding, still shows a deviation in excess of the allowable tolerance. Ensure that the area removed and replaced is the full length between transverse joints and the full width of the lane involved.~~

~~Saw the area to be removed to a smooth vertical surface. Clean the face of the adjacent (hardened) concrete, and coat it with an epoxy bonding compound before placing the replacement concrete.~~

~~Bear the costs of all surface corrections required and of all required removal and replacement of defective surface concrete..~~

350-~~15~~-*12* Joints.

350-~~15~~*12*.1 General: Construct joints at the locations and in accordance with the details shown in the ~~Roadway and Traffic~~ Design Standards, Index No. 305 and the Contract Documents.

350-~~15~~*12*.2 Longitudinal Joints:

350-~~15~~*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. ~~Where keyways are required, the Contractor may form them by placing an insert of the proper shape along the inside face of the side form or, when using the slip form method of paving, by an approved extrusion device. Use a method that produces a keyway of the shape and at the location indicated in the plans.~~

350-~~15~~*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* ~~within~~ 72 hours after placing the concrete.

350-~~15~~*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.

~~**350-15.2.4 Longitudinal Shoulder Joints (Concrete to Asphalt):** Construct a continuous joint by sawing a groove into the asphalt pavement at the abutment with the concrete pavement. Produce a groove that is 3/4 inch [19 mm] wide and 3/4 inch [19 mm] deep, after sawing and cleaning.~~

~~Seal the joint with hot-poured type sealant.~~

350-~~15~~*12*.3 Transverse Joints:

350-~~15~~*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-~~15~~*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 loadtransfer 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* ~~in general when the concrete is between 4 and~~ 12 hours *after placing the concrete*~~old~~. Make a second saw cut, to provide the joint dimensions indicated in the plans, ~~as soon as there is no danger of further raveling~~*just prior to installing 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-~~15~~*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 ~~Roadway and Traffic~~ 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 ~~on the Roadway and Traffic Design Standards, *Index 306*~~ *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-~~15~~*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 ~~the free end of~~ each dowel with one coat of approved zinc rich paint (listed on the Qualified Products List), and grease *one end* ~~it~~ with an approved lubricant, to prevent the concrete from bonding to the dowel. *Provide a cap for* ~~Provide~~ the free end of expansion joint dowels ~~with the closest fitting metal cap or sleeve, equipped with a stop to prevent closing during placement operations. Maintain a clearance of 1 inch [25 mm] between the closed end of the cap and the dowel to accommodate future slab movement.~~

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].

~~Provide the Engineer with a~~Confirmation ~~of~~ the ~~location~~*position* of ~~the~~ dowel bars *by suitable means acceptable to the Engineer, which may include non-destructive testing methods.* ~~The~~

~~Contractor shall confirm that the paving operation has not displaced the dowels from their required positions. Perform confirmation checks daily for the first two days of the paving operation and weekly thereafter.~~

350-~~15~~*12*.5 Expansion Joints Around Structures: 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-~~15~~*12*.6 Cleaning Joints and Cracks:

350-~~15~~*12*.6.1 Cleaning Joints in New Pavement:

350-~~15~~*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-~~15~~*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-~~15~~*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-~~15~~*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*~~15~~.6.2.

350-~~15~~*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-~~15~~*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 50°F [10°C] or greater.

~~*Use a heating kettle for hot-poured sealer that is of the indirect heating or double boiler type, using oil as a heat transfer medium*~~*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-~~15~~*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 40°F [5°C].

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-~~16~~-*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 ~~**350-16.1 Core Borings:** After completing the concrete pavement, including any corrective work to meet ride requirement,~~ *To determine the actual thickness,* drill cores from the pavement *and measure thickness in accordance with ASTM C 174* ~~to determine the actual thickness. When the Department is ready to core the finished pavement for thickness, provide traffic control, coring equipment, and operator to obtain the cores. The Engineer will select the coring locations and make the acceptance measurements *for thickness determination.* Take borings at random intervals and at various points on the cross-section so that each test boring represents an area not exceeding 2,500 yd^2 [2,000 m^2].~~ Replace the portions of the pavement removed by the borings at no expense to the Department.

350-14.1.2 Non-destructive Testing: ~~*To determine by*~~ *-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-~~16~~*14*.2 Method of Calculating Average Thickness: The Department will determine the average thickness of *the* pavement *by using the following method of calculation:* ~~from the length of all cores taken as indicated above and will calculate it as follows:~~

(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*~~as measured by the cores~~ 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-~~17~~-*15* Deficient Thickness.

350-~~17~~*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-~~17~~*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 ~~deficient~~ *deficiency* ~~area~~ is ~~sufficient~~ *enough* to seriously impair the anticipated service life of the pavement, ~~the Contractor shall~~ 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-*~~17~~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 Contractor may elect to leave~~ the pavement *may be left* in place, ~~but shall receive~~ *at* no compensation ~~for the area of pavement~~.

350-~~17~~*15*.4 Additional Borings: If the ~~Contractor believes that the~~ number of cores taken is not sufficient to indicate the thickness of the pavement, ~~he may request that the Engineer select~~ additional boring locations *may be requested, with prior approval* ~~by~~ *from the Engineer* ~~*and bear all cost for these additional boring locations*~~*at no additional cost to the Department.* ~~The Department will deduct the cost of these additional borings from any sums due the Contractor, unless such borings indicate that the pavement within the questioned area is of specified or greater thickness.~~

350-~~18~~-*16* Opening Pavement to Traffic.

Construct an earth berm along each edge of the pavement after the concrete is 3 days old or less than 7 days old. Build the berm to the full height of the pavement and at least 18 inches [0.5 m] wide, and sufficiently compacted ~~*it*~~ *to prevent underwash of the pavement. Maintain the berm until* ~~*completing*~~ *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 50°F [10°C]) 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 ~~AASHTO T 23~~*ASTM C 31* and tested in accordance with ~~AASHTO T 97~~*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* ~~*Department's Roadway and Traffic Design Standards for Design, Construction, Maintenance and Utility Operations on the State Highway System.*~~ ~~Provide protection that includes the erection and maintenance of signs, lights, barricades, etc., the construction and removal of temporary pavement, bridges, crossovers, etc., and the use of flagmen as may~~

~~be necessary. Arrange the protective measures so as not to interfere with traffic in lanes being utilized for required maintenance of traffic.~~

~~Before opening the pavement to traffic, construct an earth berm along each edge. Build the berm to the full height of the pavement and at least 18 inches [0.5 m] wide, and sufficiently compact it to prevent underwash of the pavement. Maintain the berm until completing the final shoulders.~~

350-~~19~~-*17* Method of Measurement.

350-~~19~~*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~~7~~.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~~ic~~ 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~~ic~~ concrete surface course constructed in accordance with Section 33~~14~~. Reinforcing steel, placed and accepted, will be measured and paid for as provided in Section 415.

350-~~19~~*17*.2 Joints and Cracks: ~~The Contractor shall include~~*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 ~~that have been~~ 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-~~20~~-*198* 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.

350 CEMENT CONCRETE PAVEMENT. (REV 1-15-04) (FA 00-00-00) (7-04)

SECTION 350 (Pages 304-322) 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.

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.

Do not use automatic grade controls 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].

350-3.7 Texturing Machine: Provide a machine that consists of a supplementary machine capable of applying the final finish to the concrete pavement. Apply the finish by rectangular shaped spring steel tines rigidly mounted in a frame operating on an adjustable track mounted under the main frame of the machine. Use a machine that is constructed so as to provide for adjustment of the downward pressure on the tines as necessary to produce the desired finish under varying conditions of the concrete surface.

The Engineer may allow variation from any specific feature of the Texturing Machine as detailed above, provided that the Contractor can produce an equivalent final finish.

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 35°F [1°C], periods when the air temperature may rise above 85°F [29°C], 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 50°F [10°C].

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. 305 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 loadtransfer 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, as soon as there is no danger of further raveling.

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: 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.

350-12.6 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 50°F [10°C] 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 40°F [5°C].

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.

Before opening the pavement to traffic, construct an earth berm along each edge. 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 50°F [10°C]) 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.

350-18 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.

John H Owens

02/02/2004 10:02 AM

To: Charles A Ishee/SM/FDOT@FDOT
cc: Michael Bergin/SM/FDOT@FDOT, Duane F Brautigam/CO/FDOT@FDOT, (bcc: Judy F Frazier/CO/FDOT)
Subject: Re: Greg Schiess comments on Sections 350, 352, 353 and 354.

Good morning Charles, here we go again. Please review and respond to the comments below submitted by Greg Schiess. Also, please note that we need answers today, as we are holding the July 2004 work book to incorporate these revised Specifications into this work book.
If these comments cannot be resolved promptly, the revised Specifications will not be implementation with the July 2004 work book and we will try for a January 2005 implementation date.

Thank You, Have A Great Day,

John H. Owens

F.D.O.T. Specifications Office

(850) 414-4113 Fax (850) 413-7385

E-Mail: john.owens@dot.state.fl.us

----- Forwarded by John H Owens/CO/FDOT on 02/02/2004 09:50 AM -----

Duane F Brautigam

02/02/2004 09:02 AM

To: Clinton Shaw/CO/FDOT@FDOT, Juanita Moore/CO/FDOT@FDOT, Shirley Harvey/CO/FDOT@FDOT, John H Owens/CO/FDOT@FDOT
cc:
Subject: DB 013004.doc

Please look at these comments from Greg Schiess ASAP. Where do we stand with these concrete pavement specs? Are we holding the workbook for this package?

Please get together and let me know today, if possible, where we are on the entire package.

Thanks - DFB

Duane F. Brautigam, P.E.
State Specifications Engineer
Florida Department of Transportation
(850) 414-4130; SC 994-4130
duane.brautigam@dot.state.fl.us

----- Forwarded by Duane F Brautigam/CO/FDOT on 02/02/2004 08:58 AM -----

"Schiess, Greg" <Greg.Schiess@fhwa.dot.gov>

01/30/2004 01:37 PM

To: <DUANE.BRAUTIGAM@DOT.STATE.FL.US>
cc:
Subject: DB 013004.doc

To: Mr. D. Brautigam

From: G Schiess

Subject: Spec Review

Date: 30-Jan-04

I have the following comments on these specifications: 354, 350, 352, and 353.

350 - There are numerous comments and these were discussed with Charles Ishee at the DME meeting this week. Charles agreed to make the changes.

354

Section 354 – 1 .....Second sentence should be eliminated and placed in 350, if it isn't already there.

Section 354-3..... Partial depth repairs are no longer allowed by the Department, (the performance has been horrible even when done right). Need section rewritten accordingly

.....Also in the development of the PCC warranty spec agreement was reached that the defective area (in the wheel path) that can be filled with silicone is when the width is 1" or less (can be left in place). Suggests this spec read the same.

352

Need to address "What" the calibration will consists of and reference that in the specification. Also need to require the calibration to be observed by the Engineer

Section 352-6 .....need to establish the maximum area, or wheel path length, that the longitudinal grooves can be ground out to correct a bump or improve the ride before the area has to be re-grooved.

Section 352-7.....Need the plans prep manual to tell designers to add this pay item to all pcc jobs.....or.....if the grinding is to be included in the cost of the pcc, reword this section accordingly.

353

Not sure why 346 isn't referenced for materials and the concrete called something like "Special Class I" . Since the acceptance and verification samples are referenced in the spec we need a frequency for S&T,...and since this spec doesn't cal the concrete mix a paving class I the how does 346 control??

..... Also is the 750 psi tolerance right for 24 hour breaks ????

Section 353-6 .. Third sentence...why is the phase "unacceptable to the Engineer," here. If the slab cracks replace it.

Will all slab replacement jobs include grinding the finished surface?? If not the spec should address the straight edging.

Judy F Frazier

01/16/2004 09:48 AM

To: donald.davis@fhwa.dot.gov,
cc: ann.allshouse@fhwa.dot.gov, Ananth Prasad/CO/FDOT, Clay McGonagill/CO/FDOT, bburleson@ftba.com, Charles A Ishee/SM/FDOT,
cc:
Subject: D3500000.D03

Please review the attached draft specification and return your approval/comments as soon as possible. Thank you.

D3500000.D03.doc

Judy Frazier
(850) 414-4127, SC 994-4127
judy.frazier@dot.state.fl.us

Florida Department of Transportation

JEB BUSH
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JOSÉ ABREU
SECRETARY

January 15, 2004

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: D3500000.D03

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 Charles Ishee of the State Materials Office to bring the specification more in agreement with the Contractor Quality Control guidelines.

Please review and transmit your comments, if any as soon as possible so that we may include this in the July 2004 Workbook. 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,

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

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

350 CEMENT CONCRETE PAVEMENT.
(REV ~~5-13-03~~*09-19-03*~~1-15-04~~*15-04*) *(FA 00-00-00) (7-04)*

SECTION 350 (Pages 304-322) is deleted and the following substituted:

SECTION 350
CEMENT CONCRETE PAVEMENT

350-1 Description.

Construct ~~portland~~ *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.*

~~For aggregates, proportioning and mixing, and other provisions for the production of the concrete, meet the applicable provisions of Section 346.~~

~~Provide adequate lighting for all work done at night, including finishing, curing, and sawing joints. Unless lighting is provided for finishing, stop construction operations soon enough each day to permit finishing during daylight.~~

~~At least 20 days prior to paving, f~~*F*urnish the following information ~~for the Engineer's review for specification compliance~~*in the Quality Control Plan (QCP) as required in Section 105*:

1. A detailed sequence and schedule of concrete placement operations including, but not ~~necessarily~~ 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. ~~*M*A detailed staking plan for subgrade controls including offset requirements~~*A method to ensure the proper placement of reinforcing steel, tie bars and dowel bars.*

3. A traffic control plan ~~for pavement construction operations~~ *that* ~~which~~ 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. ~~Identify~~ Defined provisions for adequate lighting for all work done at night, including finishing, curing, and sawing joints.

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

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

7. ~~Identify~~ 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: ~~Obtain the Engineer's approval of the equipment and tools to be used for handling materials and performing all parts of the work, as to their design, capacity, and mechanical condition. Deliver the equipment to the job site sufficiently ahead of the start of construction operations to allow the Engineer to examine it thoroughly for approval.~~

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

~~Equip all equipment which operates on the side forms with scraping devices to clean accumulations from the top of the forms and wheels.~~*~~Provide~~ Ensure the equipment and tools that are to be used ~~that~~ meet the following:*

~~Capable~~ 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 ~~meet~~ are in accordance with the contract documents, prior to the placing of concrete.

~~**350-3.2 Equipment For Trimming of Subgrade:** For equipment operating on the subgrade, provide an automatically controlled subgrade trimmer. Use a machine that is capable of trimming the subgrade to proper elevation within the tolerances established herein. Provide grade controls that operate by sensing from a taut line, set true to line and grade. Erect and maintain the taut line.~~

~~**350-3.3 Forms:**~~

~~**350-3.3.1 Form Material:** Provide steel forms, except that on curves with a radius of 45 m or less, provide flexible forms, or wooden forms that bend to the required arc.~~

~~**350-3.3.2 Dimensions:** Use forms with a minimum length of 10 feet [3 m], except wherethey are used on curves having a radius between 150 and 300 feet [45 and 90 m], in which case use a form length of 5 feet [1.5 m]. Use forms with a height that is equal to the edge thickness of the pavement. Use forms with a height greater than the edge thickness, provided the outer portion of the slab is thickened to equal the depth of the form by tapering at the rate of 1 inch of the extra thickness per foot [80 mm of the extra thickness per meter] of width. In such case, the Department will make no allowance for additional concrete. Do not use built-up forms.~~

~~**350-3.3.3 Steel Forms:** Use steel forms fabricated into an approved section and sufficiently strong to ensure rigidity under the impact, thrust, and weight of the heaviest equipment to be carried over the forms. Make the width of the base of the forms which is in direct contact with the soil at least equal to the height of the forms, but not less than 8 inches [200 mm]. Extend the flange braces outward on the base not less than two-thirds the height dimension of the form. Use steel forms of a thickness that is not less than 7/32 inch [5.5 mm]. When tested with a 10 foot [3.048 m] straightedge, ensure that the forms have no vertical variation in a 10 foot [3 m] length that is greater than 1/8 inch [3 mm] from a true plane of the surface on the top of the form, and no lateral variation that is greater than 1/4 inch [6 mm] from a true plane surface on the vertical face of the form. Do not use steel forms if, when tested as a simple beam with a span of 9 feet 6 inches [2.9 m] and a load equal to that exerted by construction equipment placed upon them, the deflection is more than 1/4 inch [6 mm].~~

~~**350-3.3.4 Form Connections:** Provide connections between adjacent sections of the form, that form a lock joint, free from vertical movement in excess of 1/8 inch [3 mm] and from horizontal movement in excess of 1/4 inch [6 mm], under the impact, thrust, and weight of the heaviest machine carried on the forms.~~

~~**350-3.3.5 Defective Forms:** Remove bent, twisted, or broken forms, and forms with battered top surfaces, from the work. Do not use repaired forms until they are inspected and approved by the Engineer.~~

~~**350-3.3.6 Form Stakes:** Provide at least three steel stakes for each 10 foot [3 m] length of form. Use stakes that are of sufficient size to prevent undue lateral movement of the form during paving operations. Fasten each of the stakes to the form by means of a suitable socket attached to the form. Equip each stake socket with steel wedges for securely keying the forms to the stakes. Locate a stake not more than 12 inches [300 mm] from the end of each section. Do not use forms with broken or badly worn sockets.~~

~~**350-3.3.7 Form Tampers:** Use adequate mechanical form tampers, capable of thoroughly compacting the soil under the forms, except when the forms rest on a cement-treated subgrade.~~

~~**350-3.4 Spreader:** Provide a mechanical spreader that is independently powered and capable of spreading the mixed concrete on the subgrade over the entire width and depth of the strip being paved in a manner which will prevent segregation of the materials. Use a spreader designed and constructed to permit the concrete to be struck-off to a uniform thickness.~~

~~**350-3.5 Strike-Off, Consolidation, and Finishing for Fixed-Form Construction:** Provide equipment for these operations that consists of a self-propelled unit, or units, that perform the following functions by mechanical means, in the sequence indicated:~~

~~(1) Strike-off.~~

~~(2) Vibratory Consolidation.~~

~~(3) Screeding.~~

~~(4) Floating.~~

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

350-3.6*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 ~~all of this~~*the* equipment is of such dimensions and arrangement as to cover the full width of the pavement strip being *placed*~~laid~~. 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.

Do not use automatic grade controls on the paver when the tracks of the slip-form paver are operating on ~~econocrete base or~~ 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.

~~The Engineer may allow variation from any specific feature of the slip-form paver as detailed above, provided the industry has generally accepted the proposed variation as an improved feature.~~

350-3.7*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 ~~cause~~ 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.

~~**350-3.8 Mechanical Floating Equipment:** Provide equipment that consists of a supplementary self-propelled machine capable of further smoothing the concrete, removing excess mortar from the surface, and minimizing hand finishing.~~

~~Use a machine that leaves the surface of the concrete 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.~~

350-3.~~9~~ *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.

~~The Contractor may use hand- p~~*P*ower-spray equipment ~~to~~ *may be used to* apply curing compound to areas where it is impracticable to operate the self-propelled equipment.

~~**350-3.10 Equipment for Sealing Joints:** Provide equipment for sealing the joints for each section of pavement. Use a heating kettle for hot-poured sealer that is of the indirect heating or double-boiler type, using oil as a heat transfer medium. 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. Use pouring equipment equipped with nozzles that discharge the seal 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 for pouring, within 10°F [5°C]*manufacturer's*.~~

350-3.~~11~~ *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. ~~The Contractor may u~~*U*se such equipment *that*~~as~~ *is approved by* the Engineer~~ may approve for such areas~~.

350-3.~~12~~ *6* Hand Finishing Tools: Provide straightedges that have a blade length of 10 feet [3~~.048~~ 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].

350-3.~~13~~ *7* Texturing Machine: Provide a machine that consists of a supplementary machine capable of applying the final finish to the concrete pavement. Apply the finish by rectangular shaped spring steel tines rigidly mounted in a frame operating on an adjustable track mounted under the main frame of the machine. Use a machine that is constructed so as to provide for adjustment of the downward pressure on the tines as necessary to produce the desired finish under varying conditions of the concrete surface.

The Engineer may allow variation from any specific feature of the Texturing Machine as detailed above, provided that the Contractor can produce an equivalent final finish.

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* moist*ure 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 35°F [1°C], periods when the air temperature may rise above 85°F [29°C], high winds, heavy rains and other conditions that might affect the final durability of the pavement. ~~Have available at the site, at all times when concrete paving operations are underway, materials for the protection of the surface and edges of the unhardened concrete. For the protection of the pavement edges, use any covering material, such as burlap, paper, or plastic sheeting material, suitable for the protection of the pavement surface.~~

~~———~~When rain appears imminent, stop all paving operations, and ~~have all available personnel~~ cover the surface of the unhardened concrete with the protective covering.

~~———During periods when the air temperature may fall below 35°F [1°C], advise the Engineer of plans for curing and protecting the fresh concrete *shall be implemented as identified in the QCP* before placing the concrete. Do not place any concrete until the Engineer has approved the proposed methods.~~

~~The Contractor is fully responsible for the quality and strength of the concrete placed in cold weather even if the Engineer approves of the provisions the Contractor employs for protecting the concrete placed during cold weather.~~

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.

~~Secure the reinforcement in position in advance of concrete placement or, with the Engineer's specific approval, place it in the plastic concrete by mechanical or vibratory means after spreading the concrete.~~ 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 ~~which could impair bonding of the steel with the concrete~~. 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. ~~and t~~*T*he surface will at no point be below the grade specified for the finished surface~~, after application of the allowable tolerance~~. ~~Deposit~~ *Place* the concrete on the subgrade in a manner which will require as little rehandling as possible. ~~Continuously place concrete between transverse joints without using intermediate bulkheads.~~

~~Deposit~~ *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.* ~~Do not dump concrete from the discharge bucket or hopper onto an assembly without centering the bucket or hopper directly over the assembly.~~

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.* ~~The Engineer will not require the Contractor to use a spreader for areas where the width of slab varies, for intersections, and for 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*). Ensure that workmen *workers* do not walk in the freshly deposited concrete with *their boots or shoes coated with* earth or other deleterious substances coated on their boots or shoes.~~

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. ~~The Engineer will not require the Contractor to alter placement operations where superelevation reverses the pavement cross slope from that shown on the typical section.~~

~~**350-8.4 Hours of Operation:** Stop placing concrete in time to complete finishing operations during daylight hours, or provide adequate approved lighting *as identified in the QCP.*~~

350-8.5*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. ~~Do not continue vibration at any one location so long as to produce puddling or the accumulation of excessive grout on the surface.~~

350-9*8.65* 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-~~10~~ *9* Striking-off, Consolidating, and Finishing Concrete.

350-~~10~~*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 ~~planning~~ 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-~~10~~*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-~~10~~*9*.3 Hand Methods:

350-~~9~~*10*.3.1 Conditions under which Allowed: ~~The Contractor may use~~ *Use* hand methods in areas of narrow width or irregular dimensions, where operation of mechanical equipment is impracticable. ~~In the event that mechanical equipment breaks down, the Contractor may use hand methods to finish only that concrete already deposited on the subgrade when the breakdown occurred.~~

350-~~9~~*10*.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.

~~In operation, move the screed forward on the forms with a combined longitudinal and transverse shearing motion, moving always in the direction in which the work is progressing, and manipulate it so that neither end is raised from the side forms during the striking off process. If necessary, repeat this until the surface is of uniform texture, true to grade and cross-section, and free from porous areas.~~

350-~~9~~*10*.3.3 Consolidation: Use hand-operated spud-type vibrators to consolidate.

350-~~9~~10.3.4 Floating: Use long-handled floats to float the concrete. Take the necessary care to avoid creating depressions or ridges during this operation.

350-~~9~~10.4 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.

~~350-11 Supplemental Floating.~~

~~In areas where performing machine strike-off, consolidation, and finishing, further 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. Waste excess mortar beyond the edge of the slab.~~

350-~~12~~ *10* Final Finish.

350-~~12~~*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.

~~After applying the burlap drag finish, apply the final finish with the texturing machine. Control the time of applying this finish and the method of operating the texturing machine so as to minimize tearing of surface and unseating of aggregate particles.~~

~~Provide a final finish that consists of transverse grooves which are 0.08 to 0.12 inch [2 to 3 mm] in width and 0.10 to 0.15 inch [2.5 to 4 mm] in depth, spaced at random intervals between 1/2 to 1 inch [13 to 25 mm]. Operate the texturing machine in a manner that minimizes the overlapping of subsequent passes of the steel comb. Create short gaps in the grooved finish as necessary to avoid overlap between passes.~~

~~In areas of irregular dimensions or narrow widths, where operating the texturing machine is impracticable, the Contractor may apply the finish by approved hand methods that achieve the required finish with a minimum of surface tearing and unseating aggregate particles. Ensure that the surface resulting from this operation is uniform in appearance and free of irregular, rough, or porous areas.~~

350-~~12~~*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-~~13~~ *11* Curing.

350-~~13~~*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 ~~all~~ cases *where*~~in which~~ 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*~~Engineer will order an immediate suspension of concreting~~

~~operations~~. 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 50°F [10°C].

350-~~13~~*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} ~~0.005 gal/ft^2~~ [~~0.2 L/m^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* ~~until the pigment is uniformly dispersed throughout the vehicle~~.

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-~~13~~*11*.3 Burlap Mats: ~~Under this method, cover the surfaces to be cured with 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 ~~so as to cause them to remain in intimate contact with the surface being cured,~~ throughout the curing period *to ensure ~~a~~ contact with the surface being cured.* Maintain the mats fully moist and in position for the entire portion of the required ~~burlap~~ curing period.

350-~~13~~*11*.4 Removal of Forms: Do not remove forms from freshly placed concrete ~~until it has set~~ 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.

~~**350-14 Surface Requirements.**~~

~~After curing, remove the curing material (except for the impervious coating), and thoroughly test the surface for pavement surface smoothness in accordance with 352-4(c). Plainly mark all variations from the required tolerances. Where pavement surfaces do not meet the smoothness requirements, the Engineer will require corrective work and retesting to ensure conformity.~~

~~Eliminate high spots exceeding 1/8 inch in 10 feet [3.2 mm in 3 m], but not in excess of 0.3 inch in 25 feet [7.6 mm in 7.6 m], by grinding either with an approved machine or with a carborundum brick and water. Do not use bush-hammering or other destructive means for removing irregularities. As directed by the Engineer, retexture corrected high areas to give skid resistance comparable to the surrounding area.~~

~~Provide grinding equipment with a power driven self propelled machine that is specifically designed to grind portland cement concrete pavement, with a minimum of a 3 foot [1 m] wide grinding head and diamond impregnated grinding blades. Produce, by grinding, a pavement surface that is true to grade and uniform in appearance with a longitudinal line type texture. Provide a line type texture that contains parallel longitudinal corrugations that present a narrow ridge corduroy type appearance. Ensure that the peaks of ridges are approximately 1/32 inch [0.8 mm] higher than the bottoms of the grooves with approximately 60 evenly spaced grooves per foot [300 mm].~~

~~Operate all milling, cutting, or grinding equipment to produce a reasonably uniform finished surface without spalling the pavement joints within corrected areas. The Engineer will not require extra grinding to eliminate minor depressions in order to provide 100% texturing of the pavement surface. Maintain the cross slope of the pavement as shown in the plans. Repair all joint seals destroyed by grinding at no expense to the Department.~~

~~Remove and replace any area of pavement which, after grinding, still shows a deviation in excess of the allowable tolerance. Ensure that the area removed and replaced is the full length between transverse joints and the full width of the lane involved.~~

~~Saw the area to be removed to a smooth vertical surface. Clean the face of the adjacent (hardened) concrete, and coat it with an epoxy bonding compound before placing the replacement concrete.~~

~~Bear the costs of all surface corrections required and of all required removal and replacement of defective surface concrete.~~

350-~~15~~ *12* Joints.

350-~~15~~*12*.1 General: Construct joints at the locations and in accordance with the details shown in the ~~Roadway and Traffic~~ Design Standards, Index No. 305 and the Contract Documents.

350-~~15~~*12*.2 Longitudinal Joints:

350-~~15~~*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. ~~Where keyways are required, the Contractor may form them by placing an insert of the proper shape along the inside face of the side form or, when using the slip form method of paving, by an approved extrusion device. Use a method that produces a keyway of the shape and at the location indicated in the plans.~~

350-~~15~~*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*~~within~~ 72 hours after placing the concrete.

350-~~15~~*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.

~~**350-15.2.4 Longitudinal Shoulder Joints (Concrete to Asphalt):** Construct a continuous joint by sawing a groove into the asphalt pavement at the abutment with the concrete pavement. Produce a groove that is 3/4 inch [19 mm] wide and 3/4 inch [19 mm] deep, after sawing and cleaning.~~

~~Seal the joint with hot-poured type sealant.~~

350-~~15~~*12*.3 Transverse Joints:

350-~~15~~*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-~~15~~*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 loadtransfer 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* ~~in general when the concrete is between 4 and~~ 12 hours *after placing the concrete*~~old~~. Make a second saw

cut, to provide the joint dimensions indicated in the plans, as soon as there is no danger of further raveling.

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-~~15~~*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 ~~Roadway and Traffic~~ 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 ~~on the Roadway and Traffic Design Standards, *Index 306*~~ *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-~~15~~*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 ~~the free end of~~ each dowel with one coat of approved zinc rich paint (listed on the Qualified Products List), and grease *one end* ~~it~~ with an approved lubricant, to prevent the concrete from bonding to the dowel. *Provide a cap for* ~~Provide~~ the free end of expansion joint dowels ~~with the closest fitting metal cap or sleeve, equipped with a stop to prevent closing during placement operations. Maintain a clearance of 1 inch [25 mm] between the closed end of the cap and the dowel to accommodate future slab movement.~~

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].

~~Provide the Engineer with c~~Confirm~~ation of~~ the ~~location~~ *position* of ~~the~~ dowel bars *by suitable means acceptable to the Engineer, which may include non-destructive testing methods.* ~~The Contractor shall confirm that the paving operation has not displaced the dowels from their required positions. Perform confirmation checks daily for the first two days of the paving operation and weekly thereafter.~~

350-~~15~~*12*.5 Expansion Joints Around Structures: 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-~~15~~*12*.6 Cleaning Joints and Cracks:

350-~~15~~*12*.6.1 Cleaning Joints in New Pavement:

350-~~15~~*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-~~15~~*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-~~15~~*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-~~15~~*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*~~15~~.6.2.

350-~~15~~*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-~~15~~*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 50°F [10°C] or greater.

~~*Use a heating kettle for hot poured sealer that is of the indirect heating or double boiler type, using oil as a heat transfer medium*~~*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-~~15~~*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 40°F [5°C].

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-~~16~~-*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 ~~**350-16.1**~~ **Core Borings:** ~~After completing the concrete pavement, including any corrective work to meet ride requirement,~~ *To determine the actual thickness,* drill cores from the pavement *and measure thickness in accordance with ASTM C 174* ~~to determine the actual thickness. When the Department is ready to core the finished pavement for thickness, provide traffic control, coring equipment, and operator to obtain the cores. The Engineer will select the coring locations and make the acceptance measurements *for thickness determination*. Take borings at random intervals and at various points on the cross-section so that each test boring represents an area not exceeding 2,500 yd^2 [2,000 m^2].~~ Replace the portions of the pavement removed by the borings at no expense to the Department.

350-14.1.2 Non-destructive Testing: ~~*To determine by*~~ *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-~~16~~*14*.2 Method of Calculating Average Thickness: The Department will determine the average thickness of *the* pavement *by using the following method of calculation:* ~~from the length of all cores taken as indicated above and will calculate it as follows:~~

(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*~~as measured by the cores~~ 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-~~17~~*15* Deficient Thickness.

350-~~17~~*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-~~17~~*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 ~~deficient~~ *deficiency* ~~area~~ is ~~sufficient~~ *enough* to seriously impair the anticipated service life of the pavement, ~~the Contractor shall~~ 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-~~17~~*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 Contractor may elect to leave~~ the pavement *may be left* in place, ~~but shall receive~~ *at* no compensation ~~for the area of pavement~~.

350-~~17~~*15*.4 Additional Borings: If the ~~Contractor believes that the~~ number of cores taken is not sufficient to indicate the thickness of the pavement, ~~he may request that the Engineer select~~ additional boring locations *may be requested, with prior approval* ~~by~~ *from the Engineer* ~~*and bear all cost for these additional boring locations*~~*at no additional cost to the Department.* ~~The Department will deduct the cost of these additional borings from any sums due the Contractor, unless such borings indicate that the pavement within the questioned area is of specified or greater thickness.~~

350-~~18~~*16* Opening Pavement to Traffic.

Before opening the pavement to traffic, construct an earth berm along each edge. Build the berm to the full height of the pavement and at least 18 inches [0.5 m] wide, and sufficiently compacted ~~*it*~~ *to prevent underwash of the pavement. Maintain the berm until* ~~*completing*~~ *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 50°F [10°C]) 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 ~~AASHTO T 23~~*ASTM C 31* and tested in accordance with ~~AASHTO T 97~~*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* ~~*Department's Roadway and Traffic Design Standards for Design, Construction, Maintenance and Utility Operations on the State Highway System.*~~ ~~Provide protection that includes the erection and maintenance of signs, lights, barricades, etc., the construction and removal of temporary pavement, bridges, crossovers, etc., and the use of flagmen as may be necessary. Arrange the protective measures so as not to interfere with traffic in lanes being utilized for required maintenance of traffic~~.

~~Before opening the pavement to traffic, construct an earth berm along each edge. Build the berm to the full height of the pavement and at least 18 inches [0.5 m] wide, and sufficiently compact it to prevent underwash of the pavement. Maintain the berm until completing the final shoulders.~~

350-~~19~~-*17* Method of Measurement.

350-~~19~~*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~~7~~.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~~ic~~ 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~~ic~~ concrete surface course constructed in accordance with Section 33~~1~~*4*. Reinforcing steel, placed and accepted, will be measured and paid for as provided in Section 415.

350-~~19~~*17*.2 Joints and Cracks: ~~The Contractor shall include~~*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 ~~that have been~~ 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-~~20~~-*198* 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.

350 CEMENT CONCRETE PAVEMENT. (REV 1-15-04) (FA 00-00-00) (7-04)

SECTION 350 (Pages 304-322) 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.

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.

Do not use automatic grade controls 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].

350-3.7 Texturing Machine: Provide a machine that consists of a supplementary machine capable of applying the final finish to the concrete pavement. Apply the finish by rectangular shaped spring steel tines rigidly mounted in a frame operating on an adjustable track mounted under the main frame of the machine. Use a machine that is constructed so as to provide for adjustment of the downward pressure on the tines as necessary to produce the desired finish under varying conditions of the concrete surface.

The Engineer may allow variation from any specific feature of the Texturing Machine as detailed above, provided that the Contractor can produce an equivalent final finish.

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 35°F [1°C], periods when the air temperature may rise above 85°F [29°C], 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 50°F [10°C].

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. 305 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 loadtransfer 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, as soon as there is no danger of further raveling.

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: 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.

350-12.6 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 50°F [10°C] 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 40°F [5°C].

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.

Before opening the pavement to traffic, construct an earth berm along each edge. 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 50°F [10°C]) 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.

350-18 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.

Florida Department of Transportation

JEB BUSH
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JOSÉ ABREU
SECRETARY

MEMORANDUM

DATE: January 12, 2003

TO: Clinton J. Shaw, State Specifications Office

FROM: Charles A. Ishee, Structural Materials Research Engineer

COPIES: Michael J. Bergin, Judy F. Frazier

SUBJECT: **Proposed Modifications to Specification: D3500000.D02**

All received comments have been reviewed regarding the subject modification to the Standard Specification and are attached with reply. If you have any questions, please e-mail me at RT822CI or charles.ishee@dot.state.fl.us.

CAI/cai

Attachment

Responses to Comments Received on Draft Specifications

1. **Specification 350-11.1 (General)**
Submitted by: David Sadler – State Construction Office
Comment: If the Contractor fails to provide sufficient curing materials to adequately cure the concrete in place in a timely manner, that portion the concrete pavement section of the QCP will be suspended.
Response: Agree, specification changed to read... "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."

2. **Specification 350-12.3.2 (Transverse Contraction Joints)**
Submitted by: David Sadler – State Construction Office
Comment: 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.
Response: Agree, this is the wording currently in the specification.

3. **Specification 350-12.3.3 (Transverse Expansion Joints)**
Submitted by: David Sadler – State Construction Office
Comment: Form transverse expansion joints using preformed joint filler, and provide them with dowel load transfer, in accordance with the details shown in the Design Standards, or in the plans. Contract Documents.
Response: Agree, specification changed to read... "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 contract documents."

4. **Specification 350-15.1 (General)**
Submitted by: David Sadler – State Construction Office
Comment: 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 the concrete pavement portion of the QCP quality control plan to be suspended until the corrections are to the satisfaction of the Engineer.
Response: Agree, specification changed to read... "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."

5. **Specification 350 (General)**
Submitted by: Jim Martin – District II Specification Office
Comment: These specs are going into CQC, so whenever there is concrete pavement to be done, it will also have to be listed in the CQC plan. However, I do not see where spec 6-8 is being changed to accommodate this additional set of specifications. Is 6-8 going to be changed?
Response: Disagree because 6-8 has been changed to address this issue. The concrete pavement needs to met the requirements of any project with concrete on it.

6. **Specification 350 (General)**
Submitted by: Jim Martin – District II Specification Office
Comment: In 352, they are not following the same protocol as they did in 350. In 350, they cross off the ".048" when going metric for 10 feet. However, in 352, they describe 10 feet as being 3.048 meters, The specs should agree in the interpretation of what 10 feet is.
Response: Agree, both specifications will be changed to describe 10 feet as being 3 meters.

7. **Specification 350-14.1.2 (Non-destructive Testing)**
Submitted by: Florida Concrete Products Association
Comment: In 350, the Non-destructive testing is now allowed, but does these tests need to be checked for accuracy more often?
Response: Agree, specification changed to read... "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."

CEMENT CONCRETE PAVEMENT.
(REV 10-23-03)

SECTION 350 (Pages 304-322) 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.

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.

Do not use automatic grade controls 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].

350-3.7 Texturing Machine: Provide a machine that consists of a supplementary machine capable of applying the final finish to the concrete pavement. Apply the finish by rectangular shaped spring steel tines rigidly mounted in a frame operating on an adjustable track mounted under the main frame of the machine. Use a machine that is constructed so as to provide for adjustment of the downward pressure on the tines as necessary to produce the desired finish under varying conditions of the concrete surface.

The Engineer may allow variation from any specific feature of the Texturing Machine as detailed above, provided that the Contractor can produce an equivalent final finish.

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 35°F [1°C], periods when the air temperature may rise above 85°F [29°C], 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 50°F [10°C].

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. 305 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 loadtransfer 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, as soon as there is no danger of further raveling.

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 contract documents.

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 on the Design Standards, Index 306.

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: 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.

350-12.6 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 50°F [10°C] 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 40°F [5°C].

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.

Before opening the pavement to traffic, construct an earth berm along each edge. 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 50°F [10°C]) 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.

350-18 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.

Judy F Frazier
01/08/2004 08:42 AM

To: Charles A Ishee/SM/FDOT,
cc: Michael Bergin/SM/FDOT,
cc:
Subject: D3500000.D02

Please disreguard the email below and use the attached document below for responding to. I inadvertently sent you the wrong document.

D3500000.D02.doc

Judy Frazier
(850) 414-4127, SC 994-4127
judy.frazier@dot.state.fl.us
----- Forwarded by Judy F Frazier/CO/FDOT on 01/08/2004 08:42 AM -----

Judy F Frazier
01/08/2004 08:41 AM

To: Charles A Ishee/SM/FDOT@FDOT
cc: Michael Bergin/SM/FDOT@FDOT
Subject: D3500000.D02

Please review the attached comments received from Industry Review and respond to each as soon as possible so that we may continue with the review process. Thank you.

D3500000.D02.doc

Judy Frazier
(850) 414-4127, SC 994-4127
judy.frazier@dot.state.fl.us

Florida Department of Transportation

JEB BUSH
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JOSÉ ABREU
SECRETARY

MEMORANDUM

DATE: January 8, 2004

TO: Charles Ishee

FROM: for Clinton J. Shaw, State Specifications Office

SUBJECT: **Proposed Modifications To Specification: D3500000.D02**

Comments received, regarding the subject modification to the Standard Specifications, are attached. Please review these comments and advise of any further modifications as soon as possible. Also, please submit an electronic summary, of your decisions concerning these comment(s) in memorandum format. This summary will be posted on the State Specifications Office Web Page and included in the Specifications folder for future reference, should someone question your response. Your assistance will be appreciated.

Please Email submittals to SP965CS or clinton.shaw@dot.state.fl.us.

CS/jf

Attachment

COMMENT FROM DAVID SADLER

John,

The following are my comments on these sections (suggested changes are in red):

350-11.1 General
If the Contractor fails to provide sufficient curing materials to adequately cure the concrete in place in a timely manner, that portion the concrete pavement section of the QCP will be suspended.

350-12.3.2 Transverse Contraction Joints
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.

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 oin the Design Standards, or in the plans. Contract Documents.

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 the concrete pavement portion of the QCP quality control plan to be suspended until the corrections are to the satisfaction of the Engineer.

John,

These are the comments from D2 personnel. If I am not following protocol please let me know.

1. These specs are going into CQC, so whenever there is concrete pavement to be done, it will also have to be listed in the CQC plan.
However, I do not see where spec 6-8 is being changed to accommodate this additional set of specifications. Is 6-8 going to be changed?
2. In 352, they are not following the same protocol as they did in 350. In 350, they cross off the ".048" when going metric for 10 feet. However, in 352, they describe 10 feet as being 3.048 meters, The specs should agree in the interpretation of what 10 feet is.
3. In 353, they have some grammar problems. See the fourth paragraph of 353-4. Delete the word "is".

Best Regards, Jim

Jim Martin, P.E.
District II Specifications Engineer
386.961.7577, SC 8

CEMENT CONCRETE PAVEMENT.
(REV ~~5-13-03~~*09-19-03*~~*10-23-03*~~)

SECTION 350 (Pages 304-322) is deleted and the following substituted:

SECTION 350
CEMENT CONCRETE PAVEMENT

350-1 Description.

Construct ~~portland~~ *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.*

~~For aggregates, proportioning and mixing, and other provisions for the production of the concrete, meet the applicable provisions of Section 346.~~

~~Provide adequate lighting for all work done at night, including finishing, curing, and sawing joints. Unless lighting is provided for finishing, stop construction operations soon enough each day to permit finishing during daylight.~~

~~At least 20 days prior to paving, f~~*F*urnish the following information ~~for the Engineer's review for specification compliance~~*in the Quality Control Plan (QCP) as required in Section 105*:

1. A detailed sequence and schedule of concrete placement operations including, but not ~~necessarily~~ 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. ~~*MA detailed staking plan for subgrade controls including offset requirements*~~*A method to ensure the proper placement of reinforcing steel, tie bars and dowel bars.*

3. A traffic control plan ~~for pavement construction operations~~ *that* ~~which~~ 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. ~~Identify~~ Defined provisions for adequate lighting for all work done at night, including finishing, curing, and sawing joints.

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

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

7. ~~Identify~~ 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: ~~Obtain the Engineer's approval of the equipment and tools to be used for handling materials and performing all parts of the work, as to their design, capacity, and mechanical~~

~~condition. Deliver the equipment to the job site sufficiently ahead of the start of construction operations to allow the Engineer to examine it thoroughly for approval.~~

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

~~Equip all equipment which operates on the side forms with scraping devices to clean accumulations from the top of the forms and wheels.~~*~~Provide~~ Ensure the equipment and tools that are to be used ~~that~~ meet the following:*

~~Capable~~ 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 ~~meet~~ are in accordance with the contract documents, prior to the placing of concrete.

~~**350-3.2 Equipment For Trimming of Subgrade:** For equipment operating on the subgrade, provide an automatically controlled subgrade trimmer. Use a machine that is capable of trimming the subgrade to proper elevation within the tolerances established herein. Provide grade controls that operate by sensing from a taut line, set true to line and grade. Erect and maintain the taut line.~~

~~**350-3.3 Forms:**~~

~~**350-3.3.1 Form Material:** Provide steel forms, except that on curves with a radius of 45 m or less, provide flexible forms, or wooden forms that bend to the required arc.~~

~~**350-3.3.2 Dimensions:** Use forms with a minimum length of 10 feet [3 m], except wherethey are used on curves having a radius between 150 and 300 feet [45 and 90 m], in which case use a form length of 5 feet [1.5 m]. Use forms with a height that is equal to the edge thickness of the pavement. Use forms with a height greater than the edge thickness, provided the outer portion of the slab is thickened to equal the depth of the form by tapering at the rate of 1 inch of the extra thickness per foot [80 mm of the extra thickness per meter] of width. In such case, the Department will make no allowance for additional concrete. Do not use built-up forms.~~

~~**350-3.3.3 Steel Forms:** Use steel forms fabricated into an approved section and sufficiently strong to ensure rigidity under the impact, thrust, and weight of the heaviest equipment to be carried over the forms. Make the width of the base of the forms which is in direct contact with the soil at least equal to the height of the forms, but not less than 8 inches [200 mm]. Extend the flange braces outward on the base not less than two-thirds the height dimension of the form. Use steel forms of a thickness that is not less than 7/32 inch [5.5 mm]. When tested with a 10 foot [3.048 m] straightedge, ensure that the forms have no vertical variation in a 10 foot [3 m] length that is greater than 1/8 inch [3 mm] from a true plane of the surface on the top of the form, and no lateral variation that is greater than 1/4 inch [6 mm] from a true plane surface on the vertical face of the form. Do not use steel forms if, when tested as a simple beam with a span of 9 feet 6 inches [2.9 m] and a load equal to that exerted by construction equipment placed upon them, the deflection is more than 1/4 inch [6 mm].~~

~~**350-3.3.4 Form Connections:** Provide connections between adjacent sections of the form, that form a lock joint, free from vertical movement in excess of 1/8 inch [3 mm] and from horizontal movement in excess of 1/4 inch [6 mm], under the impact, thrust, and weight of the heaviest machine carried on the forms.~~

~~**350-3.3.5 Defective Forms:** Remove bent, twisted, or broken forms, and forms with battered top surfaces, from the work. Do not use repaired forms until they are inspected and approved by the Engineer.~~

~~**350-3.3.6 Form Stakes:** Provide at least three steel stakes for each 10 foot [3 m] length of form. Use stakes that are of sufficient size to prevent undue lateral movement of the form during paving operations. Fasten each of the stakes to the form by means of a suitable socket attached to the form. Equip each stake socket with steel wedges for securely keying the forms to the stakes. Locate a~~

~~stake not more than 12 inches [300 mm] from the end of each section. Do not use forms with broken or badly worn sockets.~~

~~**350-3.3.7 Form Tampers:** Use adequate mechanical form tampers, capable of thoroughly compacting the soil under the forms, except when the forms rest on a cement treated subgrade.~~

~~**350-3.4 Spreader:** Provide a mechanical spreader that is independently powered and capable of spreading the mixed concrete on the subgrade over the entire width and depth of the strip being paved in a manner which will prevent segregation of the materials. Use a spreader designed and constructed to permit the concrete to be struck-off to a uniform thickness.~~

~~**350-3.5 Strike-Off, Consolidation, and Finishing for Fixed-Form Construction:** Provide equipment for these operations that consists of a self-propelled unit, or units, that perform the following functions by mechanical means, in the sequence indicated:~~

~~(1) Strike-off.~~

~~(2) Vibratory Consolidation.~~

~~(3) Screeding.~~

~~(4) Floating.~~

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

350-3.6~~.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 ~~all of this~~*the* equipment is of such dimensions and arrangement as to cover the full width of the pavement strip being *placed*~~laid~~. 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.

Do not use automatic grade controls on the paver when the tracks of the slip-form paver are operating on ~~econocrete base or~~ 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.

~~The Engineer may allow variation from any specific feature of the slip-form paver as detailed above, provided the industry has generally accepted the proposed variation as an improved feature.~~

350-3.~~7~~.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 ~~cause~~ 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.

~~**350-3.8 Mechanical Floating Equipment:** Provide equipment that consists of a supplementary self-propelled machine capable of further smoothing the concrete, removing excess mortar from the surface, and minimizing hand finishing.~~

~~Use a machine that leaves the surface of the concrete 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.~~

350-3.~~9~~ *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.

~~The Contractor may use hand p~~*P*ower-spray equipment ~~to~~ *may be used to* apply curing compound to areas where it is impracticable to operate the self-propelled equipment.

~~**350-3.10 Equipment for Sealing Joints:** Provide equipment for sealing the joints for each section of pavement. Use a heating kettle for hot-poured sealer that is of the indirect heating or double boiler type, using oil as a heat transfer medium. 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. Use pouring equipment equipped with nozzles that discharge the seal 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 for pouring, within 10°F [5°C]~~*manufacturer's*~~.~~

350-3.~~11~~ *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. ~~The Contractor may u~~*U*se such equipment *that*~~as~~ *is approved by* the Engineer~~ may approve for such areas~~.

350-3.~~12~~ *6* Hand Finishing Tools: Provide straightedges that have a blade length of 10 feet [3~~.048~~ 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].

350-3.~~13~~ *7* Texturing Machine: Provide a machine that consists of a supplementary machine capable of applying the final finish to the concrete pavement. Apply the finish by rectangular shaped spring steel tines rigidly mounted in a frame operating on an adjustable track mounted under the main frame of the machine. Use a machine that is constructed so as to provide for adjustment of the downward pressure on the tines as necessary to produce the desired finish under varying conditions of the concrete surface.

The Engineer may allow variation from any specific feature of the Texturing Machine as detailed above, provided that the Contractor can produce an equivalent final finish.

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* moist*ure 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 35°F [1°C], periods when the air temperature may rise above 85°F [29°C], high winds, heavy rains and other conditions that might affect the final durability of the pavement. ~~Have available at the site, at all times when concrete paving operations are underway, materials for the protection of the surface and edges of the unhardened concrete. For the protection of the pavement edges, use any covering material, such as burlap, paper, or plastic sheeting material, suitable for the protection of the pavement surface.~~

~~——~~When rain appears imminent, stop all paving operations, and ~~have all available personnel~~ cover the surface of the unhardened concrete with the protective covering.

~~——During periods when the air temperature may fall below 35°F [1°C], advise the Engineer of plans for curing and protecting the fresh concrete *shall be implemented as identified in the QCP* before placing the concrete. Do not place any concrete until the Engineer has approved the proposed methods.~~

~~The Contractor is fully responsible for the quality and strength of the concrete placed in cold weather even if the Engineer approves of the provisions the Contractor employs for protecting the concrete placed during cold weather.~~

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. ~~Secure the reinforcement in position in advance of concrete placement or, with the Engineer's specific approval, place it in the plastic concrete by mechanical or vibratory means after spreading the concrete.~~ 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 ~~which could impair bonding of the steel with the concrete~~. 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. ~~and t~~*T*he surface will at no point be below the grade specified for the finished surface~~, after application of the allowable tolerance~~. ~~Deposit~~ *Place* the concrete on the subgrade in a manner which will require as little rehandling as possible. ~~Continuously place concrete between transverse joints without using intermediate bulkheads.~~

~~Deposit~~ *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.* ~~Do not dump concrete from the discharge bucket or hopper onto an assembly without centering the bucket or hopper directly over the assembly.~~

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.* ~~The Engineer will not require the Contractor to use a spreader for areas where the width of slab varies, for intersections, and for 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*). Ensure that workmen *workers* do not walk in the freshly deposited concrete with *their boots or shoes coated with* earth or other deleterious substances coated on their boots or shoes.~~

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. ~~The Engineer will not require the Contractor to alter placement operations where superelevation reverses the pavement cross slope from that shown on the typical section.~~

~~**350-8.4 Hours of Operation:** Stop placing concrete in time to complete finishing operations during daylight hours, or provide adequate approved lighting *as identified in the QCP*.~~

350-8.*5*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. ~~Do not continue vibration at any one location so long as to produce puddling or the accumulation of excessive grout on the surface.~~

350-~~9~~8.*6*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-~~10~~ *9* Striking-off, Consolidating, and Finishing Concrete.

350-~~10~~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 ~~planning~~ 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-~~10~~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-~~10~~9.3 Hand Methods:

350-~~9~~10.3.1 Conditions under which Allowed: ~~The Contractor may use~~ *Use* hand methods in areas of narrow width or irregular dimensions, where operation of mechanical equipment is impracticable. ~~In the event that mechanical equipment breaks down, the Contractor may use hand methods to finish only that concrete already deposited on the subgrade when the breakdown occurred.~~

350-~~9~~10.3.2 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.

~~In operation, move the screed forward on the forms with a combined longitudinal and transverse shearing motion, moving always in the direction in which the work is progressing, and manipulate it so that neither end is raised from the side forms during the striking-off process. If necessary, repeat this until the surface is of uniform texture, true to grade and cross-section, and free from porous areas.~~

350-~~9~~10.3.3 Consolidation: Use hand-operated spud-type vibrators to consolidate.

350-~~9~~10.3.4 Floating: Use long-handled floats to float the concrete. Take the necessary care to avoid creating depressions or ridges during this operation.

350-~~9~~10.4 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.

~~350-11 Supplemental Floating.~~

~~In areas where performing machine strike-off, consolidation, and finishing, further 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. Waste excess mortar beyond the edge of the slab.~~

350-~~12~~ *10* Final Finish.

350-~~12~~*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.

~~After applying the burlap drag finish, apply the final finish with the texturing machine. Control the time of applying this finish and the method of operating the texturing machine so as to minimize tearing of surface and unseating of aggregate particles.~~

~~Provide a final finish that consists of transverse grooves which are 0.08 to 0.12 inch [2 to 3 mm] in width and 0.10 to 0.15 inch [2.5 to 4 mm] in depth, spaced at random intervals between 1/2 to 1 inch [13 to 25 mm]. Operate the texturing machine in a manner that minimizes the overlapping of subsequent passes of the steel comb. Create short gaps in the grooved finish as necessary to avoid overlap between passes.~~

~~In areas of irregular dimensions or narrow widths, where operating the texturing machine is impracticable, the Contractor may apply the finish by approved hand methods that achieve the required finish with a minimum of surface tearing and unseating aggregate particles. Ensure that the surface resulting from this operation is uniform in appearance and free of irregular, rough, or porous areas.~~

350-~~12~~*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-~~13~~-*11* Curing.

350-~~13~~*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 ~~all~~ cases *where*~~in which~~ 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 *QCP will be suspended*~~Engineer will order an immediate suspension of concreting operations~~. 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 50°F [10°C].

350-~~13~~*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}~~0.005 gal/ft^2~~ [~~0.2 L/m^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*~~until the pigment is uniformly dispersed throughout the vehicle~~.

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-~~13~~*11*.3 Burlap Mats: ~~Under this method, cover the surfaces to be cured with 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 ~~so as to cause them to remain in intimate contact with the surface being cured,~~ throughout the curing period *to ensure* ~~a~~ *contact with the surface being cured*. Maintain the mats fully moist and in position for the entire portion of the required ~~burlap~~ curing period.

350-~~13~~*11*.4 Removal of Forms: Do not remove forms from freshly placed concrete ~~until it has set~~ 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.

~~**350-14 Surface Requirements.**~~

~~After curing, remove the curing material (except for the impervious coating), and thoroughly test the surface for pavement surface smoothness in accordance with 352-4(c). Plainly mark all variations from the required tolerances. Where pavement surfaces do not meet the smoothness requirements, the Engineer will require corrective work and retesting to ensure conformity.~~

~~Eliminate high spots exceeding 1/8 inch in 10 feet [3.2 mm in 3 m], but not in excess of 0.3 inch in 25 feet [7.6 mm in 7.6 m], by grinding either with an approved machine or with a carborundum brick and water. Do not use bush hammering or other destructive means for removing irregularities. As directed by the Engineer, retexture corrected high areas to give skid resistance comparable to the surrounding area.~~

~~Provide grinding equipment with a power driven self-propelled machine that is specifically designed to grind portland cement concrete pavement, with a minimum of a 3-foot [1-m] wide grinding head and diamond impregnated grinding blades. Produce, by grinding, a pavement surface that is true to grade and uniform in appearance with a longitudinal line type texture. Provide a line type texture that contains parallel longitudinal corrugations that present a narrow ridge corduroy type appearance. Ensure~~

~~that the peaks of ridges are approximately 1/32 inch [0.8 mm] higher than the bottoms of the grooves with approximately 60 evenly spaced grooves per foot [300 mm].~~

~~Operate all milling, cutting, or grinding equipment to produce a reasonably uniform finished surface without spalling the pavement joints within corrected areas. The Engineer will not require extra grinding to eliminate minor depressions in order to provide 100% texturing of the pavement surface. Maintain the cross slope of the pavement as shown in the plans. Repair all joint seals destroyed by grinding at no expense to the Department.~~

~~Remove and replace any area of pavement which, after grinding, still shows a deviation in excess of the allowable tolerance. Ensure that the area removed and replaced is the full length between transverse joints and the full width of the lane involved.~~

~~Saw the area to be removed to a smooth vertical surface. Clean the face of the adjacent (hardened) concrete, and coat it with an epoxy bonding compound before placing the replacement concrete.~~

~~Bear the costs of all surface corrections required and of all required removal and replacement of defective surface concrete..~~

350-~~15~~-*12* Joints.

350-~~15~~*12*.1 General: Construct joints at the locations and in accordance with the details shown in the ~~Roadway and Traffic~~ Design Standards, Index No. 305 and the Contract Documents.

350-~~15~~*12*.2 Longitudinal Joints:

350-~~15~~*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. ~~Where keyways are required, the Contractor may form them by placing an insert of the proper shape along the inside face of the side form or, when using the slip form method of paving, by an approved extrusion device. Use a method that produces a keyway of the shape and at the location indicated in the plans.~~

350-~~15~~*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*~~within~~ 72 hours after placing the concrete.

350-~~15~~*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.

~~**350-15.2.4 Longitudinal Shoulder Joints (Concrete to Asphalt):** Construct a continuous joint by sawing a groove into the asphalt pavement at the abutment with the concrete pavement. Produce a groove that is 3/4 inch [19 mm] wide and 3/4 inch [19 mm] deep, after sawing and cleaning.~~

~~Seal the joint with hot poured type sealant.~~

350-~~15~~*12*.3 Transverse Joints:

350-~~15~~*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-~~15~~*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 loadtransfer 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* ~~in general when the concrete is between 4 and~~ 12 hours *after placing the concrete*~~old~~. Make a second saw cut, to provide the joint dimensions indicated in the plans, as soon as there is no danger of further raveling.

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-~~15~~*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 ~~Roadway and Traffic~~ 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 on the ~~Roadway and Traffic~~ Design Standards, *Index 306*.

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-~~15~~*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 ~~the free end of~~ each dowel with one coat of approved zinc rich paint (listed on the Qualified Products List), and grease *one end* ~~it~~ with an approved

lubricant, to prevent the concrete from bonding to the dowel. *Provide a cap for* ~~Provide~~ the free end of expansion joint dowels ~~with the closest fitting metal cap or sleeve, equipped with a stop to prevent closing during placement operations. Maintain a clearance of 1 inch [25 mm] between the closed end of the cap and the dowel to accommodate future slab movement.~~

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].

~~Provide the Engineer with c~~*C*onfirmation ~~of~~ the ~~location~~ *position* of ~~the~~ dowel bars *by suitable means acceptable to the Engineer, which may include non-destructive testing methods.* ~~The Contractor shall confirm that the paving operation has not displaced the dowels from their required positions. Perform confirmation checks daily for the first two days of the paving operation and weekly thereafter.~~

350-~~15~~*12*.5 Expansion Joints Around Structures: 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-~~15~~*12*.6 Cleaning Joints and Cracks:

350-~~15~~*12*.6.1 Cleaning Joints in New Pavement:

350-~~15~~*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-~~15~~*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-~~15~~*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-~~15~~*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*~~15~~.6.2.

350-~~15~~*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-~~15~~*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 50°F [10°C] or greater.

~~*Use a heating kettle for hot-poured sealer that is of the indirect heating or double-boiler type, using oil as a heat transfer medium*~~*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-~~15~~*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 40°F [5°C].

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-~~16~~-*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 ~~**350-16.1**~~ **Core Borings:** ~~After completing the concrete pavement, including any corrective work to meet ride requirement,~~ *To determine the actual thickness,* drill cores from the pavement *and measure thickness in accordance with ASTM C 174* ~~to determine the actual thickness. When the Department is ready to core the finished pavement for thickness, provide traffic control, coring equipment, and operator to obtain the cores. The Engineer will select the coring locations and make the acceptance measurements~~ *for thickness determination.* ~~Take borings at random intervals and at various points on the cross-section so that each test boring represents an area not exceeding 2,500 yd^2 [2,000 m^2].~~

~~———————~~Replace the portions of the pavement removed by the borings at no expense to the Department.

350-14.1.2 Non-destructive Testing: *~~To determine by~~ -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.*

350-~~16~~*14*.2 Method of Calculating Average Thickness: The Department will determine the average thickness of *the* pavement *by using the following method of calculation:* ~~from the length of all cores taken as indicated above and will calculate it as follows:~~

(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* ~~as measured by the cores~~ 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-~~17~~*15* Deficient Thickness.

350-~~17~~*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 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-~~17~~*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 ~~deficient~~ *deficiency* ~~area~~ is ~~sufficient~~ *enough* to seriously impair the anticipated service life of the pavement, ~~the Contractor shall~~ 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-~~17~~*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 Contractor may elect to leave~~ the pavement *may be left* in place, ~~but shall receive~~ *at* no compensation ~~for the area of pavement~~.

350-~~17~~*15*.4 Additional Borings: If the ~~Contractor believes that the~~ number of cores taken is not sufficient to indicate the thickness of the pavement, ~~he may request that the Engineer select~~ additional boring locations *may be requested, with prior approval ~~by~~ from the Engineer ~~and bear all cost for these additional boring locations~~ at no additional cost to the Department.* ~~The Department will deduct the cost of these additional borings from any sums due the Contractor, unless such borings indicate that the pavement within the questioned area is of specified or greater thickness.~~

350-~~18~~*16* Opening Pavement to Traffic.

Before opening the pavement to traffic, construct an earth berm along each edge. Build the berm to the full height of the pavement and at least 18 inches [0.5 m] wide, and sufficiently compacted ~~it~~ to prevent underwash of the pavement. Maintain the berm until ~~completing~~ 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 50°F [10°C]) 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 ~~AASHTO T 23~~*ASTM C 31* and tested in accordance with ~~AASHTO T 97~~*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 ~~Department's Roadway and Traffic Design Standards for Design, Construction, Maintenance and Utility Operations on the State Highway System.~~* ~~Provide protection that includes the erection and maintenance of signs, lights, barricades, etc., the construction and removal of temporary pavement, bridges, crossovers, etc., and the use of flagmen as may be necessary. Arrange the protective measures so as not to interfere with traffic in lanes being utilized for required maintenance of traffic.~~

~~Before opening the pavement to traffic, construct an earth berm along each edge. Build the berm to the full height of the pavement and at least 18 inches [0.5 m] wide, and sufficiently compact it to prevent underwash of the pavement. Maintain the berm until completing the final shoulders.~~

350-~~19~~*17* Method of Measurement.

350-~~19~~*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 350-1~~5~~7.3 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~~ic~~ 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~~ic~~ concrete surface course constructed in accordance with Section 33~~1~~*4*. Reinforcing steel, placed and accepted, will be measured and paid for as provided in Section 415.

350-~~19~~*17*.2 Joints and Cracks: ~~The Contractor shall include~~*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 ~~that have been~~ 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.

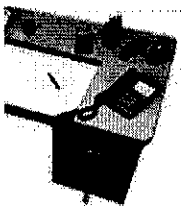
350-~~20~~*198* Basis of Payment.

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.



Bouzid Choubane

12/02/2003 03:47 PM

To: Clinton Shaw/CO/FDOT@FDOT
cc: Richard J Kessler/SM/FDOT@FDOT, Duane F Brautigam/CO/FDOT@FDOT, Susan Blazo/SM/FDOT@FDOT, Charles A Ishee/SM/FDOT@FDOT, Michael Bergin/SM/FDOT@FDOT, John H Owens/CO/FDOT@FDOT, Shirley Harvey/CO/FDOT@FDOT, Judy F Frazier/CO/FDOT@FDOT
Subject: Re: Industry Review for D3500000.D02 - Cement Concrete Pavement, D3520000.D01 – Grinding Concrete Pavement, D3530000.D01 – Concrete Pavement Slab Replacement, D3540000.D01 - Patching Portland Cement Concrete Pavement and D3550000 – Value Added Portland Cement

Please find below our suggested changes to two of the subject specs. No further comments on the other two. Please let me know if you need further details.
Regards,

D3520000 reviewed.doc D3550000 reviewed.doc

Bouzid Choubane
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Pavement Systems Evaluation
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Fax: (352) 955-6345

We are what we repeatedly do. Excellence, then, is not an act but a habit.
Aristotle
----- Forwarded by Bouzid Choubane/SM/FDOT on 12/02/2003 03:41 PM -----

Richard J Kessler

12/02/2003 03:06 PM

To: Bouzid Choubane/SM/FDOT@FDOT
cc:
Subject: Re: Industry Review for D3500000.D02 - Cement Concrete Pavement, D3520000.D01 – Grinding Concrete Pavement, D3530000.D01 – Concrete Pavement Slab Replacement, D3540000.D01 - Patching Portland Cement Concrete Pavement and D3550000 – Value Added Portland Cement

Can you follow this through?

Richard J. Kessler
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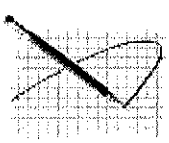
----- Forwarded by Richard J Kessler/SM/FDOT on 12/02/2003 03:05 PM -----



Clinton Shaw

12/02/2003 12:33 PM

To: Richard J Kessler/SM/FDOT@FDOT
cc: Duane F Brautigam/CO/FDOT@FDOT, Susan Blazo/SM/FDOT@FDOT, Charles A Ishee/SM/FDOT@FDOT, Michael Bergin/SM/FDOT@FDOT, John H Owens/CO/FDOT@FDOT, Shirley Harvey/CO/FDOT@FDOT, Judy F Frazier/CO/FDOT@FDOT
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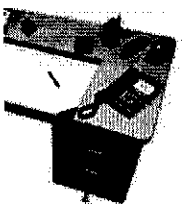
Upon closer examination, it became apparent that the recommended changes proposed below, were not done to the latest versions of the specification. The latest versions are those that were sent to you with the Industry comments and which have been amended to include all the agreed to modifications up to that point of the process.

Unfortunately, the submittals below present a very confusing dilemma for the folks who are shepherding these spec changes through the process and everyone else involved. I am sure you can appreciate our concern of how time consuming it would be, to try to retrace all the previous changes in order to bring these up to date and then when that is done, to find conflict with what you are now proposing and at the same time we are all trying to have these ready for a July 2004 implementation.

I am requesting that you make the new changes to the document that was returned to you along with the Industry comments. In that way we can all move forward instead of rehashing old issues that we thought were already settled.

Thank you for your time and patience.

Clinton J. Shaw
(850) 414-4129 SC 994-4129
Clinton.Shaw@dot.state.fl.us
----- Forwarded by Clinton Shaw/CO/FDOT on 12/02/2003 11:54 AM -----



Duane F Brautigam
12/02/2003 10:02 AM

To: Clinton Shaw/CO/FDOT@FDOT
cc:
Subject: Re: Industry Review for D3500000.D02 - Cement Concrete Pavement, D3520000.D01 – Grinding Concrete Pavement, D3530000.D01 – Concrete Pavement Slab Replacement, D3540000.D01 - Patching Portland Cement Concrete Pavement and D3550000 – Value Added Portland Cement

Duane F. Brautigam, P.E.
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----- Forwarded by Duane F Brautigam/CO/FDOT on 12/02/2003 10:02 AM -----

Richard J Kessler
12/02/2003 08:27 AM

To: Duane F Brautigam/CO/FDOT@FDOT
cc: Susan Blazo/SM/FDOT@FDOT, Charles A Ishee/SM/FDOT@FDOT, Michael Bergin/SM/FDOT@FDOT
Subject: Re: Industry Review for D3500000.D02 - Cement Concrete Pavement, D3520000.D01 – Grinding Concrete Pavement, D3530000.D01 – Concrete Pavement Slab Replacement, D3540000.D01 - Patching Portland Cement Concrete Pavement and D3550000 – Value Added Portland Cement

Comments from subject specifications.

Richard J. Kessler
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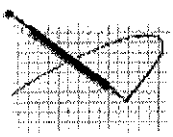
Gainesville, FL 32609



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12/02/2003 12:33 PM

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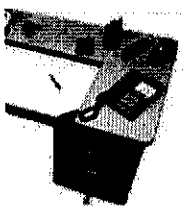

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----- Forwarded by Duane F Brautigam/CO/FDOT on 12/02/2003 10:02 AM -----

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Comments from subject specifications.

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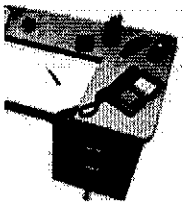
----- Forwarded by Richard J Kessler/SM/FDOT on 12/02/2003 08:26 AM -----



Bouzid Choubane
12/02/2003 07:21 AM

To: Richard J Kessler/SM/FDOT@FDOT
cc:
Subject: Re: Industry Review for D3500000.D02 - Cement Concrete Pavement, D3520000.D01 – Grinding Concrete Pavement, D3530000.D01 – Concrete Pavement Slab Replacement, D3540000.D01 - Patching Portland Cement Concrete Pavement and D3550000 – Value Added Portland Cement

Greetings Rick:
Please find attached the subject specifications with some suggested changes. I apologize for the dealy.
Regards,

D3500000 Cement Concrete.d D3520000_Grinding Concrete Pavement. D3530000_ Grinding Concrete Pavement.

Bouzid Choubane
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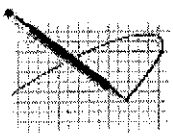
We are what we repeatedly do. Excellence, then, is not an act but a habit.
Aristotle



Clinton Shaw
12/02/2003 11:31 AM

To: Judy F Frazier/CO/FDOT@FDOT
cc:
Subject: Re: Industry Review for D3500000.D02 - Cement Concrete Pavement, D3520000.D01 – Grinding Concrete Pavement, D3530000.D01 – Concrete Pavement Slab Replacement, D3540000.D01 - Patching Portland Cement Concrete Pavement and D3550000 – Value Added Portland Cement

Bouzid's comments are in this version of 350.

Thanks

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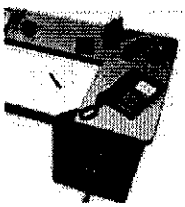
Clinton.Shaw@dot.state.fl.us
----- Forwarded by Clinton Shaw/CO/FDOT on 12/02/2003 11:29 AM -----



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12/02/2003 08:27 AM

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Comments from subject specifications.

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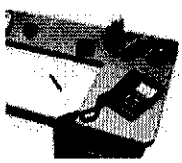

Bouzid Choubane
12/02/2003 07:21 AM

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Subject: Re: Industry Review for D3500000.D02 - Cement Concrete Pavement, D3520000.D01 – Grinding Concrete Pavement, D3530000.D01 – Concrete Pavement Slab Replacement, D3540000.D01 - Patching

Portland Cement Concrete Pavement and D3550000 – Value Added Portland Cement

Greetings Rick:
Please find attached the subject specifications with some suggested changes. I apologize for the dealy.
Regards,

D3500000 Cement Concrete.d

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Aristotle

SECTION 350
CEMENT CONCRETE PAVEMENT

350-1 Description.

Construct ~~portland~~ *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.

~~For aggregates, proportioning and mixing, and other provisions for the production of the concrete, meet the applicable provisions of Section 346.~~

~~Provide adequate lighting for all work done at night, including finishing, curing, and sawing joints. Unless lighting is provided for finishing, stop construction operations soon enough each day to permit finishing during daylight.~~

~~At least 20 days prior to paving, f~~*F*urnish the following information ~~for the Engineer's review for specification compliance~~*in the Quality Control Plan (QCP) as required in Section 105*:

1. A detailed sequence and schedule of concrete placement operations including, but not necessarily limited to, width of pavement to be placed, proposed equipment, production rates, working hours, concrete hauling, and placement, curing, sawing, and sealing methods.
2. A detailed staking plan for subgrade controls including offset requirements.
3. A traffic control plan for pavement construction operations *that* ~~which~~ 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. *Identify provisions for adequate lighting for all work done at night, including finishing, curing, and sawing joints.*

350-2 Materials.

Meet the following requirements:

Concrete, Class I *(Pavement)*.....

Section 346

Curing Materials..... Section 925
Embedded Items.....-Section 931
Joint Seal..... Section 932

350-3 Equipment.

350-3.1 General: ~~Obtain the Engineer's approval of the equipment and tools to be used for handling materials and performing all parts of the work, as to their design, capacity, and mechanical condition. Deliver the equipment to the job site sufficiently ahead of the start of construction operations to allow the Engineer to examine it thoroughly for approval.~~

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

~~Equip all equipment which operates on the side forms with scraping devices to clean accumulations from the top of the forms and wheels.~~

Provide equipment and tools to be used ~~for handing materials~~ that meet the following criteria:

1. *Capable of handling materials and performing all parts of the work.*
2. *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.*

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

350-3.2 Equipment ~~For~~ *for* Trimming of Subgrade: For equipment operating on the subgrade, provide an automatically controlled subgrade trimmer. Use a machine that is capable of trimming the subgrade to proper elevation within the tolerances established herein. Provide grade controls that operate by sensing from a taut line, set true to line and grade. Erect and maintain the taut line.

350-3.3 Forms:

350-3.3.1 Form Material: Provide steel forms, except ~~that~~ on curves with a radius of *150 feet [*45 m*]* or less, *in which case* provide flexible ~~forms,~~ or wooden forms that bend to the required arc.

350-3.3.2 Dimensions: Use forms with a minimum length of 10 feet [3 m], except where they are used on curves having a radius between 150 and 300 feet [45 and 90 m], in which case use a form length of 5 feet [1.5 m]. Use forms with a height that is equal to the edge thickness of the pavement. Use forms with a height greater than the edge thickness, provided the outer portion of the slab is thickened to equal the depth of the form by tapering at the rate of 1 inch *[25 mm]* of the extra thickness per foot [80 mm of the extra thickness per meter] of width. In such case, the Department will make no allowance for additional concrete. Do not use built-up forms.

350-3.3.3 Steel Forms: Use steel forms fabricated into an approved section and sufficiently strong to ensure rigidity under the impact, thrust, and weight of the heaviest equipment to be carried over the forms. Make the width of the bases of the forms ~~which~~ *that* ~~is~~ *are* in direct contact with the soil at least equal to the height of the forms, but not less than 8 inches [200 mm]. Extend the flange braces outward on the base ~~not less than~~ *by at least* two-thirds *of* the height dimension of the form. Use steel forms of a thickness ~~that is~~ not less than 7/32 inch [5.5 mm]. When tested with a 10 foot [3.048 m] straightedge, ensure that the forms have no vertical variation in a 10 foot [3 m] length that is greater than 1/8 inch [3 mm] *in thickness* from a true plane of the surface on the top of the form, and no lateral variation that is greater than 1/4 inch [6 mm] from a true plane surface on the vertical face of the form. Do not use steel forms if, when tested as a simple beam with a span of 9 feet 6 inches [2.9 m] and a load equal to that exerted by construction equipment placed upon them, the deflection is more than 1/4 inch [6 mm].

350-3.3.4 Form Connections: Provide connections between adjacent sections of the form~~,~~ that ~~form~~ *make* a lock joint~~,~~ *that are* free from vertical movement in excess of 1/8 inch [3 mm] and from horizontal movement in excess of 1/4 inch [6 mm]~~,~~ *when* under the impact, thrust, and weight of the heaviest machine carried on the forms.

350-3.3.5 Defective Forms: Remove bent, twisted, or broken forms, and forms with ~~battered~~ *damaged* top surfaces~~,~~ from the *form* work. ~~Do not use repaired forms until they are inspected and approved by the Engineer.~~*The use of repaired forms will be based on the final product meeting all applicable contract requirements.*

350-3.3.6 Form Stakes: Provide at least three steel stakes for each 10 foot [3 m] length of form. Use stakes that are of sufficient size to prevent ~~undue~~ lateral movement of the form during paving operations. Fasten each of the stakes to the form by means of a suitable socket attached to the form. Equip each stake socket with steel wedges for securely keying the forms to the stakes. ~~Locate~~ *Place* a stake not more than 12 inches [300 mm] from the end of each section. ~~Do not use forms with broken or badly worn sockets.~~

350-3.3.7 Form Tampers: Use adequate mechanical form tampers, capable of thoroughly compacting the soil under the forms, except when the forms rest on a cement-treated subgrade.

350-3.4 Spreader: Provide a mechanical spreader that is independently powered and capable of spreading the mixed concrete on the subgrade over the entire width and depth of the strip being paved in a

manner ~~which~~ *that* will prevent segregation of the materials. Use a spreader designed and constructed to permit the concrete to be struck-off to a uniform thickness.

350-3.5 Strike-Off, Consolidation, and Finishing for Fixed-Form Construction: Provide equipment for these operations that consists of a self-propelled unit, or units, that perform the following functions by mechanical means~~,~~ in the sequence indicated:

(1) Strike-off~~.~~,
(2) Vibratory Consolidation~~.~~,
(3) Screeding~~.~~, *and*
(4) Floating.

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

350-3.6 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~~ *requiring* a minimum amount of hand-finishing ~~will be necessary~~ to provide a dense and homogeneous pavement. Ensure that ~~all of this~~*the* equipment is ~~of such dimensions and arrangement as to~~*capable of covering* ~~cover~~ the full width of the pavement strip being *placed*~~laid~~. Use equipment that is adjustable as to crown and superelevation and that can shape and compact the concrete into a dense and stable mass~~,~~ *and* 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 *specified* ~~riding~~*ride*-quality requirements ~~specified.~~

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

~~If necessary, in~~ *In* order to produce a pavement of the required cross-section and meet~~ing~~ 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 necessary.*

~~If using trailing forms, p~~*P*rovide forms that are rigidly supported laterally *whenever training forms are used.*

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

Do not use automatic grade controls on the paver when the tracks of the slip-form paver are operating on ~~econocrete base or~~ 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.

~~The Engineer may allow variation from any specific feature of the slip-form paver as detailed above, provided the industry has generally accepted the proposed variation as an improved feature.~~

350-3.7 Vibratory Units: Consolidate the concrete for the full width of the strip being placed with either surface pan type or internal type vibrators.

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.

350-3.8 Mechanical Floating Equipment: Provide equipment that consists of a supplementary self-propelled machine capable of further smoothing the concrete, removing excess mortar from the surface, and minimizing hand finishing.

~~Use a machine that leaves the surface of the concrete 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.~~

350-3.9 Device for Application of Membrane Curing Compound: Provide *a self-propelled* equipment *capable of uniformly applying* ~~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.

The Contractor may use hand power-spray equipment to apply curing compound ~~to~~ *in* areas where ~~it is impracticable to operate~~ *operating* the self-propelled equipment *is impracticable*.

350-3.10 Equipment for Sealing Joints: Provide equipment for sealing the joints for each section of pavement. Use a heating kettle for hot-poured sealer that is of the indirect heating or double-boiler type, using oil as a heat transfer medium. 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. Use ~~pouring~~ equipment ~~equipped~~ with nozzles that discharge the seal 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 ~~for pouring,~~ within ~~10°F [5°C]~~*the ~~manufactures~~ manufacturer's recommendation.*

350-3.11 Equipment for Paving Small or Narrow Areas: For variable width areas, other than mainline, ramps, and shoulders, the Engineer ~~will~~ *may* not require the full paving train as specified for the standard run of paving. The Contractor may use ~~such~~ equipment ~~as the Engineer may~~ approve*d by the Engineer* for such areas.

350-3.12 Hand Finishing Tools: Provide straightedges ~~that~~ *with a* ~~have a blade length of~~ 10-~~feet~~ *foot* [3~~.048~~ m] *blade length.* 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*s* with a length that exceeds *by 3 feet [1 m]* ~~1/2~~ *half* the width of the strip being placed ~~by 3 feet [1 m].~~

350-3.13 Texturing Machine: Provide ~~a machine that consists of~~ a supplementary machine capable of applying the final finish to the concrete pavement. Apply the finish ~~by~~ *using* rectangular shaped spring steel tines rigidly mounted in a frame operating on an adjustable track mounted under the main frame of the machine. Use a *texturing* machine that ~~is constructed so as to~~ provides ~~for~~ adjustment of the downward pressure on the tines as necessary to produce the desired finish under varying conditions of the concrete surface.

The Engineer may allow variation from any specific feature of the ~~Texturing~~ *texturing* ~~Machine~~ *machine* as ~~detailed~~ *described* above, provided that the Contractor can produce an equivalent final finish.

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~~ *that* are disturbed prior to placing the concrete. Do not place concrete on a frozen subgrade.

Ensure that the subgrade is moist 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 *any* 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 *not* 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~~ *removing* them in less than 12 hours after placing the concrete *is unnecessary*.

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.

~~Have available at the site, at~~ *At* all times when concrete paving operations are underway, *have available on site* materials for the protection of the surface and edges of the unhardened concrete. For the protection of the pavement edges, use ~~any~~ covering material~~, such as burlap, paper, or plastic sheeting material,~~ suitable for the protection of the pavement surface *as identified in the QCP*.

When rain appears imminent, stop all paving operations, and have all available personnel cover the surface of the unhardened concrete with the protective covering.

During periods when the air temperature may fall below 35°F [1°C], ~~advise the Engineer of~~ plans for curing and protecting the fresh concrete *shall be implemented as identified in the QCP* before placing the concrete. ~~Do not place any concrete until the Engineer has approved the proposed methods.~~

~~The Contractor is fully responsible for the quality and strength of the concrete placed in cold weather even if the Engineer approves of the provisions the Contractor employs for protecting the concrete placed during cold weather.~~

350-7 Placement of Reinforcement.

350-7.1 General: ~~Where~~ *When* the plans call for reinforced concrete pavement, place the steel reinforcement in the pavement slab in accordance with the details shown in the plans.

Secure the reinforcement in position in advance of concrete placement or~~, with the Engineer's specific approval,~~ place it in the plastic concrete by mechanical or vibratory means after spreading the concrete *as identified in the QCP*. At the time of the concrete placement, ensure that the reinforcing steel is free from dirt, oil, paint, grease, mill scale, and any loose or thick rust ~~which~~ *that* could impair bonding of the steel with the concrete. 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 a~~*A*djacent sheets of fabric *should have an overlap of* not less than 6 inches [150 mm]. Make the *over*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~~ *Overlap* 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. ~~and t~~*T*he surface will at no point be below the grade specified for the finished surface~~, after application of the allowable tolerance~~. Deposit the concrete on the subgrade in a manner ~~which~~ *that* will require as little rehandling as possible. Continuously place concrete between transverse joints without using intermediate bulkheads.

Deposit concrete as near to expansion and contraction joint assemblies as possible without disturbing them. Do not ~~dump~~*deposit* concrete from the discharge bucket or hopper onto an assembly without centering the bucket or hopper directly over the assembly.

350-8.2 Use of Spreader: Place concrete on the subgrade by an approved spreading device. The Engineer ~~will~~ *may* not require the Contractor to use a spreader for areas where the width of slab varies, for intersections, and for 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*). Ensure that ~~workmen~~ *workers* do not walk in the freshly deposited concrete ~~with *their*~~ *wearing boots or shoes coated with* earth or other deleterious substances ~~coated on their boots or shoes~~.

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, *first* place the lanes adjacent to the low edge of the pavement, as shown on the typical section~~, first~~. The Engineer will not require the Contractor to alter placement operations where superelevation reverses the pavement cross slope from that shown on the typical section.

350-8.4 Hours of Operation: Stop placing concrete in time to complete finishing operations during daylight hours~~,~~ or provide adequate ~~approved~~ lighting *as identified in the QCP.*

350-8.5 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. Do not continue vibration at any one location ~~so~~ long ~~as~~ *enough* to produce puddling or the accumulation of excessive grout on the surface.

350-9 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.

350-10 Striking-off, Consolidating, and Finishing Concrete.

350-10.1 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 ~~C~~contract ~~D~~*d*ocuments. Perform the sequence of operations as follows: strike-off; vibratory consolidation; screeding; floating; removal of laitance; straightedging; and final surface finish. Except ~~as~~ *when* specified, perform strike-off, consolidation, screeding, and floating by the machine method.

Provide a concrete surface true to grade and crown, and free of irregularities. Do not add water to the concrete surface to assist in finishing operations.

350-10.2 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.

350-10.3 Hand Methods:

350-10.3.1 Conditions under which Allowed: The Contractor may use hand methods in areas of narrow width or irregular dimensions~~,~~ where operation of mechanical equipment is impracticable. In the event that mechanical equipment breaks down, the Contractor may use hand methods to finish only that concrete already deposited on the subgrade when the breakdown occurred.

350-10.3.2 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.

In operation, move the screed forward on the forms with a combined longitudinal and transverse shearing motion~~,~~ moving always in the direction in which the work is progressing~~, and m~~*M*anipulate it so that neither end is raised from the side forms during the striking-off process. If

necessary, repeat this until the surface is of uniform texture, true to grade and cross-section, and free from porous areas.

350-10.3.3 Consolidation: Use hand-operated spud-type vibrators to consolidate.

350-10.3.4 Floating: Use long-handled floats to float the concrete. Take the necessary care to avoid creating depressions or ridges during this operation.

350-10.4 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.

350-11 Supplemental Floating.

In areas where performing machine strike-off, consolidation, and finishing, further 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. Waste excess mortar beyond the edge of the slab.

350-12 Final Finish.

350-12.1 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.

After applying the burlap drag finish, apply the final finish with the texturing machine. Control the time of applying this finish and the method of operating the texturing machine so as to minimize tearing of surface and unseating of aggregate particles.

Provide a final finish that consists of transverse grooves which are 0.08 to 0.12 inch [2 to 3 mm] in width and 0.10 to 0.15 inch [2.5 to 4 mm] in depth, spaced at random intervals between 1/2 to 1 inch [13 to 25 mm]. Operate the texturing machine in a manner that minimizes the overlapping of subsequent passes of the steel comb. Create short gaps in the grooved finish as necessary to avoid overlap between passes.

In areas of irregular dimensions or narrow widths, where operating the texturing machine is impracticable, the Contractor may apply the finish by approved hand methods that achieve the required finish with a minimum of surface tearing and unseating aggregate particles. Ensure that the surface resulting from this operation is uniform in appearance and free of irregular, rough, or porous areas.

350-12.2 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.

350-13 Curing.

350-13.1 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, the edges of the newly placed concrete in accordance with one or more of the methods described below. In ~~all~~ cases *where*~~in which~~ 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 *QCP will be suspended*~~Engineer will order an immediate suspension of concreting operations~~. 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 50°F [10°C].

350-13.2 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 *1gallon to every 200 ft*^{2}~~0.005 gal/ft^2~~ [~~0.2 L/m^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 manufactures recommendation*~~until the pigment is uniformly dispersed throughout the vehicle~~.

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.

350-13.3 Burlap Mats: ~~Under this method, cover the surfaces to be cured with burlap mats.~~ Thoroughly saturate the *burlap* 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 ~~so as to cause them to remain in intimate contact with the surface being cured,~~ throughout the curing period *to ensure a contact with the surface being cured.* Maintain the mats fully moist and in position for the entire portion of the required ~~burlap~~ curing period.

350-13.4 Removal of Forms: Do not remove forms from freshly placed concrete ~~until it has set~~ 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.

350-14 Surface Requirements.

After *the* curing *period,* ~~remove the curing material (except for the impervious coating), and thoroughly~~ test the surface for pavement surface smoothness in accordance with 352-4(c). Plainly mark all variations from the required tolerances. Where pavement surfaces do not meet the smoothness requirements, the Engineer will require corrective work and retesting to ensure conformity.

Eliminate high spots exceeding 1/8 inch in 10 feet [3.2 mm in 3 m], but not in excess of 0.3 inch in 25 feet [7.6 mm in 7.6 m], by grinding either with an approved machine or with a carborundum brick and water. Do not use bush-hammering or other destructive means for removing irregularities. As directed by the Engineer, retexture corrected high areas to give skid resistance comparable to the surrounding area.

Provide grinding equipment with a power driven self-propelled machine that is specifically designed to grind portland cement concrete pavement, with a minimum of a 3 foot [1 m] wide grinding head and diamond impregnated grinding blades. Produce, by grinding, a pavement surface that is true to grade and uniform in appearance with a longitudinal line type texture. Provide a line type texture that contains parallel longitudinal corrugations that present a narrow ridge corduroy type appearance. Ensure

that the peaks of ridges are approximately 1/32 inch [0.8 mm] higher than the bottoms of the grooves with approximately 60 evenly spaced grooves per foot [300 mm].

Operate all milling, cutting, or grinding equipment to produce a reasonably uniform finished surface without spalling the pavement joints within corrected areas. The Engineer will not require extra grinding to eliminate minor depressions in order to provide 100% texturing of the pavement surface. Maintain the cross slope of the pavement as shown in the plans. Repair all joint seals destroyed by grinding at no expense to the Department.

Remove and replace any area of pavement which, after grinding, still shows a deviation in excess of the allowable tolerance. Ensure that the area removed and replaced is the full length between transverse joints and the full width of the lane involved.

Saw the area to be removed to a smooth vertical surface. Clean the face of the adjacent (hardened) concrete, and coat it with an epoxy bonding compound before placing the replacement concrete.

Bear the costs of all surface corrections required and of all required removal and replacement of defective surface concrete.

350-15 Joints.

350-15.1 General: Construct joints at the locations and in accordance with the details shown in the Roadway and Traffic Design Standards, Index No. 305 and the Contract Documents.

350-15.2 Longitudinal Joints:

350-15.2.1 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. Where keyways are required, the Contractor may form them by placing an insert of the proper shape along the inside face of the side form or, when using the slip form method of paving, by an approved extrusion device. Use a method that produces a keyway of the shape and at the location indicated in the plans.

350-15.2.2 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 within 72 hours after placing the concrete.

350-15.2.3 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.

350-15.2.4 Longitudinal Shoulder Joints (Concrete to Asphalt): Construct a continuous joint by sawing a groove into the asphalt pavement at the abutment with the concrete pavement. Produce a groove that is 3/4 inch [19 mm] wide and 3/4 inch [19 mm] deep, after sawing and cleaning.

Seal the joint with hot-poured type sealant.

350-15.3 Transverse Joints:

350-15.3.1 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.

350-15.3.2 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 loadtransfer 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 in general when the concrete is between 4 and 12 hours old. Make a second saw cut, to provide the joint dimensions indicated in the plans, as soon as there is no danger of further raveling.

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.

350-15.3.3 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 Roadway and Traffic 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 on the Roadway and Traffic Design Standards.

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.

350-15.4 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 the free end of each dowel with one coat of approved zinc rich paint (listed on the Qualified Products List), and grease it with an approved lubricant, to prevent the concrete from bonding to the dowel. Provide the free end of expansion joint dowels with the closest fitting metal cap or sleeve, equipped with a stop to prevent closing during placement operations. Maintain a clearance of 1 inch [25 mm] between the closed end of the cap and the dowel to accommodate future slab movement.

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].

Provide the Engineer with confirmation of the location of the dowel bars. The Contractor shall confirm that the paving operation has not displaced the dowels from their required positions. Perform confirmation checks daily for the first two days of the paving operation and weekly thereafter.

350-15.5 Expansion Joints Around Structures: 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.

350-15.6 Cleaning Joints and Cracks:

350-15.6.1 Cleaning Joints in New Pavement:

350-15.6.1.1 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.

350-15.6.1.2 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.

350-15.6.2 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.

350-15.6.3 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 350-15.6.2.

350-15.7 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.

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.

350-15.7.1 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 50°F [10°C] or greater.

350-15.7.2 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 40°F [5°C].

350-16 Thickness Determinations.

350-16.1 Core Borings: After completing the concrete pavement, including any corrective work to meet ride requirement, drill cores from the pavement to determine the actual thickness. When the ~~Department~~ *Contractor* is ready to core the finished pavement for thickness, provide traffic control, coring equipment, and operator to obtain the cores. ~~The Engineer will s~~Select the coring locations and make the ~~acceptance *Quality Control*~~ measurements *for thickness determination.* Take borings at random intervals and at various points on the cross-section so that each test boring represents an area not exceeding 2,500 yd^2 [2,000 m^2]. *The Engineer may select the boring locations or measure the thickness.*

Replace the portions of the pavement removed by the borings at no expense to the Department.

350-16.2 Method of Calculating Average Thickness: ~~The Department will d~~*D*etermine the average thickness of pavement from the length of all cores taken as indicated above and ~~will~~ calculate it as follows:

(a) ~~The Department will~~*Do* 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 as measured by the cores 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 c~~Calculate the average thickness for the entire job as a unit.

350-17 Deficient Thickness.

350-17.1 General: The Department will not pay for any pavement which is more than 1/2 inch [13 mm] less than the specified thickness. 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.

350-17.2 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 deficient area is sufficient to seriously impair the anticipated service life of the pavement, the Contractor shall 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.

350-17.3 Deficient Pavement Left in Place: If the Engineer determines that the deficiency will not seriously impair the anticipated service life of the pavement, the Contractor may elect to leave the pavement in place, but shall receive no compensation for the area of pavement.

350-17.4 Additional Borings: If the Contractor believes that the number of cores taken is not sufficient to indicate the thickness of the pavement, he may request that the Engineer select additional boring locations. The Department will deduct the cost of these additional borings from any sums due the Contractor, unless such borings indicate that the pavement within the questioned area is of specified or greater thickness.

350-18 Opening Pavement to Traffic.

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 50°F [10°C]) 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 AASHTO T 23 and tested in accordance with AASHTO T 97, 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. Provide protection that includes the erection and maintenance of signs, lights, barricades, etc., the construction and removal of temporary pavement, bridges, crossovers, etc., and the use of flagmen as may be necessary. Arrange the protective measures so as not to interfere with traffic in lanes being utilized for required maintenance of traffic.

Before opening the pavement to traffic, construct an earth berm along each edge. Build the berm to the full height of the pavement and at least 18 inches [0.5 m] wide, and sufficiently compact it to prevent underwash of the pavement. Maintain the berm until completing the final shoulders.

350-19 Method of Measurement.

350-19.1 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 350-17.3 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 asphaltic 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 asphaltic 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.

350-19.2 Joints and Cracks: The Contractor shall 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 that have been 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.

350-20 Basis of Payment.

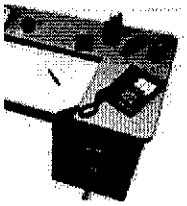
Prices and payments will be full compensation for all work specified in this Section, including any preparation of the subgrade not included in the work to be paid for under another Contract item; all transverse and longitudinal joint construction, including tie-bars and dowel bars; the furnishing of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

Phone: 352-955-6686 / SunCom 625-6686, Fax: 352-955-6689
Email: richard.kessler@dot.state.fl.us

----- Forwarded by Richard J Kessler/SM/FDOT on 12/02/2003 08:26 AM -----



Bouzid Choubane
12/02/2003 07:21 AM

To: Richard J Kessler/SM/FDOT@FDOT
cc:
Subject: Re: Industry Review for D3500000.D02 - Cement Concrete Pavement, D3520000.D01 – Grinding Concrete Pavement, D3530000.D01 – Concrete Pavement Slab Replacement, D3540000.D01 - Patching Portland Cement Concrete Pavement and D3550000 – Value Added Portland Cement

Greetings Rick:
Please find attached the subject specifications with some suggested changes. I apologize for the dealy.
Regards,

D3500000 Cement Concrete.d D3520000_Grinding Concrete Pavement. D3530000_ Grinding Concrete Pavement.

Bouzid Choubane
State Materials Office
Pavement Systems Evaluation
Phone: (352) 955-6302
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We are what we repeatedly do. Excellence, then, is not an act but a habit.
Aristotle

POSTED 11/3/03

Florida Department of Transportation

JEB BUSH
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JOSÉ ABREU
SECRETARY

MEMORANDUM

DATE: November 3 2003

TO: Specification Review Distribution List

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

SUBJECT: **Proposed Specifications Change: D3500000.D02 - Cement Concrete Pavement**

In accordance with Specification Development Procedures, we are sending you a copy of a proposed specification change to Section 353.

This change was proposed by Charles Ishee of the State Materials Office to bring the specification more in agreement with the Contractor Quality Control guidelines.

Please share this proposal with others within your responsibility. Review comments are due within four weeks and should be sent to Mail Station 75 or to my attention via e-mail at SP965DB or duane.brautigam@dot.state.fl.us. Comments received after December 1, 2003 may not be considered. Your input is encouraged.

DFB/jf

Attachment

COMMENTS: _____

_____

_____

_____

_____

_____

Submitted by: _____ Phone #: _____

CEMENT CONCRETE PAVEMENT.
(REV ~~5-13-03~~*~~09-19-03~~10-23-03*)

SECTION 350 (Pages 304-322) is deleted and the following substituted:

SECTION 350
CEMENT CONCRETE PAVEMENT

350-1 Description.

Construct ~~portland~~ *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.*

~~For aggregates, proportioning and mixing, and other provisions for the production of the concrete, meet the applicable provisions of Section 346.~~

~~Provide adequate lighting for all work done at night, including finishing, curing, and sawing joints. Unless lighting is provided for finishing, stop construction operations soon enough each day to permit finishing during daylight.~~

~~At least 20 days prior to paving, f~~*F*urnish the following information ~~for the Engineer's review for specification compliance~~*in the Quality Control Plan (QCP) as required in Section 105*:

1. A detailed sequence and schedule of concrete placement operations including, but not ~~necessarily~~ 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. ~~*MA detailed staking plan for subgrade controls including offset requirements.*~~*A method to ensure the proper placement of reinforcing steel, tie bars and dowel bars.*

3. A traffic control plan ~~for pavement construction operations~~ *that* ~~which~~ 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. ~~Identify~~ Defined provisions for adequate lighting for all work done at night, including finishing, curing, and sawing joints.

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

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

7. ~~Identify~~ 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: ~~Obtain the Engineer's approval of the equipment and tools to be used for handling materials and performing all parts of the work, as to their design, capacity, and mechanical~~

~~condition. Deliver the equipment to the job site sufficiently ahead of the start of construction operations to allow the Engineer to examine it thoroughly for approval.~~

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

~~Equip all equipment which operates on the side forms with scraping devices to clean accumulations from the top of the forms and wheels.~~*~~Provide~~ Ensure the equipment and tools that are to be used ~~that~~ meet the following:*

~~Capable~~ 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 ~~meet~~ are in accordance with the contract documents, prior to the placing of concrete.

~~**350-3.2 Equipment For Trimming of Subgrade:** For equipment operating on the subgrade, provide an automatically controlled subgrade trimmer. Use a machine that is capable of trimming the subgrade to proper elevation within the tolerances established herein. Provide grade controls that operate by sensing from a taut line, set true to line and grade. Erect and maintain the taut line.~~

~~**350-3.3 Forms:**~~

~~**350-3.3.1 Form Material:** Provide steel forms, except that on curves with a radius of 45 m or less, provide flexible forms, or wooden forms that bend to the required arc.~~

~~**350-3.3.2 Dimensions:** Use forms with a minimum length of 10 feet [3 m], except wherethey are used on curves having a radius between 150 and 300 feet [45 and 90 m], in which case use a form length of 5 feet [1.5 m]. Use forms with a height that is equal to the edge thickness of the pavement. Use forms with a height greater than the edge thickness, provided the outer portion of the slab is thickened to equal the depth of the form by tapering at the rate of 1 inch of the extra thickness per foot [80 mm of the extra thickness per meter] of width. In such case, the Department will make no allowance for additional concrete. Do not use built-up forms.~~

~~**350-3.3.3 Steel Forms:** Use steel forms fabricated into an approved section and sufficiently strong to ensure rigidity under the impact, thrust, and weight of the heaviest equipment to be carried over the forms. Make the width of the base of the forms which is in direct contact with the soil at least equal to the height of the forms, but not less than 8 inches [200 mm]. Extend the flange braces outward on the base not less than two-thirds the height dimension of the form. Use steel forms of a thickness that is not less than 7/32 inch [5.5 mm]. When tested with a 10-foot [3.048 m] straightedge, ensure that the forms have no vertical variation in a 10-foot [3 m] length that is greater than 1/8 inch [3 mm] from a true plane of the surface on the top of the form, and no lateral variation that is greater than 1/4 inch [6 mm] from a true plane surface on the vertical face of the form. Do not use steel forms if, when tested as a simple beam with a span of 9 feet 6 inches [2.9 m] and a load equal to that exerted by construction equipment placed upon them, the deflection is more than 1/4 inch [6 mm].~~

~~**350-3.3.4 Form Connections:** Provide connections between adjacent sections of the form, that form a lock joint, free from vertical movement in excess of 1/8 inch [3 mm] and from horizontal movement in excess of 1/4 inch [6 mm], under the impact, thrust, and weight of the heaviest machine carried on the forms.~~

~~**350-3.3.5 Defective Forms:** Remove bent, twisted, or broken forms, and forms with battered top surfaces, from the work. Do not use repaired forms until they are inspected and approved by the Engineer.~~

~~**350-3.3.6 Form Stakes:** Provide at least three steel stakes for each 10 foot [3 m] length of form. Use stakes that are of sufficient size to prevent undue lateral movement of the form during paving operations. Fasten each of the stakes to the form by means of a suitable socket attached to the form. Equip each stake socket with steel wedges for securely keying the forms to the stakes. Locate a~~

~~stake not more than 12 inches [300 mm] from the end of each section. Do not use forms with broken or badly worn sockets.~~

~~**350-3.3.7 Form Tampers:** Use adequate mechanical form tampers, capable of thoroughly compacting the soil under the forms, except when the forms rest on a cement-treated subgrade.~~

~~**350-3.4 Spreader:** Provide a mechanical spreader that is independently powered and capable of spreading the mixed concrete on the subgrade over the entire width and depth of the strip being paved in a manner which will prevent segregation of the materials. Use a spreader designed and constructed to permit the concrete to be struck off to a uniform thickness.~~

~~**350-3.5 Strike-Off, Consolidation, and Finishing for Fixed-Form Construction:** Provide equipment for these operations that consists of a self-propelled unit, or units, that perform the following functions by mechanical means, in the sequence indicated:~~

~~(1) Strike-off.~~

~~(2) Vibratory Consolidation.~~

~~(3) Screeding.~~

~~(4) Floating.~~

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

350-3.6~~.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 ~~all of this~~*the* equipment is of such dimensions and arrangement as to cover the full width of the pavement strip being *placed*~~laid~~. 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.

Do not use automatic grade controls on the paver when the tracks of the slip-form paver are operating on ~~econocrete base or~~ 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.

~~The Engineer may allow variation from any specific feature of the slip-form paver as detailed above, provided the industry has generally accepted the proposed variation as an improved feature.~~

350-3.~~7~~.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 ~~cause~~ 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.

~~**350-3.8 Mechanical Floating Equipment:** Provide equipment that consists of a supplementary self-propelled machine capable of further smoothing the concrete, removing excess mortar from the surface, and minimizing hand finishing.~~

~~Use a machine that leaves the surface of the concrete 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.~~

350-3.~~9~~*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.

~~The Contractor may use hand-p~~*P*ower-spray equipment ~~to~~*may be used to* apply curing compound to areas where it is impracticable to operate the self-propelled equipment.

~~**350-3.10 Equipment for Sealing Joints:** Provide equipment for sealing the joints for each section of pavement. Use a heating kettle for hot-poured sealer that is of the indirect heating or double-boiler type, using oil as a heat transfer medium. 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. Use pouring equipment equipped with nozzles that discharge the seal 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 for pouring, within 10°F [5°C]*manufacturer's*.~~

350-3.~~11~~*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. ~~The Contractor may u~~*U*se such equipment *that*~~as~~ *is approved by* the Engineer~~ may approve for such areas~~.

350-3.~~12~~*6* Hand Finishing Tools: Provide straightedges that have a blade length of 10 feet [3.~~048~~ 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].

350-3.~~13~~*7* Texturing Machine: Provide a machine that consists of a supplementary machine capable of applying the final finish to the concrete pavement. Apply the finish by rectangular shaped spring steel tines rigidly mounted in a frame operating on an adjustable track mounted under the main frame of the machine. Use a machine that is constructed so as to provide for adjustment of the downward pressure on the tines as necessary to produce the desired finish under varying conditions of the concrete surface.

The Engineer may allow variation from any specific feature of the Texturing Machine as detailed above, provided that the Contractor can produce an equivalent final finish.

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* moist*ure 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 35°F [1°C], periods when the air temperature may rise above 85°F [29°C], high winds, heavy rains and other conditions that might affect the final durability of the pavement. ~~Have available at the site, at all times when concrete paving operations are underway, materials for the protection of the surface and edges of the unhardened concrete. For the protection of the pavement edges, use any covering material, such as burlap, paper, or plastic sheeting material, suitable for the protection of the pavement surface.~~

~~——~~When rain appears imminent, stop all paving operations, and ~~have all available personnel~~ cover the surface of the unhardened concrete with the protective covering.

~~——During periods when the air temperature may fall below 35°F [1°C], advise the Engineer of plans for curing and protecting the fresh concrete *shall be implemented as identified in the QCP* before placing the concrete. Do not place any concrete until the Engineer has approved the proposed methods.~~

~~The Contractor is fully responsible for the quality and strength of the concrete placed in cold weather even if the Engineer approves of the provisions the Contractor employs for protecting the concrete placed during cold weather.~~

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. ~~Secure the reinforcement in position in advance of concrete placement or, with the Engineer's specific approval, place it in the plastic concrete by mechanical or vibratory means after spreading the concrete.~~ 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 ~~which could impair bonding of the steel with the concrete~~. 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. ~~and t~~*T*he surface will at no point be below the grade specified for the finished surface~~, after application of the allowable tolerance~~. ~~Deposit~~ *Place* the concrete on the subgrade in a manner which will require as little rehandling as possible. ~~Continuously place concrete between transverse joints without using intermediate bulkheads.~~

~~Deposit~~ *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.* ~~Do not dump concrete from the discharge bucket or hopper onto an assembly without centering the bucket or hopper directly over the assembly.~~

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.* ~~The Engineer will not require the Contractor to use a spreader for areas where the width of slab varies, for intersections, and for 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*). Ensure that workmen *workers* do not walk in the freshly deposited concrete with *their boots or shoes coated with* earth or other deleterious substances coated on their boots or shoes.~~

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. ~~The Engineer will not require the Contractor to alter placement operations where superelevation reverses the pavement cross slope from that shown on the typical section.~~

~~**350-8.4 Hours of Operation:** Stop placing concrete in time to complete finishing operations during daylight hours, or provide adequate approved lighting *as identified in the QCP*.~~

350-8.5*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. ~~Do not continue vibration at any one location so long as to produce puddling or the accumulation of excessive grout on the surface.~~

350-~~9~~8.*65* 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-~~10~~-*9* Striking-off, Consolidating, and Finishing Concrete.

350-~~10~~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 ~~planning~~ 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-~~10~~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-~~10~~9.3 Hand Methods:

350-~~9~~10.3.1 Conditions under which Allowed: ~~The Contractor may use~~ *Use* hand methods in areas of narrow width or irregular dimensions, where operation of mechanical equipment is impracticable. ~~In the event that mechanical equipment breaks down, the Contractor may use hand methods to finish only that concrete already deposited on the subgrade when the breakdown occurred.~~

350-~~9~~10.3.2 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.

~~In operation, move the screed forward on the forms with a combined longitudinal and transverse shearing motion, moving always in the direction in which the work is progressing, and manipulate it so that neither end is raised from the side forms during the striking-off process. If necessary, repeat this until the surface is of uniform texture, true to grade and cross-section, and free from porous areas.~~

350-~~9~~10.3.3 Consolidation: Use hand-operated spud-type vibrators to consolidate.

350-~~9~~10.3.4 Floating: Use long-handled floats to float the concrete. Take the necessary care to avoid creating depressions or ridges during this operation.

350-~~9~~10.4 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.

~~350-11 Supplemental Floating.~~

~~In areas where performing machine strike-off, consolidation, and finishing, further 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. Waste excess mortar beyond the edge of the slab.~~

350-~~12~~-*10* Final Finish.

350-~~12~~*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.

~~After applying the burlap drag finish, apply the final finish with the texturing machine. Control the time of applying this finish and the method of operating the texturing machine so as to minimize tearing of surface and unseating of aggregate particles.~~

~~Provide a final finish that consists of transverse grooves which are 0.08 to 0.12 inch [2 to 3 mm] in width and 0.10 to 0.15 inch [2.5 to 4 mm] in depth, spaced at random intervals between 1/2 to 1 inch [13 to 25 mm]. Operate the texturing machine in a manner that minimizes the overlapping of subsequent passes of the steel comb. Create short gaps in the grooved finish as necessary to avoid overlap between passes.~~

~~In areas of irregular dimensions or narrow widths, where operating the texturing machine is impracticable, the Contractor may apply the finish by approved hand methods that achieve the required finish with a minimum of surface tearing and unseating aggregate particles. Ensure that the surface resulting from this operation is uniform in appearance and free of irregular, rough, or porous areas.~~

350-~~12~~*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-~~13~~-*11* Curing.

350-~~13~~*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 method*s* described below. In ~~all~~ cases *where*~~in which~~ 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 *QCP will be suspended*~~Engineer will order an immediate suspension of concreting operations~~. 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 50°F [10°C].

350-~~13~~*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}~~0.005 gal/ft^2~~ [~~0.2 L/m^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*~~until the pigment is uniformly dispersed throughout the vehicle~~.

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-~~13~~*11*.3 Burlap Mats: ~~Under this method, cover the surfaces to be cured with 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 ~~so as to cause them to remain in intimate contact with the surface being cured,~~ throughout the curing period *to ensure* ~~a~~ *contact with the surface being cured*. Maintain the mats fully moist and in position for the entire portion of the required ~~burlap~~ curing period.

350-~~13~~*11*.4 Removal of Forms: Do not remove forms from freshly placed concrete ~~until it has set~~ 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.

~~**350-14 Surface Requirements.**~~

~~After curing, remove the curing material (except for the impervious coating), and thoroughly test the surface for pavement surface smoothness in accordance with 352-4(c). Plainly mark all variations from the required tolerances. Where pavement surfaces do not meet the smoothness requirements, the Engineer will require corrective work and retesting to ensure conformity.~~

~~Eliminate high spots exceeding 1/8 inch in 10 feet [3.2 mm in 3 m], but not in excess of 0.3 inch in 25 feet [7.6 mm in 7.6 m], by grinding either with an approved machine or with a carborundum brick and water. Do not use bush hammering or other destructive means for removing irregularities. As directed by the Engineer, retexture corrected high areas to give skid resistance comparable to the surrounding area.~~

~~Provide grinding equipment with a power driven self-propelled machine that is specifically designed to grind portland cement concrete pavement, with a minimum of a 3 foot [1 m] wide grinding head and diamond impregnated grinding blades. Produce, by grinding, a pavement surface that is true to grade and uniform in appearance with a longitudinal line type texture. Provide a line type texture that contains parallel longitudinal corrugations that present a narrow ridge corduroy type appearance. Ensure~~

~~that the peaks of ridges are approximately 1/32 inch [0.8 mm] higher than the bottoms of the grooves with approximately 60 evenly spaced grooves per foot [300 mm].~~

~~Operate all milling, cutting, or grinding equipment to produce a reasonably uniform finished surface without spalling the pavement joints within corrected areas. The Engineer will not require extra grinding to eliminate minor depressions in order to provide 100% texturing of the pavement surface. Maintain the cross slope of the pavement as shown in the plans. Repair all joint seals destroyed by grinding at no expense to the Department.~~

~~Remove and replace any area of pavement which, after grinding, still shows a deviation in excess of the allowable tolerance. Ensure that the area removed and replaced is the full length between transverse joints and the full width of the lane involved.~~

~~Saw the area to be removed to a smooth vertical surface. Clean the face of the adjacent (hardened) concrete, and coat it with an epoxy bonding compound before placing the replacement concrete.~~

~~Bear the costs of all surface corrections required and of all required removal and replacement of defective surface concrete.~~

350-~~15~~ *12* Joints.

350-~~15~~*12*.1 General: Construct joints at the locations and in accordance with the details shown in the ~~Roadway and Traffic~~ Design Standards, Index No. 305 and the Contract Documents.

350-~~15~~*12*.2 Longitudinal Joints:

350-~~15~~*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. ~~Where keyways are required, the Contractor may form them by placing an insert of the proper shape along the inside face of the side form or, when using the slip form method of paving, by an approved extrusion device. Use a method that produces a keyway of the shape and at the location indicated in the plans.~~

350-~~15~~*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*~~within~~ 72 hours after placing the concrete.

350-~~15~~*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.

~~**350-15.2.4 Longitudinal Shoulder Joints (Concrete to Asphalt):** Construct a continuous joint by sawing a groove into the asphalt pavement at the abutment with the concrete pavement. Produce a groove that is 3/4 inch [19 mm] wide and 3/4 inch [19 mm] deep, after sawing and cleaning.~~

~~Seal the joint with hot-poured type sealant.~~

350-~~15~~*12*.3 Transverse Joints:

350-~~15~~*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-~~15~~*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 loadtransfer 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* ~~in general when the concrete is between 4 and~~ 12 hours *after placing the concrete*~~old~~. Make a second saw cut, to provide the joint dimensions indicated in the plans, as soon as there is no danger of further raveling.

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-~~15~~*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 ~~Roadway and Traffic~~ 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 on the ~~Roadway and Traffic~~ Design Standards, *Index 306*.

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-~~15~~*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 ~~the free end of~~ each dowel with one coat of approved zinc rich paint (listed on the Qualified Products List), and grease *one end* ~~it~~ with an approved

lubricant, to prevent the concrete from bonding to the dowel. *Provide a cap for* ~~Provide~~ the free end of expansion joint dowels ~~with the closest fitting metal cap or sleeve, equipped with a stop to prevent closing during placement operations. Maintain a clearance of 1 inch [25 mm] between the closed end of the cap and the dowel to accommodate future slab movement.~~

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].

~~Provide the Engineer with c~~Confirm~~ation of~~ the ~~location~~ *position* of ~~the~~ dowel bars *by suitable means acceptable to the Engineer, which may include non-destructive testing methods.* ~~The Contractor shall confirm that the paving operation has not displaced the dowels from their required positions. Perform confirmation checks daily for the first two days of the paving operation and weekly thereafter.~~

350-~~15~~*12*.5 Expansion Joints Around Structures: 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-~~15~~*12*.6 Cleaning Joints and Cracks:

350-~~15~~*12*.6.1 Cleaning Joints in New Pavement:

350-~~15~~*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-~~15~~*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-~~15~~*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-~~15~~*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*~~15~~.6.2.

350-~~15~~*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-~~15~~*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 50°F [10°C] or greater.

~~*Use a heating kettle for hot-poured sealer that is of the indirect heating or double-boiler type, using oil as a heat transfer medium*~~*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-~~15~~*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 40°F [5°C].

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-~~16~~-*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 ~~**350-16.1**~~ **Core Borings:** ~~After completing the concrete pavement, including any corrective work to meet ride requirement,~~ *To determine the actual thickness,* drill cores from the pavement *and measure thickness in accordance with ASTM C 174* ~~to determine the actual thickness. When the Department is ready to core the finished pavement for thickness, provide traffic control, coring equipment, and operator to obtain the cores. The Engineer will select the coring locations and make the acceptance measurements *for thickness determination*. Take borings at random intervals and at various points on the cross-section so that each test boring represents an area not exceeding 2,500 yd^2 [2,000 m^2].~~

~~———————~~Replace the portions of the pavement removed by the borings at no expense to the Department.

350-14.1.2 Non-destructive Testing: ~~*To determine by*~~ *-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.*

350-~~16~~*14*.2 Method of Calculating Average Thickness: The Department will determine the average thickness of *the* pavement *by using the following method of calculation:* ~~from the length of all cores taken as indicated above and will calculate it as follows:~~

(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*~~as measured by the cores~~ 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-~~17~~*15* Deficient Thickness.

350-~~17~~*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 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-~~17~~*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 ~~deficient~~ *deficiency* ~~area~~ is ~~sufficient~~ *enough* to seriously impair the anticipated service life of the pavement, ~~the Contractor shall~~ 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-~~17~~*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 Contractor may elect to leave~~ the pavement *may be left* in place, ~~but shall receive~~ *at* no compensation ~~for the area of pavement~~.

350-~~17~~*15*.4 Additional Borings: If the ~~Contractor believes that the~~ number of cores taken is not sufficient to indicate the thickness of the pavement, ~~he may request that the Engineer select~~ additional boring locations *may be requested, with prior approval* ~~by~~ *from the Engineer* ~~*and bear all cost for these additional boring locations*~~ *at no additional cost to the Department.* ~~The Department will deduct the cost of these additional borings from any sums due the Contractor, unless such borings indicate that the pavement within the questioned area is of specified or greater thickness.~~

350-~~18~~*16* Opening Pavement to Traffic.

Before opening the pavement to traffic, construct an earth berm along each edge. Build the berm to the full height of the pavement and at least 18 inches [0.5 m] wide, and sufficiently compacted ~~*it*~~ *to prevent underwash of the pavement. Maintain the berm until* ~~*completing*~~ *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 50°F [10°C]) 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 ~~AASHTO T 23~~*ASTM C 31* and tested in accordance with ~~AASHTO T 97~~*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 ~~Department's Roadway and Traffic~~ Design Standards ~~for Design, Construction, Maintenance and Utility Operations on the State Highway System~~*. ~~Provide protection that includes the erection and maintenance of signs, lights, barricades, etc., the construction and removal of temporary pavement, bridges, crossovers, etc., and the use of flagmen as may be necessary. Arrange the protective measures so as not to interfere with traffic in lanes being utilized for required maintenance of traffic.~~

~~Before opening the pavement to traffic, construct an earth berm along each edge. Build the berm to the full height of the pavement and at least 18 inches [0.5 m] wide, and sufficiently compact it to prevent underwash of the pavement. Maintain the berm until completing the final shoulders.~~

350-~~19~~-*17* Method of Measurement.

350-~~19~~*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 350-1~~5~~7.3 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~~ic~~ 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~~ic~~ concrete surface course constructed in accordance with Section 33~~1~~*4*. Reinforcing steel, placed and accepted, will be measured and paid for as provided in Section 415.

350-~~19~~*17*.2 Joints and Cracks: ~~The Contractor shall include~~*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 ~~that have been~~ 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-~~20~~-*198* 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.

Charles A Ishee
10/25/2003 12:53 PM

To: Judy F Frazier/CO/FDOT@FDOT
cc:
Subject: Re: D3500000.D02

Judy:

All the comments look good to me. It looks like none of the concepts were changed, but just the way it was presented. I count on you and your office to keep us straight on how it should linguistically work. I look forward to seeing it go our for industry review soon. Thanks =)

Charles A. Ishee, P.E.
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Judy F Frazier

Judy F Frazier
10/24/2003 01:23 PM

To: Charles A Ishee/SM/FDOT@FDOT
cc:
Subject: D3500000.D02

Good afternoon Charles. Please take a look at the attached draft specification. Clinton Shaw took the version that you submitted recently and made some modifications. He has put comment blocks where his suggested changes were made. They will show up with my ID though since he only made the comments and I made the actual text changes. Let us know what you think. If okay, we will submit this version back out for Industry Review. Thank you.

D3500000.D02.doc

Judy Frazier
(850) 414-4127, SC 994-4127
judy.frazier@dot.state.fl.us

Judy F Frazier

10/24/2003 01:18 PM

To: Charles A Ishee/SM/FDOT
cc:
cc:
Subject: D3500000.D02

Good afternoon Charles. Please take a look at the attached draft specification. Clinton Shaw took the version that you submitted recently and made some modifications. He has put comment blocks where his suggested changes were made. They will show up with my ID though since he only made the comments and I made the actual text changes. Let us know what you think. If okay, we will submit this version back out for Industry Review. Thank you.

D3500000.D02.doc

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CEMENT CONCRETE PAVEMENT.
(REV ~~5-13-03~~*09-19-03~~*10-23-03*~~**)**

SECTION 350 (Pages 304-322) is deleted and the following substituted:

SECTION 350
CEMENT CONCRETE PAVEMENT

350-1 Description.

Construct ~~portland~~ *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.*

~~For aggregates, proportioning and mixing, and other provisions for the production of the concrete, meet the applicable provisions of Section 346.~~

~~Provide adequate lighting for all work done at night, including finishing, curing, and sawing joints. Unless lighting is provided for finishing, stop construction operations soon enough each day to permit finishing during daylight.~~

~~At least 20 days prior to paving, f~~*F*urnish the following information ~~for the Engineer's review for specification compliance~~*in the Quality Control Plan (QCP) as required in Section 105*:

1. A detailed sequence and schedule of concrete placement operations including, but not ~~necessarily~~ 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. ~~*MA detailed staking plan for subgrade controls including offset requirements*~~*A method to ensure the proper placement of reinforcing steel, tie bars and dowel bars.*

3. A traffic control plan ~~for pavement construction operations~~ *that* ~~which~~ 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. ~~Identify~~ Defined provisions for adequate lighting for all work done at night, including finishing, curing, and sawing joints.

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

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

7. ~~Identify~~ 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: ~~Obtain the Engineer's approval of the equipment and tools to be used for handling materials and performing all parts of the work, as to their design, capacity, and mechanical condition. Deliver the equipment to the job site sufficiently ahead of the start of construction operations to allow the Engineer to examine it thoroughly for approval.~~

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

~~Equip all equipment which operates on the side forms with scraping devices to clean accumulations from the top of the forms and wheels.~~ ~~*Provide*~~ *Ensure the equipment and tools that are to be used ~~that~~ meet the following:*

~~*Capable*~~ *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 ~~meet~~ are in accordance with the contract documents, prior to the placing of concrete.

~~**350-3.2 Equipment For Trimming of Subgrade:** For equipment operating on the subgrade, provide an automatically controlled subgrade trimmer. Use a machine that is capable of trimming the subgrade to proper elevation within the tolerances established herein. Provide grade controls that operate by sensing from a taut line, set true to line and grade. Erect and maintain the taut line.~~

~~**350-3.3 Forms:**~~

~~**350-3.3.1 Form Material:** Provide steel forms, except that on curves with a radius of 45 m or less, provide flexible forms, or wooden forms that bend to the required arc.~~

~~**350-3.3.2 Dimensions:** Use forms with a minimum length of 10 feet [3 m], except wherethey are used on curves having a radius between 150 and 300 feet [45 and 90 m], in which case use a form length of 5 feet [1.5 m]. Use forms with a height that is equal to the edge thickness of the pavement. Use forms with a height greater than the edge thickness, provided the outer portion of the slab is thickened to equal the depth of the form by tapering at the rate of 1 inch of the extra thickness per foot [80 mm of the extra thickness per meter] of width. In such case, the Department will make no allowance for additional concrete. Do not use built up forms.~~

~~**350-3.3.3 Steel Forms:** Use steel forms fabricated into an approved section and sufficiently strong to ensure rigidity under the impact, thrust, and weight of the heaviest equipment to be carried over the forms. Make the width of the base of the forms which is in direct contact with the soil at least equal to the height of the forms, but not less than 8 inches [200 mm]. Extend the flange braces outward on the base not less than two thirds the height dimension of the form. Use steel forms of a thickness that is not less than 7/32 inch [5.5 mm]. When tested with a 10 foot [3.048 m] straightedge, ensure that the forms have no vertical variation in a 10 foot [3 m] length that is greater than 1/8 inch [3 mm] from a true plane of the surface on the top of the form, and no lateral variation that is greater than 1/4 inch [6 mm] from a~~

~~true plane surface on the vertical face of the form. Do not use steel forms if, when tested as a simple beam with a span of 9 feet 6 inches [2.9 m] and a load equal to that exerted by construction equipment placed upon them, the deflection is more than 1/4 inch [6 mm].~~

~~**350-3.3.4 Form Connections:** Provide connections between adjacent sections of the form, that form a lock joint, free from vertical movement in excess of 1/8 inch [3 mm] and from horizontal movement in excess of 1/4 inch [6 mm], under the impact, thrust, and weight of the heaviest machine carried on the forms.~~

~~**350-3.3.5 Defective Forms:** Remove bent, twisted, or broken forms, and forms with battered top surfaces, from the work. Do not use repaired forms until they are inspected and approved by the Engineer.~~

~~**350-3.3.6 Form Stakes:** Provide at least three steel stakes for each 10 foot [3 m] length of form. Use stakes that are of sufficient size to prevent undue lateral movement of the form during paving operations. Fasten each of the stakes to the form by means of a suitable socket attached to the form. Equip each stake socket with steel wedges for securely keying the forms to the stakes. Locate a stake not more than 12 inches [300 mm] from the end of each section. Do not use forms with broken or badly worn sockets.~~

~~**350-3.3.7 Form Tampers:** Use adequate mechanical form tampers, capable of thoroughly compacting the soil under the forms, except when the forms rest on a cement-treated subgrade.~~

~~**350-3.4 Spreader:** Provide a mechanical spreader that is independently powered and capable of spreading the mixed concrete on the subgrade over the entire width and depth of the strip being paved in a manner which will prevent segregation of the materials. Use a spreader designed and constructed to permit the concrete to be struck-off to a uniform thickness.~~

~~**350-3.5 Strike-Off, Consolidation, and Finishing for Fixed-Form Construction:** Provide equipment for these operations that consists of a self-propelled unit, or units, that perform the following functions by mechanical means, in the sequence indicated:~~

~~(1) Strike-off.~~
~~(2) Vibratory Consolidation.~~
~~(3) Screeding.~~
~~(4) Floating.~~

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

350-3.6~~.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 ~~all of this~~*the* equipment is of such dimensions and arrangement as to cover the full width of the pavement strip being *placed*~~laid~~. 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.

Do not use automatic grade controls on the paver when the tracks of the slip-form paver are operating on ~~econocrete base or~~ 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.

~~The Engineer may allow variation from any specific feature of the slip-form paver as detailed above, provided the industry has generally accepted the proposed variation as an improved feature.~~

350-3.~~7~~*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* ~~cause~~ *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.

~~**350-3.8 Mechanical Floating Equipment:** Provide equipment that consists of a supplementary self-propelled machine capable of further smoothing the concrete, removing excess mortar from the surface, and minimizing hand finishing.~~

~~Use a machine that leaves the surface of the concrete 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.~~

350-3.~~9~~*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.

~~The Contractor may use hand~~ p*P*ower-spray equipment ~~to~~ *may be used to* apply curing compound to areas where it is impracticable to operate the self-propelled equipment.

~~**350-3.10 Equipment for Sealing Joints:** Provide equipment for sealing the joints for each section of pavement. Use a heating kettle for hot-poured sealer that is of the indirect heating or double-boiler type, using oil as a heat transfer medium. 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. Use pouring equipment equipped with nozzles that discharge the seal 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 for pouring, within 10°F [5°C]*manufacturer's* .~~

350-3.~~11~~ 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. ~~The Contractor may u~~*U*se such equipment *that*~~as~~ *is approved by* the Engineer ~~may approve for such areas~~.

350-3.~~12~~ *6* Hand Finishing Tools: Provide straightedges that have a blade length of 10 feet [3.~~048~~ 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].

350-3.~~13~~ *7* Texturing Machine: Provide a machine that consists of a supplementary machine capable of applying the final finish to the concrete pavement. Apply the finish by rectangular shaped spring steel tines rigidly mounted in a frame operating on an adjustable track mounted under the main frame of the machine. Use a machine that is constructed so as to provide for adjustment of the downward pressure on the tines as necessary to produce the desired finish under varying conditions of the concrete surface.

The Engineer may allow variation from any specific feature of the Texturing Machine as detailed above, provided that the Contractor can produce an equivalent final finish.

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* moist*ure 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 35°F [1°C], periods when the air temperature may rise above 85°F [29°C], high winds, heavy rains and other conditions that might affect the final durability of the pavement.
~~Have available at the site, at all times when concrete paving operations are underway, materials for the protection of the surface and edges of the unhardened concrete. For the protection of the pavement edges, use any covering material, such as burlap, paper, or plastic sheeting material, suitable for the protection of the pavement surface.~~

~~———~~When rain appears imminent, stop all paving operations, and ~~have all available personnel~~ cover the surface of the unhardened concrete with the protective covering.

~~———During periods when the air temperature may fall below 35°F [1°C], advise the Engineer of plans for curing and protecting the fresh concrete *shall be implemented as identified in the QCP* before placing the concrete. Do not place any concrete until the Engineer has approved the proposed methods.~~

~~The Contractor is fully responsible for the quality and strength of the concrete placed in cold weather even if the Engineer approves of the provisions the Contractor employs for protecting the concrete placed during cold weather.~~

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. ~~Secure the reinforcement in position in advance of concrete placement or, with the Engineer's specific approval, place it in the plastic concrete by mechanical or vibratory means after spreading the concrete.~~ 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 ~~which could impair bonding of the steel with the concrete~~. 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. ~~and t~~*T*he surface will at no point be below the grade specified for the finished surface~~, after application of the allowable tolerance~~. ~~Deposit~~ *Place* the concrete on the subgrade in a manner which will require as little rehandling as possible. ~~Continuously place concrete between transverse joints without using intermediate bulkheads.~~

~~Deposit~~ *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.* ~~Do not dump concrete from the discharge bucket or hopper onto an assembly without centering the bucket or hopper directly over the assembly.~~

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.* ~~The Engineer will not require the Contractor to use a spreader for areas where the width of slab varies, for intersections, and for 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*). Ensure that workmen *workers* do not walk in the freshly deposited concrete with *their boots or shoes coated with* earth or other deleterious substances coated on their boots or shoes.~~

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. ~~The Engineer will not require the~~

~~Contractor to alter placement operations where superelevation reverses the pavement cross slope from that shown on the typical section.~~

~~**350-8.4 Hours of Operation:** Stop placing concrete in time to complete finishing operations during daylight hours, or provide adequate approved lighting *as identified in the QCP*.~~

350-8.~~5~~*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. ~~Do not continue vibration at any one location so long as to produce puddling or the accumulation of excessive grout on the surface.~~

350-~~9~~8.*65* 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-~~10~~ *9* Striking-off, Consolidating, and Finishing Concrete.

350-~~10~~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~~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-~~10~~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-~~10~~9.3 Hand Methods:

350-~~9~~10.3.1 Conditions under which Allowed: ~~The Contractor may use~~ *Use* hand methods in areas of narrow width or irregular dimensions, where operation of mechanical equipment is impracticable. ~~In the event that mechanical equipment breaks down, the Contractor may use hand methods to finish only that concrete already deposited on the subgrade when the breakdown occurred.~~

350-~~9~~10.3.2 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.

~~In operation, move the screed forward on the forms with a combined longitudinal and transverse shearing motion, moving always in the direction in which the work is progressing, and manipulate it so that neither end is raised from the side forms during the striking-off process. If necessary, repeat this until the surface is of uniform texture, true to grade and cross-section, and free from porous areas.~~

350-~~9~~10.3.3 Consolidation: Use hand-operated spud-type vibrators to consolidate.

350-~~9~~10.3.4 Floating: Use long-handled floats to float the concrete. Take the necessary care to avoid creating depressions or ridges during this operation.

350-~~9~~10.4 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.

~~**350-11 Supplemental Floating.**~~

~~In areas where performing machine strike-off, consolidation, and finishing, further 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. Waste excess mortar beyond the edge of the slab.~~

350-~~12~~ *10* Final Finish.

350-~~12~~*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.

~~After applying the burlap drag finish, apply the final finish with the texturing machine. Control the time of applying this finish and the method of operating the texturing machine so as to minimize tearing of surface and unseating of aggregate particles.~~

~~Provide a final finish that consists of transverse grooves which are 0.08 to 0.12 inch [2 to 3 mm] in width and 0.10 to 0.15 inch [2.5 to 4 mm] in depth, spaced at random intervals between 1/2 to 1 inch [13 to 25 mm]. Operate the texturing machine in a manner that minimizes the overlapping of subsequent passes of the steel comb. Create short gaps in the grooved finish as necessary to avoid overlap between passes.~~

~~In areas of irregular dimensions or narrow widths, where operating the texturing machine is impracticable, the Contractor may apply the finish by approved hand methods that achieve the required finish with a minimum of surface tearing and unseating aggregate particles. Ensure that the surface resulting from this operation is uniform in appearance and free of irregular, rough, or porous areas.~~

350-~~13~~*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-~~13~~ *11* Curing.

350-~~13~~*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 ~~all~~ cases *where*~~in which~~ 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 *QCP will be suspended*~~Engineer will order an immediate suspension of concreting operations~~. 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 50°F [10°C].

350-~~13~~*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}~~0.005 gal/ft^2~~ [~~0.2 L/m^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* ~~until the pigment is uniformly dispersed throughout the vehicle~~.

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.

350-13*11*.3 Burlap Mats: ~~Under this method, cover the surfaces to be cured with 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 ~~so as to cause them to remain in intimate contact with the surface being cured,~~ throughout the curing period *to ensure ~~a~~ contact with the surface being cured.* Maintain the mats fully moist and in position for the entire portion of the required ~~burlap~~ curing period.

350-13*11*.4 Removal of Forms: Do not remove forms from freshly placed concrete ~~until it has set~~ 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.

~~**350-14 Surface Requirements.**~~

~~After curing, remove the curing material (except for the impervious coating), and thoroughly test the surface for pavement surface smoothness in accordance with 352-4(c). Plainly mark all variations from the required tolerances. Where pavement surfaces do not meet the smoothness requirements, the Engineer will require corrective work and retesting to ensure conformity.~~

~~Eliminate high spots exceeding 1/8 inch in 10 feet [3.2 mm in 3 m], but not in excess of 0.3 inch in 25 feet [7.6 mm in 7.6 m], by grinding either with an approved machine or with a carborundum brick and water. Do not use bush-hammering or other destructive means for removing irregularities. As directed by the Engineer, retexture corrected high areas to give skid resistance comparable to the surrounding area.~~

~~Provide grinding equipment with a power driven self-propelled machine that is specifically designed to grind portland cement concrete pavement, with a minimum of a 3-foot [1-m] wide grinding head and diamond impregnated grinding blades. Produce, by grinding, a pavement surface that is true to grade and uniform in appearance with a longitudinal line type texture. Provide a line type texture that contains parallel longitudinal corrugations that present a narrow ridge corduroy type appearance. Ensure that the peaks of ridges are approximately 1/32 inch [0.8 mm] higher than the bottoms of the grooves with approximately 60 evenly spaced grooves per foot [300 mm].~~

~~Operate all milling, cutting, or grinding equipment to produce a reasonably uniform finished surface without spalling the pavement joints within corrected areas. The Engineer will not require extra grinding to eliminate minor depressions in order to provide 100% texturing of the pavement surface. Maintain the cross slope of the pavement as shown in the plans. Repair all joint seals destroyed by grinding at no expense to the Department.~~

~~Remove and replace any area of pavement which, after grinding, still shows a deviation in excess of the allowable tolerance. Ensure that the area removed and replaced is the full length between transverse joints and the full width of the lane involved.~~

~~Saw the area to be removed to a smooth vertical surface. Clean the face of the adjacent (hardened) concrete, and coat it with an epoxy bonding compound before placing the replacement concrete.~~

~~Bear the costs of all surface corrections required and of all required removal and replacement of defective surface concrete.~~

350-~~15~~-*12* Joints.

350-~~15~~*12*.1 General: Construct joints at the locations and in accordance with the details shown in the ~~Roadway and Traffic~~ Design Standards, Index No. 305 and the Contract Documents.

350-~~15~~*12*.2 Longitudinal Joints:

350-~~15~~*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. ~~Where keyways are required, the Contractor may form them by placing an insert of the proper shape along the inside face of the side form or, when using the slip form method of paving, by an approved extrusion device. Use a method that produces a keyway of the shape and at the location indicated in the plans.~~

350-~~15~~*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*~~within~~ 72 hours after placing the concrete.

350-~~15~~*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.

~~**350-15.2.4 Longitudinal Shoulder Joints (Concrete to Asphalt):** Construct a continuous joint by sawing a groove into the asphalt pavement at the abutment with the concrete pavement. Produce a groove that is 3/4 inch [19 mm] wide and 3/4 inch [19 mm] deep, after sawing and cleaning.~~

~~Seal the joint with hot-poured type sealant.~~

350-~~15~~*12*.3 Transverse Joints:

350-~~15~~*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-~~15~~*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 loadtransfer 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* ~~in general when the concrete is between 4 and~~ 12 hours *after placing the concrete*~~old~~. Make a second saw cut, to provide the joint dimensions indicated in the plans, as soon as there is no danger of further raveling.

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-~~15~~*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 ~~Roadway and Traffic~~ 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 on the ~~Roadway and Traffic~~ Design Standards, *Index 306*.

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-~~15~~*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 ~~the free end of~~ each dowel with one coat of approved zinc rich paint (listed on the Qualified Products List), and grease *one end* ~~it~~ with an approved lubricant, to prevent the concrete from bonding to the dowel. *Provide a cap for* ~~Provide~~ the free end of expansion joint dowels ~~with the closest fitting metal cap or sleeve, equipped with a stop to prevent closing during placement operations. Maintain a clearance of 1 inch [25 mm] between the closed end of the cap and the dowel to accommodate future slab movement.~~

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].

~~Provide the Engineer with c~~*C*onfirm~~ation of~~ the ~~location~~ *position* of ~~the~~ dowel bars *by suitable means acceptable to the Engineer, which may include non-destructive testing methods.* ~~The Contractor shall confirm that the paving operation has not displaced the dowels from their required positions. Perform confirmation checks daily for the first two days of the paving operation and weekly thereafter.~~

350-~~15~~*12*.5 Expansion Joints Around Structures: 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-~~15~~*12*.6 Cleaning Joints and Cracks:

350-~~15~~*12*.6.1 Cleaning Joints in New Pavement:

350-~~15~~*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-~~15~~*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-~~15~~*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-~~15~~*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*~~15~~.6.2.

350-~~15~~*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-~~15~~*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 50°F [10°C] or greater.

~~*Use a heating kettle for hot poured sealer that is of the indirect heating or double boiler type, using oil as a heat transfer medium*~~*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-~~15~~*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 40°F [5°C].

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-~~16~~-*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 ~~**350-16.1 Core Borings:** After completing the concrete pavement, including any corrective work to meet ride requirement,~~ *To determine the actual thickness,* drill cores from the pavement *and measure thickness in accordance with ASTM C 174* ~~to determine the actual thickness. When the Department is ready to core the finished pavement for thickness, provide traffic control, coring equipment, and operator to obtain the cores. The Engineer will select the coring locations and make the acceptance measurements *for thickness determination.* Take borings at random intervals and at various points on the cross-section so that each test boring represents an area not exceeding 2,500 yd^2 [2,000 m^2].~~

~~———————~~Replace the portions of the pavement removed by the borings at no expense to the Department.

350-14.1.2 Non-destructive Testing: ~~*To determine by*~~ *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.*

350-~~16~~*14*.2 Method of Calculating Average Thickness: The Department will determine the average thickness of *the* pavement *by using the following method of calculation:* ~~from the length of all cores taken as indicated above and will calculate it as follows:~~

(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* ~~as measured by the cores~~ 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-~~17~~-*15* Deficient Thickness.

350-~~17~~*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 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-~~17~~*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 ~~deficient~~ *deficiency* ~~area~~ is ~~sufficient~~ *enough* to seriously impair the anticipated service life of the pavement, ~~the Contractor shall~~ 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-~~17~~*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 Contractor may elect to leave~~ the pavement *may be left* in place, ~~but shall receive~~ *at* no compensation ~~for the area of pavement~~.

350-~~17~~*15*.4 Additional Borings: If the ~~Contractor believes that the~~ number of cores taken is not sufficient to indicate the thickness of the pavement, ~~he may request that the Engineer select~~ additional boring locations *may be requested, with prior approval ~~by~~ from the Engineer ~~and bear all cost for those additional boring locations~~at no additional cost to the Department.* ~~The Department will deduct the cost of these additional borings from any sums due the Contractor, unless such borings indicate that the pavement within the questioned area is of specified or greater thickness.~~

350-~~18~~*16* Opening Pavement to Traffic.

Before opening the pavement to traffic, construct an earth berm along each edge. Build the berm to the full height of the pavement and at least 18 inches [0.5 m] wide, and sufficiently compacted ~~it~~ to prevent underwash of the pavement. Maintain the berm until ~~completing~~ 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 50°F [10°C]) 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 ~~AASHTO T 23~~*ASTM C 31* and tested in accordance with ~~AASHTO T 97~~*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 ~~Department's Roadway and Traffic Design Standards for Design, Construction, Maintenance and Utility Operations on the State Highway System~~.* ~~Provide protection that includes the erection and maintenance of signs, lights, barricades, etc., the construction and removal of temporary pavement, bridges, crossovers, etc., and the use of flagmen as may be necessary. Arrange the protective measures so as not to interfere with traffic in lanes being utilized for required maintenance of traffic.~~

~~Before opening the pavement to traffic, construct an earth berm along each edge. Build the berm to the full height of the pavement and at least 18 inches [0.5 m] wide, and sufficiently~~

~~compact it to prevent underwash of the pavement. Maintain the berm until completing the final shoulders.~~

350-~~19~~-*17* Method of Measurement.

350-~~19~~*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 350-1~~5~~7.3 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~~ic~~ 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~~ic~~ concrete surface course constructed in accordance with Section 33~~1~~*4*. Reinforcing steel, placed and accepted, will be measured and paid for as provided in Section 415.

350-~~19~~*17*.2 Joints and Cracks: ~~The Contractor shall include~~*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 ~~that have been~~ 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-~~20~~-*198* 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.

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detailed staking plan for subgrade controls including offset requirements		
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proper placement of reinforcing steel, tie bars and dowel bars		
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for pavement construction operations		
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Page: 4 ~~Identify~~ Defined provisions ……		
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provisions for adequate lighting for all work done at night, including finishing, curing, and sawing joints.		

5. Method

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A method ……

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

6. If forms are to be utilized, identify

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, identify

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define

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the material, dimensions, type, connections, and staking of the forms.

7. Identify

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Identify

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Define

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

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(Pavement)

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Grinding Concrete Pavement.....Section 352

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Obtain the Engineer's approval of the equipment and tools to be used for handling materials and performing all parts of the work, as to their design, capacity, and mechanical condition. Deliver the equipment to the job site sufficiently ahead of the start of construction operations to allow the Engineer to examine it thoroughly for approval.

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

Equip all equipment which operates on the side forms with scraping devices to clean accumulations from the top of the forms and wheels.

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Provide

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Provide		
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Page: 4 Ensure the		
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equipment and tools		
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that are		
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to be used that meet the following:		
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that		
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Capable		
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Capable		
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Page: 4 The capability		
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handling materials and		
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performing all parts of the work.		
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To be of such capacity		
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that the paver operates continuously and at a constant rate of production, with starting and stopping held to a minimum.		
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When equipment operates on the side forms		
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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

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that		
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the alignment and grade of all forms meet		
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meet		
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Page: 6 are in accordance with		
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the contract documents		
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prior to the placing of concrete.		
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350-3.2 Equipment For Trimming of Subgrade: For equipment operating on the subgrade, provide an automatically controlled subgrade trimmer. Use a machine that is capable of trimming the subgrade to proper elevation within the tolerances established herein. Provide grade controls that operate by sensing from a taut line, set true to line and grade. Erect and maintain the taut line.

350-3.3 Forms:

350-3.3.1 Form Material: Provide steel forms, except that on curves with a radius of 45 m or less, provide flexible forms, or wooden forms that bend to the required arc.

350-3.3.2 Dimensions: Use forms with a minimum length of 10 feet [3 m], except wherethey are used on curves having a radius between 150 and 300 feet [45 and 90 m], in which case use a form length of 5 feet [1.5 m]. Use forms with a height that is equal to the edge thickness of the pavement. Use forms with a height greater than the edge thickness, provided the outer portion of the slab is thickened to equal the depth of the form by tapering at the rate of 1 inch of the extra thickness per foot [80 mm of the extra thickness per meter] of width. In such case, the Department will make no allowance for additional concrete. Do not use built-up forms.

350-3.3.3 Steel Forms: Use steel forms fabricated into an approved section and sufficiently strong to ensure rigidity under the impact, thrust, and weight of the heaviest equipment to be carried over the forms. Make the width of the base of the forms which is in direct contact with the soil at least equal to the height of the forms, but not less than 8 inches [200 mm]. Extend the flange braces outward on the base not less than two-thirds the height dimension of the form. Use steel forms of a thickness that is not less than 7/32 inch [5.5 mm]. When tested with a 10 foot [3.048 m] straightedge,

ensure that the forms have no vertical variation in a 10 foot [3 m] length that is greater than 1/8 inch [3 mm] from a true plane of the surface on the top of the form, and no lateral variation that is greater than 1/4 inch [6 mm] from a true plane surface on the vertical face of the form. Do not use steel forms if, when tested as a simple beam with a span of 9 feet 6 inches [2.9 m] and a load equal to that exerted by construction equipment placed upon them, the deflection is more than 1/4 inch [6 mm].

350-3.3.4 Form Connections: Provide connections between adjacent sections of the form, that form a lock joint, free from vertical movement in excess of 1/8 inch [3 mm] and from horizontal movement in excess of 1/4 inch [6 mm], under the impact, thrust, and weight of the heaviest machine carried on the forms.

350-3.3.5 Defective Forms: Remove bent, twisted, or broken forms, and forms with battered top surfaces, from the work. Do not use repaired forms until they are inspected and approved by the Engineer.

350-3.3.6 Form Stakes: Provide at least three steel stakes for each 10 foot [3 m] length of form. Use stakes that are of sufficient size to prevent undue lateral movement of the form during paving operations. Fasten each of the stakes to the form by means of a suitable socket attached to the form. Equip each stake socket with steel wedges for securely keying the forms to the stakes. Locate a stake not more than 12 inches [300 mm] from the end of each section. Do not use forms with broken or badly worn sockets.

350-3.3.7 Form Tampers: Use adequate mechanical form tampers, capable of thoroughly compacting the soil under the forms, except when the forms rest on a cement-treated subgrade.

350-3.4 Spreader: Provide a mechanical spreader that is independently powered and capable of spreading the mixed concrete on the subgrade over the entire width and depth of the strip being paved in a manner which will prevent segregation of the materials. Use a spreader designed and constructed to permit the concrete to be struck-off to a uniform thickness.

350-3.5 Strike-Off, Consolidation, and Finishing for Fixed-Form Construction: Provide equipment for these operations that consists of a self-propelled unit, or units, that perform the following functions by mechanical means, in the sequence indicated:

(1) Strike-off.
(2) Vibratory Consolidation.
(3) Screeding.
(4) Floating.

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

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econocrete base or

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The Engineer may allow variation from any specific feature of the slip-form paver as detailed above, provided the industry has generally accepted the proposed variation as an improved feature.

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Use a vibration method with sufficient intensity and duration to cause

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cause

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ensure

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complete consolidation of the concrete without causing segregation of the materials.

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350-3.8 Mechanical Floating Equipment: Provide equipment that consists of a supplementary self-propelled machine capable of further smoothing the concrete, removing excess mortar from the surface, and minimizing hand finishing.
Use a machine that leaves the surface of the concrete 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.

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The Contractor may use hand		
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350-3.10 Equipment for Sealing Joints: Provide equipment for sealing the joints for each section of pavement. Use a heating kettle for hot-poured sealer that is of the indirect heating or double-boiler type, using oil as a heat transfer medium. 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. Use pouring equipment equipped with nozzles that discharge the seal 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 for pouring, within 10°F [5°C]manufacturer's .

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manufacturer's		
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is approved by

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may approve for such areas

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within 2 percent of the optimum

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ure content

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Inclement weather may include, but

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is

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not limited to, periods when the air temperature may fall below 35°F [1°C], periods when the air temperature may rise above 85°F [29°C], high winds, heavy rains and other conditions that might affect the final durability of the pavement.

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Have available at the site, at all times when concrete paving operations are underway, materials for the protection of the surface and edges of the unhardened concrete. For the protection of the pavement edges, use any covering material, such as burlap, paper, or plastic sheeting material, suitable for the protection of the pavement surface.

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have all available personnel

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During periods when the air temperature may fall below 35°F [1°C], ~~advise the Engineer of~~ plans for curing and protecting the fresh concrete shall be implemented as identified in the QCP before placing the concrete. ~~Do not place any concrete until the Engineer has approved the proposed methods~~.

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Main document changes and comments

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The Engineer may require a demonstration of equipment and paving operations.		
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For aggregates, proportioning and mixing, and other provisions for the production of the concrete, meet the applicable provisions of Section 346.

Provide adequate lighting for all work done at night, including finishing, curing, and sawing joints. Unless lighting is provided for finishing, stop construction operations soon enough each day to permit finishing during daylight.

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for the Engineer's review for specification compliance		
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in the Quality Control Plan (QCP)		
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as required in Section		
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Identify backup equipment and the procedures that will be followed in the case of a breakdown of equipment.		
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The Contractor is fully responsible for the quality and strength of the concrete placed in cold weather even if the Engineer approves of the provisions the Contractor employs for protecting the concrete placed during cold weather.

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shall be implemented as identified in the QCP

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Secure the reinforcement in position in advance of concrete placement or, with the Engineer's specific approval, place it in the plastic concrete by mechanical or vibratory means after spreading the concrete.

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any

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The original is preferable. This new language gives the impression that only the items listed would impair bonding. "At the time of the concrete placement, ensure that the reinforcing steel is free from dirt, oil, paint, grease, mill scale, loose or thick rust or anything which could impair bonding of the steel with the concrete."

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of the following which could impair bonding of the steel with the concrete:

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which could impair bonding of the steel with the concrete

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, after application of the allowable tolerance

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Deposit

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Place

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Continuously place concrete between transverse joints without using intermediate bulkheads.

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Deposit

Page 7: Inserted **rt822ci** **9/17/2003 11:52 AM**
Place

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Ensure that workers do not walk in the freshly placed concrete with their boots or shoes coated with earth or other deleterious substances.

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Do not dump concrete from the discharge bucket or hopper onto an assembly without centering the bucket or hopper directly over the assembly.

Page 7: Inserted **Judy Frazier** **5/13/2003 2:59 PM**

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Do not place concrete from the discharge bucket or hopper onto an assembly without centering the bucket or hopper directly over the assembly.

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The Engineer will not require the Contractor to use a spreader for areas where the width of slab varies, for intersections, and for 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). Ensure that ~~workmen~~ workers do not walk in the freshly deposited concrete with their boots or shoes coated with earth or other deleterious substances ~~coated on their boots or shoes~~.

Page 7: Inserted **David Wang** **1/2/2003 5:12 PM**
or hoes

Page 7: Inserted **David Wang** **1/2/2003 5:13 PM**
workers

Page 7: Inserted **David Wang** **1/2/2003 5:14 PM**
their boots or shoes coated with

Page 7: Inserted **rt822ci** **7/3/2003 11:15 AM**

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).

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The Engineer will not require the Contractor to alter placement operations where superelevation reverses the pavement cross slope from that shown on the typical section.

350-8.4 Hours of Operation: Stop placing concrete in time to complete finishing operations during daylight hours, or provide adequate ~~approved~~ lighting as identified in the QCP.

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as identified in the QCP		
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reinforcement,		
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Do not continue vibration at any one location so long as to produce puddling or the accumulation of excessive grout on the surface.		
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8.6		
Page 8: Comment	**Clinton J. Shaw**	**10/23/2003 3:19 PM**
Page: 25 No. A period, not a colon.		
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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.

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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 planning

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planning

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planing

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Page 8: Inserted	**rt822ci**	**9/19/2003 11:36 PM**

. 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.

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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.

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The Contractor may use		
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In the event that mechanical equipment breaks down, the Contractor may use hand methods to finish only that concrete already deposited on the subgrade when the breakdown occurred.

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In operation, move the screed forward on the forms with a combined longitudinal and transverse shearing motion, moving always in the direction in which the work is progressing, and manipulate it so that neither end is raised from the side forms during the striking-off process. If necessary, repeat this until the surface is of uniform texture, true to grade and cross-section, and free from porous areas.

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350-11 Supplemental Floating.

In areas where performing machine strike-off, consolidation, and finishing, further 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. Waste excess mortar beyond the edge of the slab.

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After applying the burlap drag finish, apply the final finish with the texturing machine. Control the time of applying this finish and the method of operating the texturing machine so as to minimize tearing of surface and unseating of aggregate particles.

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Provide a final finish that consists of transverse grooves which are 0.08 to 0.12 inch [2 to 3 mm] in width and 0.10 to 0.15 inch [2.5 to 4 mm] in depth, spaced at

random intervals between 1/2 to 1 inch [13 to 25 mm]. Operate the texturing machine in a manner that minimizes the overlapping of subsequent passes of the steel comb. Create short gaps in the grooved finish as necessary to avoid overlap between passes.

In areas of irregular dimensions or narrow widths, where operating the texturing machine is impracticable, the Contractor may apply the finish by approved hand methods that achieve the required finish with a minimum of surface tearing and unseating aggregate particles. Ensure that the surface resulting from this operation is uniform in appearance and free of irregular, rough, or porous areas.

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Page: 32 cover and cure the		
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s		
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all		
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in which		

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that portion of		
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QCP will be suspended		
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Engineer will order an immediate suspension of concreting operations		
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gallon to every 200		
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ft^2		
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0.005 gal/ft^2		
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0.2 L/m^2		
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in accordance with the manufacture		

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until the pigment is uniformly dispersed throughout the vehicle		
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Under this method, cover the surfaces to be cured with burlap mats.		
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so as to cause them to remain in intimate contact with the surface being cured,		
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to ensure a contact with the surface being cured		
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burlap		
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until it has set		
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after placement		
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350-14 Surface Requirements.

After curing, remove the curing material (except for the impervious coating), and thoroughly test the surface for pavement surface smoothness in accordance with 352-4(c). Plainly mark all variations from the required tolerances. Where pavement surfaces do not

meet the smoothness requirements, the Engineer will require corrective work and retesting to ensure conformity.

Eliminate high spots exceeding 1/8 inch in 10 feet [3.2 mm in 3 m], but not in excess of 0.3 inch in 25 feet [7.6 mm in 7.6 m], by grinding either with an approved machine or with a carborundum brick and water. Do not use bush-hammering or other destructive means for removing irregularities. As directed by the Engineer, retexture corrected high areas to give skid resistance comparable to the surrounding area.

Provide grinding equipment with a power driven self-propelled machine that is specifically designed to grind portland cement concrete pavement, with a minimum of a 3 foot [1 m] wide grinding head and diamond impregnated grinding blades. Produce, by grinding, a pavement surface that is true to grade and uniform in appearance with a longitudinal line type texture. Provide a line type texture that contains parallel longitudinal corrugations that present a narrow ridge corduroy type appearance. Ensure that the peaks of ridges are approximately 1/32 inch [0.8 mm] higher than the bottoms of the grooves with approximately 60 evenly spaced grooves per foot [300 mm].

Operate all milling, cutting, or grinding equipment to produce a reasonably uniform finished surface without spalling the pavement joints within corrected areas. The Engineer will not require extra grinding to eliminate minor depressions in order to provide 100% texturing of the pavement surface. Maintain the cross slope of the pavement as shown in the plans. Repair all joint seals destroyed by grinding at no expense to the Department.

Remove and replace any area of pavement which, after grinding, still shows a deviation in excess of the allowable tolerance. Ensure that the area removed and replaced is the full length between transverse joints and the full width of the lane involved.

Saw the area to be removed to a smooth vertical surface. Clean the face of the adjacent (hardened) concrete, and coat it with an epoxy bonding compound before placing the replacement concrete.

Bear the costs of all surface corrections required and of all required removal and replacement of defective surface concrete.

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Roadway and Traffic

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Where keyways are required, the Contractor may form them by placing an insert of the proper shape along the inside face of the side form or, when using the slip form method of paving, by an approved extrusion device. Use a method that produces a keyway of the shape and at the location indicated in the plans.

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350-15.2.4 Longitudinal Shoulder Joints (Concrete to Asphalt):

Construct a continuous joint by sawing a groove into the asphalt pavement at the

abutment with the concrete pavement. Produce a groove that is 3/4 inch [19 mm] wide and 3/4 inch [19 mm] deep, after sawing and cleaning.

Seal the joint with hot-poured type sealant.

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in general when the concrete is between 4 and

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after placing the concrete		
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Roadway and Traffic		
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Provide a cap for

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Provide

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with the closest fitting metal cap or sleeve, equipped with a stop to prevent closing during placement operations

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Maintain a clearance of 1 inch [25 mm] between the closed end of the cap and the dowel to accommodate future slab movement.

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Provide the Engineer with c

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of

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by suitable means acceptable to the Engineer, which may include non-destructive testing methods

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The Contractor shall confirm that the paving operation has not displaced the dowels from their required positions. Perform confirmation checks daily for the first two days of the paving operation and weekly thereafter.

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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.

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Use equipment equipped with nozzles that discharge the seal

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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.

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Use a heating kettle for hot-poured sealer that is of the indirect heating or double-boiler type, using oil as a heat transfer medium

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"Use an indirect heating or double boiler type heating kettle that uses oil as a heat transfer medium, for hot poured sealer."

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. 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.

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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.

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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

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350-16.1

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After completing the concrete pavement, including any corrective work to meet ride requirement,

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To determine the actual thickness,

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and measure thickness in accordance with ASTM C 174

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to determine the actual thickness

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When the ~~Department~~ is ready to core the finished pavement for thickness, provide traffic control, coring equipment, and operator to obtain the cores. The Engineer will select the coring locations and make the acceptance measurements for thickness determination. Take borings at random intervals and at various points on the cross-section so that each test boring represents an area not exceeding 2,500 yd^2 [2,000 m^2].

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for thickness determination

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350-14.1.2 Non-destructive Testing: To determine by

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To determine by

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"For a determination using the .....

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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.

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following		
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method of calculation		
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from the length of all cores taken as indicated above and will calculate it		
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as follows:		
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of the pavement		
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as measured by the cores		
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Any deficient pavement will be just cause for that portion of the quality control plan to be suspended until the corrections are to the satisfaction of the Engineer.		
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deficient		
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deficiency		
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enough		
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the Contractor shall		
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the Contractor may elect to leave		
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but shall receive		
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at		
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for the area of pavement		
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Contractor believes that the

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he may request

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that the Engineer select

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may be requested,

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with prior approval by

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by

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the Engineer and bear all cost for these additional boring locations

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and bear all cost for these additional boring locations

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at no additional cost to the Department.

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The Department will deduct the cost of these additional borings from any sums due the Contractor, unless such borings indicate that the pavement within the questioned area is of specified or greater thickness.

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Before opening the pavement to traffic, construct an earth berm along each edge. Build the berm to the full height of the pavement and at least 18 inches [0.5 m] wide, and sufficiently compact

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it to prevent underwash of the pavement. Maintain the berm until completing the final shoulders

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completing		
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are complete		
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in accordance with the current edition of the Department's Roadway and Traffic Design Standards for Design, Construction, Maintenance and Utility Operations on the State Highway System		
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Department's Roadway and Traffic

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for Design, Construction, Maintenance and Utility Operations on the State Highway System

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. Provide protection that includes the erection and maintenance of signs, lights, barricades, etc., the construction and removal of temporary pavement, bridges, crossovers, etc., and the use of flagmen as may be necessary. Arrange the protective measures so as not to interfere with traffic in lanes being utilized for required maintenance of traffic

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Before opening the pavement to traffic, construct an earth berm along each edge. Build the berm to the full height of the pavement and at least 18 inches [0.5 m] wide, and sufficiently compact it to prevent underwash of the pavement. Maintain the berm until completing the final shoulders.

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Header and footer changes

Text box changes

Header and footer text box changes

Footnote changes

Endnote changes

Clinton Shaw
10/23/2003 09:42 AM

To: Judy F Frazier/CO/FDOT@FDOT, Shirley Harvey/CO/FDOT@FDOT
cc:
Subject: Specifications 350, 352, 353, 354 & 355

Hello,

D3500000.D02 is now in the Develop folder. This proposed change is to be resubmitted to Industry for another review.

Thanks

Clinton J. Shaw
(850) 414-4129 SC 994-4129
Clinton.Shaw@dot.state.fl.us
----- Forwarded by Clinton Shaw/CO/FDOT on 10/23/2003 09:38 AM -----

John H Owens
10/14/2003 07:41 AM

To: Clinton Shaw/CO/FDOT@FDOT
cc:
Subject: Specifications 350, 352, 353, 354 & 355

Good morning, well here they are.

Thank You, Have A Great Day,

John H. Owens
F.D.O.T. Specifications Office
(850) 414-4113 Fax (850) 413-7385
E-Mail: john.owens@dot.state.fl.us

----- Forwarded by John H Owens/CO/FDOT on 10/14/2003 07:40 AM -----

Charles A Ishee
10/13/2003 08:37 PM

To: Duane F Brautigam/CO/FDOT@FDOT
cc: John H Owens/CO/FDOT@FDOT, Michael Bergin/SM/FDOT@FDOT, David Sadler/CO/FDOT@FDOT
Subject: Specifications 350, 352, 353, 354 & 355

Duane:

After receiving multiple comments from industry and FHWA, the following specifications has been modified to address all parties concerns. Please prepare these documents and send them back out for industry review to become part of the Standard Specifications. The one specification that may not need to be sent out is 355, because just one sentence was added to allow for materials meeting the requirements of 354. So, please send out the following specifications for industry review. If you have any comments or questions, please feel free to give me a call. Thanks =)

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Charles A. Ishee, P.E.
Structural Materials Research Engineer

T: 352-955-6668 (SC 625-6668)
F: 352-955-6680 (SC 625-6680)
E: charles.ishee@dot.state.fl.us

CEMENT CONCRETE PAVEMENT.
(REV ~~5-13-03~~*09-19-03*)

SECTION 350 (Pages 304-322) is deleted and the following substituted:

SECTION 350
CEMENT CONCRETE PAVEMENT

350-1 Description.

Construct ~~portland~~ *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.*

~~For aggregates, proportioning and mixing, and other provisions for the production of the concrete, meet the applicable provisions of Section 346.~~

~~Provide adequate lighting for all work done at night, including finishing, curing, and sawing joints. Unless lighting is provided for finishing, stop construction operations soon enough each day to permit finishing during daylight.~~

~~At least 20 days prior to paving, f~~*F*urnish the following information ~~for the Engineer's review for specification compliance~~*in the Quality Control Plan (QCP) as required in Section 105*:

1. A detailed sequence and schedule of concrete placement operations including, but not ~~necessarily~~ 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. *M*~~A detailed staking plan for subgrade controls including offset requirements~~*ethod to ensure proper placement of reinforcing steel, tie bars and dowel bars.*

3. A traffic control plan ~~for pavement construction operations~~ *that* ~~which~~ 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. Identify provisions for adequate lighting for all work done at night, including finishing, curing, and sawing joints.

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

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

7. Identify 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: ~~Obtain the Engineer's approval of the equipment and tools to be used for handling materials and performing all parts of the work, as to their design, capacity, and mechanical condition. Deliver the equipment to the job site sufficiently ahead of the start of construction operations to allow the Engineer to examine it thoroughly for approval.~~

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

~~Equip all equipment which operates on the side forms with scraping devices to clean accumulations from the top of the forms and wheels.~~*Provide equipment and tools to be used that meet the following:*

Capable 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 the alignment and grade of all forms meet the contract documents prior to the placing of concrete.

~~**350-3.2 Equipment For Trimming of Subgrade:** For equipment operating on the subgrade, provide an automatically controlled subgrade trimmer. Use a machine that is capable of trimming the subgrade to proper elevation within the tolerances established herein. Provide grade controls that operate by sensing from a taut line, set true to line and grade. Erect and maintain the taut line.~~

~~**350-3.3 Forms:**~~

~~**350-3.3.1 Form Material:** Provide steel forms, except that on curves with a radius of 45 m or less, provide flexible forms, or wooden forms that bend to the required arc.~~

~~**350-3.3.2 Dimensions:** Use forms with a minimum length of 10 feet [3 m], except wherethey are used on curves having a radius between 150 and 300 feet [45 and 90 m], in which case use a form length of 5 feet [1.5 m]. Use forms with a height that is equal to the edge thickness of the pavement. Use forms with a height greater than the edge thickness, provided the outer portion of the slab is thickened to equal the depth of the form by tapering at the rate of 1 inch of the extra thickness per foot [80 mm of the extra thickness per meter] of width. In such case, the Department will make no allowance for additional concrete. Do not use built-up forms.~~

~~**350-3.3.3 Steel Forms:** Use steel forms fabricated into an approved section and sufficiently strong to ensure rigidity under the impact, thrust, and weight of the heaviest equipment to be carried over the forms. Make the width of the base of the forms which is in direct contact with the soil at least equal to the height of the forms, but not less than 8 inches [200 mm]. Extend the flange braces outward on the base not less than two-thirds the height dimension of the form. Use steel forms of a thickness that is not less than 7/32 inch [5.5 mm]. When tested with a 10 foot [3.048 m] straightedge, ensure that the forms have no vertical variation in a 10 foot [3 m] length that is greater than 1/8 inch [3 mm] from a true plane of the surface on the top of the form, and no lateral variation that is greater than 1/4 inch [6 mm] from a true plane surface on the vertical face of the form. Do not use steel forms if, when tested as a simple beam with a span of 9 feet 6 inches [2.9 m] and a load equal to that exerted by construction equipment placed upon them, the deflection is more than 1/4 inch [6 mm].~~

~~**350-3.3.4 Form Connections:** Provide connections between adjacent sections of the form, that form a lock joint, free from vertical movement in excess of 1/8 inch [3 mm] and from horizontal movement in excess of 1/4 inch [6 mm], under the impact, thrust, and weight of the heaviest machine carried on the forms.~~

~~**350-3.3.5 Defective Forms:** Remove bent, twisted, or broken forms, and forms with battered top surfaces, from the work. Do not use repaired forms until they are inspected and approved by the Engineer.~~

~~**350-3.3.6 Form Stakes:** Provide at least three steel stakes for each 10 foot [3 m] length of form. Use stakes that are of sufficient size to prevent undue lateral movement of the form during paving operations. Fasten each of the stakes to the form by means of a suitable socket attached to the form. Equip each stake socket with steel wedges for securely keying the forms to the stakes. Locate a~~

~~stake not more than 12 inches [300 mm] from the end of each section. Do not use forms with broken or badly worn sockets.~~

~~**350-3.3.7 Form Tampers:** Use adequate mechanical form tampers, capable of thoroughly compacting the soil under the forms, except when the forms rest on a cement-treated subgrade.~~

~~**350-3.4 Spreader:** Provide a mechanical spreader that is independently powered and capable of spreading the mixed concrete on the subgrade over the entire width and depth of the strip being paved in a manner which will prevent segregation of the materials. Use a spreader designed and constructed to permit the concrete to be struck off to a uniform thickness.~~

~~**350-3.5 Strike-Off, Consolidation, and Finishing for Fixed-Form Construction:** Provide equipment for these operations that consists of a self-propelled unit, or units, that perform the following functions by mechanical means, in the sequence indicated:~~

~~(1) Strike-off.~~
~~(2) Vibratory Consolidation.~~
~~(3) Screeding.~~
~~(4) Floating.~~

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

350-3.6*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 ~~all of this~~*the* equipment is of such dimensions and arrangement as to cover the full width of the pavement strip being *placed*~~laid~~. 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.

Do not use automatic grade controls on the paver when the tracks of the slip-form paver are operating on ~~econocrete base or~~ 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.

~~The Engineer may allow variation from any specific feature of the slip-form paver as detailed above, provided the industry has generally accepted the proposed variation as an improved feature.~~

350-3.~~7~~*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 cause 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.

~~**350-3.8 Mechanical Floating Equipment:** Provide equipment that consists of a supplementary self-propelled machine capable of further smoothing the concrete, removing excess mortar from the surface, and minimizing hand finishing.~~

~~Use a machine that leaves the surface of the concrete 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.~~

350-3.~~9~~ *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.

The Contractor may use hand power-spray equipment to apply curing compound to areas where it is impracticable to operate the self-propelled equipment.

~~**350-3.10 Equipment for Sealing Joints:** Provide equipment for sealing the joints for each section of pavement. Use a heating kettle for hot-poured sealer that is of the indirect heating or double-boiler type, using oil as a heat transfer medium. 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. Use pouring equipment equipped with nozzles that discharge the seal 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 for pouring, within 10°F [5°C]*manufacturer's*.~~

350-3.~~11~~ *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. ~~The Contractor may u~~*U*se such equipment *that*~~as~~ *is approved by* the Engineer~~may approve for such areas~~.

350-3.~~12~~ *6* Hand Finishing Tools: Provide straightedges that have a blade length of 10 feet [3.~~048~~ 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].

350-3.~~13~~ *7* Texturing Machine: Provide a machine that consists of a supplementary machine capable of applying the final finish to the concrete pavement. Apply the finish by rectangular shaped spring steel tines rigidly mounted in a frame operating on an adjustable track mounted under the main frame of the machine. Use a machine that is constructed so as to provide for adjustment of the downward pressure on the tines as necessary to produce the desired finish under varying conditions of the concrete surface.

The Engineer may allow variation from any specific feature of the Texturing Machine as detailed above, provided that the Contractor can produce an equivalent final finish.

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* moist*ure 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 not limited to, periods when the air temperature may fall below 35°F [1°C], periods when the air temperature may rise above 85°F [29°C], high winds, heavy rains and other conditions that might affect the final durability of the pavement. ~~Have available at the site, at all times when concrete paving operations are underway, materials for the protection of the surface and edges of the unhardened concrete. For the protection of the pavement edges, use any covering material, such as burlap, paper, or plastic sheeting material, suitable for the protection of the pavement surface.~~

~~———~~When rain appears imminent, stop all paving operations, and ~~have all available personnel~~ cover the surface of the unhardened concrete with the protective covering.

~~———During periods when the air temperature may fall below 35°F [1°C], advise the Engineer of plans for curing and protecting the fresh concrete *shall be implemented as identified in the QCP* before placing the concrete. Do not place any concrete until the Engineer has approved the proposed methods.~~
~~The Contractor is fully responsible for the quality and strength of the concrete placed in cold weather even if the Engineer approves of the provisions the Contractor employs for protecting the concrete placed during cold weather.~~

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. ~~Secure the reinforcement in position in advance of concrete placement or, with the Engineer's specific approval, place it in the plastic concrete by mechanical or vibratory means after spreading the concrete.~~ 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 ~~which could impair bonding of the steel with the concrete~~. 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. ~~and t~~The surface will at no point be below the grade specified for the finished surface~~, after application of the allowable tolerance~~. ~~Deposit~~ *Place* the concrete on the subgrade in a manner which will require as little rehandling as possible. ~~Continuously place concrete between transverse joints without using intermediate bulkheads.~~

~~Deposit~~ *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.* ~~Do not dump concrete from the discharge bucket or hopper onto an assembly without centering the bucket or hopper directly over the assembly.~~

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.* ~~The Engineer will not require the Contractor to use a spreader for areas where the width of slab varies, for intersections, and for 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*). Ensure that workmen *workers* do not walk in the freshly deposited concrete with *their boots or shoes coated with* earth or other deleterious substances coated on their boots or shoes.~~

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. ~~The Engineer will not require the Contractor to alter placement operations where superelevation reverses the pavement cross slope from that shown on the typical section.~~

~~**350-8.4 Hours of Operation:** Stop placing concrete in time to complete finishing operations during daylight hours, or provide adequate approved lighting *as identified in the QCP*.~~

350-8.5 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. ~~Do not continue vibration at any one location so long as to produce puddling or the accumulation of excessive grout on the surface.~~

350-~~9~~8.6 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-~~10~~9 Striking-off, Consolidating, and Finishing Concrete.

350-~~10~~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 planning. 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-~~10~~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-~~10~~9.3 Hand Methods:

350-~~9~~10.3.1 Conditions under which Allowed: The Contractor may use hand methods in areas of narrow width or irregular dimensions, where operation of mechanical equipment is impracticable. ~~In the event that mechanical equipment breaks down, the Contractor may use hand methods to finish only that concrete already deposited on the subgrade when the breakdown occurred.~~

350-~~9~~10.3.2 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.

~~In operation, move the screed forward on the forms with a combined longitudinal and transverse shearing motion, moving always in the direction in which the work is progressing, and manipulate it so that neither end is raised from the side forms during the striking-off process. If necessary, repeat this until the surface is of uniform texture, true to grade and cross-section, and free from porous areas.~~

350-~~9~~10.3.3 Consolidation: Use hand-operated spud-type vibrators to consolidate.

350-~~9~~10.3.4 Floating: Use long-handled floats to float the concrete. Take the necessary care to avoid creating depressions or ridges during this operation.

350-~~9~~10.4 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.

~~350-11 Supplemental Floating.~~

~~In areas where performing machine strike-off, consolidation, and finishing, further 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. Waste excess mortar beyond the edge of the slab.~~

350-~~12~~ *10* Final Finish.

350-~~12~~*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.

~~After applying the burlap drag finish, apply the final finish with the texturing machine. Control the time of applying this finish and the method of operating the texturing machine so as to minimize tearing of surface and unseating of aggregate particles.~~

~~Provide a final finish that consists of transverse grooves which are 0.08 to 0.12 inch [2 to 3 mm] in width and 0.10 to 0.15 inch [2.5 to 4 mm] in depth, spaced at random intervals between 1/2 to 1 inch [13 to 25 mm]. Operate the texturing machine in a manner that minimizes the overlapping of subsequent passes of the steel comb. Create short gaps in the grooved finish as necessary to avoid overlap between passes.~~

~~In areas of irregular dimensions or narrow widths, where operating the texturing machine is impracticable, the Contractor may apply the finish by approved hand methods that achieve the required finish with a minimum of surface tearing and unseating aggregate particles. Ensure that the surface resulting from this operation is uniform in appearance and free of irregular, rough, or porous areas.~~

350-~~12~~*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-~~13~~-*11* Curing.

350-~~13~~*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, the edges of the newly placed concrete in accordance with one or more of the methods described below. In ~~all~~ cases *where*~~in which~~ 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 *QCP will be suspended*~~Engineer will order an immediate suspension of concreting operations~~. 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 50°F [10°C].

350-~~13~~*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}~~0.005 gal/ft^2~~ [~~0.2 L/m^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 manufactures recommendation*~~until the pigment is uniformly dispersed throughout the vehicle~~.

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-~~13~~*11*.3 Burlap Mats: ~~Under this method, cover the surfaces to be cured with 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 ~~so as to cause them to remain in intimate contact with the surface being cured,~~ throughout the curing period *to ensure a contact with the surface being cured.* Maintain the mats fully moist and in position for the entire portion of the required ~~burlap~~ curing period.

350-~~13~~*11*.4 Removal of Forms: Do not remove forms from freshly placed concrete ~~until it has set~~ 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.

~~**350-14 Surface Requirements.**~~

~~After curing, remove the curing material (except for the impervious coating), and thoroughly test the surface for pavement surface smoothness in accordance with 352-4(c). Plainly mark all variations from the required tolerances. Where pavement surfaces do not meet the smoothness requirements, the Engineer will require corrective work and retesting to ensure conformity.~~

~~Eliminate high spots exceeding 1/8 inch in 10 feet [3.2 mm in 3 m], but not in excess of 0.3 inch in 25 feet [7.6 mm in 7.6 m], by grinding either with an approved machine or with a carborundum brick and water. Do not use bush-hammering or other destructive means for removing irregularities. As directed by the Engineer, retexture corrected high areas to give skid resistance comparable to the surrounding area.~~

~~Provide grinding equipment with a power driven self-propelled machine that is specifically designed to grind portland cement concrete pavement, with a minimum of a 3-foot [1-m] wide grinding head and diamond impregnated grinding blades. Produce, by grinding, a pavement surface that is true to grade and uniform in appearance with a longitudinal line-type texture. Provide a line-type texture that contains parallel longitudinal corrugations that present a narrow-ridge corduroy type appearance. Ensure that the peaks of ridges are approximately 1/32 inch [0.8 mm] higher than the bottoms of the grooves with approximately 60 evenly spaced grooves per foot [300 mm].~~

~~Operate all milling, cutting, or grinding equipment to produce a reasonably uniform finished surface without spalling the pavement joints within corrected areas. The Engineer will not require extra~~

~~grinding to eliminate minor depressions in order to provide 100% texturing of the pavement surface. Maintain the cross slope of the pavement as shown in the plans. Repair all joint seals destroyed by grinding at no expense to the Department.~~

~~Remove and replace any area of pavement which, after grinding, still shows a deviation in excess of the allowable tolerance. Ensure that the area removed and replaced is the full length between transverse joints and the full width of the lane involved.~~

~~Saw the area to be removed to a smooth vertical surface. Clean the face of the adjacent (hardened) concrete, and coat it with an epoxy bonding compound before placing the replacement concrete.~~

~~Bear the costs of all surface corrections required and of all required removal and replacement of defective surface concrete.~~.

350-~~15~~-*12* Joints.

350-~~15~~*12*.1 General: Construct joints at the locations and in accordance with the details shown in the ~~Roadway and Traffic~~ Design Standards, Index No. 305 and the Contract Documents.

350-~~15~~*12*.2 Longitudinal Joints:

350-~~15~~*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. ~~Where keyways are required, the Contractor may form them by placing an insert of the proper shape along the inside face of the side form or, when using the slip form method of paving, by an approved extrusion device. Use a method that produces a keyway of the shape and at the location indicated in the plans.~~

350-~~15~~*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*~~within~~ 72 hours after placing the concrete.

350-~~15~~*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.

~~**350-15.2.4 Longitudinal Shoulder Joints (Concrete to Asphalt):** Construct a continuous joint by sawing a groove into the asphalt pavement at the abutment with the concrete pavement. Produce a groove that is 3/4 inch [19 mm] wide and 3/4 inch [19 mm] deep, after sawing and cleaning.~~

~~Seal the joint with hot-poured type sealant.~~

350-~~15~~*12*.3 Transverse Joints:

350-~~15~~*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-~~15~~*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 loadtransfer 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* ~~in general when the concrete is between 4 and~~ 12 hours *after placing the concrete*~~old~~. Make a second saw cut, to provide the joint dimensions indicated in the plans, as soon as there is no danger of further raveling.

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-~~15~~*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 ~~Roadway and Traffic~~ 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 on the ~~Roadway and Traffic~~ Design Standards, *Index 306*.

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-~~15~~*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 ~~the free end of~~ each dowel with one coat of approved zinc rich paint (listed on the Qualified Products List), and grease *one end* ~~it~~ with an approved lubricant, to prevent the concrete from bonding to the dowel. *Provide a cap for* ~~Provide~~ the free end of expansion joint dowels ~~with the closest fitting metal cap or sleeve, equipped with a stop to prevent closing during placement operations. Maintain a clearance of 1 inch [25 mm] between the closed end of the cap and the dowel to accommodate future slab movement.~~

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].

~~Provide the Engineer with e~~Confirmation ~~of~~ the ~~location~~ *position* of ~~the~~ dowel bars *by suitable means acceptable to the Engineer, which may include non-destructive testing methods.* ~~The Contractor shall confirm that the paving operation has not displaced the dowels from their required positions. Perform confirmation checks daily for the first two days of the paving operation and weekly thereafter.~~

350-~~15~~*12*.5 Expansion Joints Around Structures: 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-~~15~~*12*.6 Cleaning Joints and Cracks:

350-~~15~~*12*.6.1 Cleaning Joints in New Pavement:

350-~~15~~*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-~~15~~*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-~~15~~*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-~~15~~*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*~~15~~.6.2.

350-~~15~~*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 seal 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-~~15~~*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 50°F [10°C] or greater.

Use a heating kettle for hot-poured sealer that is of the indirect heating or double-boiler type, using oil as a heat transfer medium. 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-~~15~~*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 40°F [5°C].

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-~~16~~-*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 ~~**350-16.1 Core Borings:** After completing the concrete pavement, including any corrective work to meet ride requirement,~~ *To determine the actual thickness,* drill cores from the pavement *and measure thickness in accordance with ASTM C 174* ~~to determine the actual thickness. When the Department is ready to core the finished pavement for thickness, provide traffic control, coring equipment, and operator to obtain the cores. The Engineer will select the coring locations and make the acceptance measurements *for thickness determination.* Take borings at random intervals and at various points on the cross-section so that each test boring represents an area not exceeding 2,500 yd^2 [2,000 m^2].~~ Replace the portions of the pavement removed by the borings at no expense to the Department.

350-14.1.2 Non-destructive Testing: *To determine by 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.

350-~~16~~*14*.2 Method of Calculating Average Thickness: The Department will determine the average thickness of *the* pavement *by using the method of calculation* ~~from the length of all cores taken as indicated above and will calculate it~~ as follows:

(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*~~as measured by the cores~~ 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-~~17~~*15* Deficient Thickness.

350-~~17~~*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 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-~~17~~*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 deficient area is sufficient to seriously impair the anticipated service life of the pavement, the Contractor shall 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-~~17~~*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 Contractor may elect to leave the pavement in place, but shall receive no compensation for the area of pavement.

350-~~17~~*15*.4 Additional Borings: If the Contractor believes that the number of cores taken is not sufficient to indicate the thickness of the pavement, he may request ~~that the Engineer select~~ additional boring locations *with prior approval by the Engineer and bear all cost for these additional boring locations*. ~~The Department will deduct the cost of these additional borings from any sums due the Contractor, unless such borings indicate that the pavement within the questioned area is of specified or greater thickness.~~

350-~~18~~*16* Opening Pavement to Traffic.

Before opening the pavement to traffic, construct an earth berm along each edge. Build the berm to the full height of the pavement and at least 18 inches [0.5 m] wide, and sufficiently compact it to prevent underwash of the pavement. Maintain the berm until completing the final shoulders.

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 50°F [10°C]) 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 ~~AASHTO T 23~~*ASTM C 31* and tested in accordance with ~~AASHTO T 97~~*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 Department's Roadway and Traffic*

Design Standards for Design, Construction, Maintenance and Utility Operations on the State Highway System. ~~Provide protection that includes the erection and maintenance of signs, lights, barricades, etc., the construction and removal of temporary pavement, bridges, crossovers, etc., and the use of flagmen as may be necessary. Arrange the protective measures so as not to interfere with traffic in lanes being utilized for required maintenance of traffic.~~

~~Before opening the pavement to traffic, construct an earth berm along each edge. Build the berm to the full height of the pavement and at least 18 inches [0.5 m] wide, and sufficiently compact it to prevent underwash of the pavement. Maintain the berm until completing the final shoulders.~~

350-~~19~~-*17* Method of Measurement.

350-~~19~~*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 350-1~~5~~7.3 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~~ic~~ 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~~ic~~ concrete surface course constructed in accordance with Section 33~~1~~*4*. Reinforcing steel, placed and accepted, will be measured and paid for as provided in Section 415.

350-~~19~~*17*.2 Joints and Cracks: The Contractor shall 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 that have been 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-~~20~~-*19* 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.

Judy F Frazier
07/14/2003 11:13 AM

To: Michael Bergin/SM/FDOT,
cc:
cc:
Subject: Re: D3500000 and D3520000

Attached is the draft D3500000.D01 which reflect the latest changes requested by your office and FHWA. Shirley is working on 352 and will send you that one.

D3500000.D01.doc

Judy Frazier
(850) 414-4127, SC 994-4127
judy.frazier@dot.state.fl.us
----- Forwarded by Judy F Frazier/CO/FDOT on 07/14/2003 11:13 AM -----

Michael Bergin
07/14/2003 10:28 AM

To: Duane F Brautigam/CO/FDOT@FDOT
cc: Charles A Ishee/SM/FDOT@FDOT, Clinton Shaw/CO/FDOT@FDOT, David Sadler/CO/FDOT@FDOT, John H Owens/CO/FDOT@FDOT, Shirley Harvey/CO/FDOT@FDOT, Steve I Plotkin/CO/FDOT@FDOT
Subject: Re: D3500000 and D3520000

Duane:

Unless the Construction Office has a need to get this into the contracts, I would prefer to get the opportunity to look at these one last time. We kind of put this together at the last minute and I'm not sure that we have 350, 352, 353, and 355 tied together the way that we want them.

----- Mike

.....

Michael Bergin
State Structural Material Engineer
Florida Department of Transportation
State Materials Office
Gainesville, Florida 32609
(352) 955-6666
SC 625-6666
FAX (352) 955-6680
michael.bergin@dot.state.fl.us
Duane F Brautigam

Duane F Brautigam
07/14/2003 09:43 AM

To: Clinton Shaw/CO/FDOT@FDOT
cc: Michael Bergin/SM/FDOT@FDOT, Charles A Ishee/SM/FDOT@FDOT, David Sadler/CO/FDOT@FDOT, John H Owens/CO/FDOT@FDOT, Shirley Harvey/CO/FDOT@FDOT, Steve I Plotkin/CO/FDOT@FDOT
Subject: Re: D3500000 and D3520000

Clinton - After having discussed this with you, I think these changes are substantial enough that they should go back through Industry Review for another round, as you recommended in the FTBA meeting.

The priority specs for upper management are the 338 and 355 Value Added specs. Although the 350 and 352 specs are indirectly related, they are not a show stopper, per my understanding.

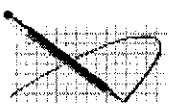
Is the 353 spec directly related to the 350 and 352 specs, or is it a stand alone change?

Ananth/Dave - As I understand Clinton, you are in basic agreement that these deserve a second Industry Review, and are not a must to implement 338 and 355, correct? Please advise.

Mike/Charles - Can you live with delaying implementation to allow a second Industry Review? Please advise.

Thanks - DFB

Duane F. Brautigam, P.E.
State Specifications Engineer
Florida Department of Transportation
(850) 414-4130; SC 994-4130
duane.brautigam@dot.state.fl.us
Clinton Shaw



Clinton Shaw
07/10/2003 03:33 PM

To: Duane F Brautigam/CO/FDOT@FDOT
cc:
Subject: D3500000 and D3520000

Hey Chief,

D3500000 - Cement Concrete Pavement and D3520000 - Grinding Concrete Pavement.

Mr Ishee has been in direct contact with FHWA even before our FHWA submittal. Changes that were made to the Industry reviewed version, I believe, are extensive enough to warrant another Industry review. These changes were generated from FHWA comments.

The problem is, if I remember correctly, these changes 350, 352 and 353 are hot ticket items with the 5th floor and need to be in the January workbook.

Please take a look and let me know.

Reply to Spec 350 with FHWA Comments

Reply to Spec 352 with FHWA Comments

Thanks

Clinton J. Shaw
(850) 414-4129 SC 994-4129
Clinton.Shaw@dot.state.fl.us

Shirley Harvey
07/14/2003 09:54 AM

To: Judy F Frazier/CO/FDOT@FDOT
cc:
Subject: Re: D3500000 and D3520000

FYI

Thanks,
shirley harvey
SC 994-4120
(850)414-4120
shirley.harvey@dot.state.fl.us
----- Forwarded by Shirley Harvey/CO/FDOT on 07/14/2003 09:53 AM -----

Duane F Brautigam
07/14/2003 09:43 AM

To: Clinton Shaw/CO/FDOT@FDOT
cc: Michael Bergin/SM/FDOT@FDOT, Charles A Ishee/SM/FDOT@FDOT, David Sadler/CO/FDOT@FDOT, John H Owens/CO/FDOT@FDOT, Shirley Harvey/CO/FDOT@FDOT, Steve I Plotkin/CO/FDOT@FDOT
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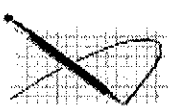
Clinton Shaw



Clinton Shaw
07/10/2003 03:33 PM

To: Duane F Brautigam/CO/FDOT@FDOT
cc:
Subject: D3500000 and D3520000

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Reply to Spec 350 with FHWA Comments

Reply to Spec 352 with FHWA Comments

Thanks

Clinton J. Shaw
(850) 414-4129 SC 994-4129
Clinton.Shaw@dot.state.fl.us

Florida Department of Transportation

JEB BUSH
GOVERNOR

State Materials Office
5007 Northeast 39th Avenue
Gainesville, FL 32609

JOSÉ ABREU
SECRETARY

MEMORANDUM

DATE: July 8, 2003

TO: Clinton J. Shaw, State Specifications Office

FROM: Charles A. Ishee, P.E., Structural Materials Research Engineer

COPIES: John Owens, Shirley Harvey, Michael Bergin

SUBJECT: **Proposed Modifications To Specification: D3500000 – Cement Concrete Pavement**

Attached at the comments for the above-modified specification. These comments incorporate the comments received from the Federal Highway Administration. The concept of the specification has been modified with the additional comment. In general these comment produce a specification that is closer to the being performance based. To paraphrase a quote from Greg Schiess "As long as the ride is good, the concrete is the right thickness with the minimum strength, and the Contractor describes how he/she is going to consolidate the pavement, why put additional restrictions on the Contractor?" This specification works more in lines with the new 355 Specification. Comments reviewed, regarding the subject modification to the Standard Specifications, are attached. If you have any questions, please Email me at RT822CI or charles.ishee@dot.state.fl.us.

Attachment

Responses to Comments Received on Draft Specifications

1. **Specification 350-10.1**
Submitted by: Daniel Haldi – District 5 Concrete Technologist
Comment: Very Last Sectence. "Do not add water to the concrete surface to assist in finishing operations", is a novel idea ... but suppose the contractor has a very stiff concrete that is unfinishable, he will need to do something, that might mean adding something to the surface. If we say no water, then he may add something else. We should say "no fluids" that are deleterious, or better, maybe say if extraneous substances are used to assist finishing, that are not approved in the QCP ... then that portion of the finishing operation is suspended....
Response: Change sentence to "Do not add *any deleterious substances* to the concrete surface to assist in finishing operations *unless previously approved in the Quality Control Plan.*"

2. **Specification 350**
Submitted by: Don Rauch
Comment: For D3500000, the only comment I would have is to add a Section 5 in 350-1 which would read something like: Provide information for all QC inspection that will be done to comply with the various sections in this specification.
Response: All concrete specifications fall into the CQC specifications and the information should be required under specification 105. Disagree – No change

3. **Specification 350-1**
Submitted by: Greg Schiess – Federal Highway Administration
Comment: Delete number 2 because that is never provided nor needed. Also, there is several areas of the specification that require information in the Contractor's QCP… put those items up front for ease of use.
Response: Agree – see changes below

4. **Specification 350-3.1**
Submitted by: Greg Schiess – Federal Highway Administration
Comment: What is a "continuous and at a constant rate of production"? The wording of this sentence does not stop the contractor in any way.
Response: Agree that this statement is ambiguous, but no way to avoid – no change

5. **Specification 350-3.2**
Submitted by: Greg Schiess – Federal Highway Administration
Comment: Look to omit this subsection because a large project will have this equipment anyway.
Response: Agree – see changes below

6. **Specification 350-3.3**
Submitted by: Greg Schiess – Federal Highway Administration
Comment: Look to omit this subsection because all you need is rigid forms that are mortar tight.
Response: Agree – see changes below

7. **Specification 350-3.4**
Submitted by: Greg Schiess – Federal Highway Administration
Comment: Look to omit this subsection because a large project will have this equipment anyway.
Response: Agree – see changes below

8. **Specification 350-3.5**
Submitted by: Greg Schiess – Federal Highway Administration
Comment: Last paragraph – delete "is equipped with a double screed and" why tell the contractor how to do a good job, just demand the good job.
Response: Agree – see changes below

9. **Specification 350-3.7**
Submitted by: Greg Schiess – Federal Highway Administration
Comment: This section need to be updated with new information on vibration requirements.
Response: Agree – see changes below

10. **Specification 350-3.8**
Submitted by: Greg Schiess – Federal Highway Administration
Comment: Look to omit this subsection because a large project will have this equipment anyway. Last sentence – look to put back in because is the contractor has a method to add water by fog it is better than nothing when it will be needed.
Response: Agree – see changes below

11. **Specification 350-3.10**
Submitted by: Greg Schiess – Federal Highway Administration
Comment: Look to omit this subsection because the process is not used anymore.
Response: Agree – see changes below

12. **Specification 350-3.13**
Submitted by: Greg Schiess – Federal Highway Administration
Comment: Use a burlag drag and grind per Specification 352.
Response: Agree – see changes below

13. **Specification 350-4**
Submitted by: Greg Schiess – Federal Highway Administration
Comment: Discussed with Dr. Horhota and the term "moist" could be better defined as within optimum moisture ± 2%.
Response: Agree – see changes below

14. **Specification 350-5**
Submitted by: Greg Schiess – Federal Highway Administration
Comment: Look to omit entire section because the Department should look at the final product, not how the contractor will deliver this
Response: Agree – see changes below

15. **Specification 350-7**
Submitted by: Greg Schiess – Federal Highway Administration
Comment: Need something in this section so the Contractor will demonstrate that the reinforcement will be placed in the proper location.
Response: Agree – see changes below

16. **Specification 350-8.1**
Submitted by: Greg Schiess – Federal Highway Administration
Comment: Delete last sentence of first paragraph. In the second paragraph, the last sentence deals with spreaders only, so make it clearer that it is talking about using concrete spreaders.
Response: Agree – see changes below

17. **Specification 350-8.5**
Submitted by: Greg Schiess – Federal Highway Administration
Comment: Have the contractor put into the QCP how he will meet the requirements of this section.
Response: Agree – see changes below

18. **Specification 350-10.1**
Submitted by: Greg Schiess – Federal Highway Administration
Comment: Last paragraph, last sentence that was added – look to eliminate this and allow fog, but nothing else (mainly for small projects).
Response: Agree – see changes below

19. **Specification 350-10.3.2**
Submitted by: Greg Schiess – Federal Highway Administration
Comment: Second Paragraph – delete entire paragraph because all the concrete needs to be ground in accordance with 352
Response: Agree – see changes below

20. **Specification 350-11&12**
Submitted by: Greg Schiess – Federal Highway Administration
Comment: These two section refer to slip for operations only… so reorganize better.
Response: Agree – see changes below

21. **Specification 350-12.1**
Submitted by: Greg Schiess – Federal Highway Administration
Comment: Fourth, fifth & sixth paragraphs – delete entire paragraph because all the concrete needs to be ground in accordance with 352
Response: Agree – see changes below

22. **Specification 350-13.2**
Submitted by: Greg Schiess – Federal Highway Administration
Comment: Add a verification test to ensure the amount of curing compound that is added is

what is placed on the concrete.
Response: Agree – see changes below

23. **Specification 350-14**
Submitted by: Greg Schiess – Federal Highway Administration
Comment: Look to see if entire section can be put into 352 and just refer the 352 specification
Response: Agree – see changes below

24. **Specification 350-15.2**
Submitted by: Greg Schiess – Federal Highway Administration
Comment: Was under the assumption that the Department was getting rid of keyways.
Response: Agree – see changes below

25. **Specification 350-15.2.2**
Submitted by: Greg Schiess – Federal Highway Administration
Comment: Add to the last sentece "or as soon as practical to prevent cracking".
Response: Agree – see changes below

26. **Specification 350-15.2.4**
Submitted by: Greg Schiess – Federal Highway Administration
Comment: Eliminate subsection because it is in Standard Index 305 that is previous required.
Response: Agree – see changes below

27. **Specification 350-15.3.2**
Submitted by: Greg Schiess – Federal Highway Administration
Comment: Third Paragraph – leave in the maximum of 12 hours, but don't put a minimum.
Response: Agree – see changes below

28. **Specification 350-15.3.3**
Submitted by: Greg Schiess – Federal Highway Administration
Comment: Second Paragraph – add at the end Standard Index 306.
Response: Agree – see changes below

29. **Specification 350-15.4**
Submitted by: Greg Schiess – Federal Highway Administration
Comment: Paint entire dowel bar, not just the half that will be greased. Second and third paragraphs should be moved to QCP.
Response: Agree – see changes below

30. **Specification 350-16**
Submitted by: Greg Schiess – Federal Highway Administration
Comment: Make this section more process control. Core at the discretion of the Engineer, with the Engineer taking the thickness. Dictate the location.
Response: Agree – see changes below

31. **Specification 350-17**
Submitted by: Greg Schiess – Federal Highway Administration
Comment: Shut down the contractor's QCP if pavement is ½-inch or more deficient in thickness.
Response: Agree – see changes below

32. **Specification 350-18**
Submitted by: Greg Schiess – Federal Highway Administration
Comment: Last paragraph – put somewhere closer to the beginning because it is buried to far in the back of the specification
Response: Agree – see changes below

33. **Specification 350**
Submitted by: Greg Schiess – Federal Highway Administration
Comment: General comment – reorganize the specification so that it flows better with the operation of a concrete pavement operation
Response: Agree – see changes below

CEMENT CONCRETE PAVEMENT.
(REV ~~5-13-03~~*07-07-03*)

SECTION 350 (Pages 304-322) 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.*

~~For aggregates, proportioning and mixing, and other provisions for the production of the concrete, meet the applicable provisions of Section 346.~~

~~Provide adequate lighting for all work done at night, including finishing, curing, and sawing joints. Unless lighting is provided for finishing, stop construction operations soon enough each day to permit finishing during daylight.~~

~~At least 20 days prior to paving, f~~*F*urnish the following information ~~for the Engineer's review for specification compliance~~*in the Quality Control Plan (QCP) as required in Section 105*:

1. A detailed sequence and schedule of concrete placement operations including, but not ~~necessarily~~ 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 operations that will follow in the case of a breakdown of equipement.*

2. *M*~~A detailed staking plan for subgrade controls including offset requirements~~*ethod to ensure proper placement of reinforcing steel, tie bars and dowel bars.*

3. A traffic control plan for pavement construction operations *that* ~~which~~ 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. Identify provisions for adequate lighting for all work done at night, including finishing, curing, and sawing joints.

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

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

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

350-2 Materials.

Meet the following requirements:

Concrete, Class I *(Pavement)*	Section 346
Curing Materials	Section 925
Embedded Items	Section 931
Joint Seal	Section 932

350-3 Equipment.

350-3.1 General: ~~Obtain the Engineer's approval of the equipment and tools to be used for handling materials and performing all parts of the work, as to their design, capacity, and mechanical condition. Deliver the equipment to the job site sufficiently ahead of the start of construction operations to allow the Engineer to examine it thoroughly for approval.~~

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

~~Equip all equipment which operates on the side forms with scraping devices to clean accumulations from the top of the forms and wheels.~~*Provide equipment and tools to be used that meet the following:*

Capable 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 the alignment and grade of all forms meet the contract documents prior to the placing of concrete.

~~**350-3.2 Equipment For Trimming of Subgrade:** For equipment operating on the subgrade, provide an automatically controlled subgrade trimmer. Use a machine that is capable of trimming the subgrade to proper elevation within the tolerances established herein. Provide grade controls that operate by sensing from a taut line, set true to line and grade. Erect and maintain the taut line.~~

~~**350-3.3 Forms:**~~

~~**350-3.3.1 Form Material:** Provide steel forms, except that on curves with a radius of 45 m or less, provide flexible forms, or wooden forms that bend to the required arc.~~

~~**350-3.3.2 Dimensions:** Use forms with a minimum length of 10 feet [3 m], except wherethey are used on curves having a radius between 150 and 300 feet [45 and 90 m], in which case use a form length of 5 feet [1.5 m]. Use forms with a height that is equal to the edge thickness of the pavement. Use forms with a height greater than the edge thickness, provided the outer portion of the slab is thickened to equal the depth of the form by tapering at the rate of 1 inch of the extra thickness per foot [80 mm of the extra thickness per meter] of width. In such case, the Department will make no allowance for additional concrete. Do not use built-up forms.~~

~~**350-3.3.3 Steel Forms:** Use steel forms fabricated into an approved section and sufficiently strong to ensure rigidity under the impact, thrust, and weight of the heaviest equipment to be carried over the forms. Make the width of the base of the forms which is in direct contact with the soil at least equal to the height of the forms, but not less than 8 inches [200 mm]. Extend the flange braces outward on the base not less than two-thirds the height dimension of the form. Use steel forms of a thickness that is not less than 7/32 inch [5.5 mm]. When tested with a 10 foot [3.048 m] straightedge, ensure that the forms have no vertical variation in a 10 foot [3 m] length that is greater than 1/8 inch [3 mm] from a true plane of the surface on the top of the form, and no lateral variation that is greater than 1/4 inch [6 mm] from a true plane surface on the vertical face of the form. Do not use steel forms if, when tested as a simple beam with a span of 9 feet 6 inches [2.9 m] and a load equal to that exerted by construction equipment placed upon them, the deflection is more than 1/4 inch [6 mm].~~

~~**350-3.3.4 Form Connections:** Provide connections between adjacent sections of the form, that form a lock joint, free from vertical movement in excess of 1/8 inch [3 mm] and from horizontal movement in excess of 1/4 inch [6 mm], under the impact, thrust, and weight of the heaviest machine carried on the forms.~~

~~**350-3.3.5 Defective Forms:** Remove bent, twisted, or broken forms, and forms with battered top surfaces, from the work. Do not use repaired forms until they are inspected and approved by the Engineer.~~

~~**350-3.3.6 Form Stakes:** Provide at least three steel stakes for each 10 foot [3 m] length of form. Use stakes that are of sufficient size to prevent undue lateral movement of the form during paving operations. Fasten each of the stakes to the form by means of a suitable socket attached to the form. Equip each stake socket with steel wedges for securely keying the forms to the stakes. Locate a stake not more than 12 inches [300 mm] from the end of each section. Do not use forms with broken or badly worn sockets.~~

~~**350-3.3.7 Form Tampers:** Use adequate mechanical form tampers, capable of thoroughly compacting the soil under the forms, except when the forms rest on a cement-treated subgrade.~~

~~**350-3.4 Spreader:** Provide a mechanical spreader that is independently powered and capable of spreading the mixed concrete on the subgrade over the entire width and depth of the strip being paved in a manner which will prevent segregation of the materials. Use a spreader designed and constructed to permit the concrete to be struck-off to a uniform thickness.~~

~~**350-3.5 Strike-Off, Consolidation, and Finishing for Fixed-Form Construction:** Provide equipment for these operations that consists of a self-propelled unit, or units, that perform the following functions by mechanical means, in the sequence indicated:~~

~~(1) Strike-off.~~

~~(2) Vibratory Consolidation.~~

~~(3) Screeding.~~

~~(4) Floating.~~

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

350-3.6~~.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 ~~all of this~~*the* equipment is of such dimensions and arrangement as to cover the full width of the pavement strip being *placed*~~laid~~. 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.

Do not use automatic grade controls on the paver when the tracks of the slip-form paver are operating on ~~econcrete base or~~ 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.

~~The Engineer may allow variation from any specific feature of the slip-form paver as detailed above, provided the industry has generally accepted the proposed variation as an improved feature.~~

350-3.~~7~~.*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 cause 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.

~~**350-3.8 Mechanical Floating Equipment:** Provide equipment that consists of a supplementary self-propelled machine capable of further smoothing the concrete, removing excess mortar from the surface, and minimizing hand finishing.~~

~~Use a machine that leaves the surface of the concrete 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.~~

350-3.~~9~~ *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.

The Contractor may use hand power-spray equipment to apply curing compound to areas where it is impracticable to operate the self-propelled equipment.

~~**350-3.10 Equipment for Sealing Joints:** Provide equipment for sealing the joints for each section of pavement. Use a heating kettle for hot-poured sealer that is of the indirect heating or double-boiler type, using oil as a heat transfer medium. 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. Use pouring equipment equipped with nozzles that discharge the seal 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 for pouring, within 10°F [5°C]*manufacturer's* .~~

350-3.~~11~~ *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. ~~The Contractor may u~~*Use* such equipment *that*~~as~~ *is approved by* the Engineer~~may approve for such areas~~.

350-3.~~12~~ *6* Hand Finishing Tools: Provide straightedges that have a blade length of 10 feet [3.~~048~~ 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].

350-3.~~13~~ *7* Texturing Machine: Provide a machine that consists of a supplementary machine capable of applying the final finish to the concrete pavement. Apply the finish by rectangular shaped spring steel tines rigidly mounted in a frame operating on an adjustable track mounted under the main frame of the machine. Use a machine that is constructed so as to provide for adjustment of the downward pressure on the tines as necessary to produce the desired finish under varying conditions of the concrete surface.

The Engineer may allow variation from any specific feature of the Texturing Machine as detailed above, provided that the Contractor can produce an equivalent final finish.

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* moist *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.~~

350-6-5 Protection from Weather.

~~Have available at the site, at all times when concrete paving operations are underway, materials for the protection of the surface and edges of the unhardened concrete. For the protection of the pavement edges, use any covering material, such as burlap, paper, or plastic sheeting material, suitable for the protection of the pavement surface.~~

When rain appears imminent, stop all paving operations, and have all available personnel cover the surface of the unhardened concrete with the protective covering.

During periods when the air temperature may fall below 35°F [1°C], ~~advise the Engineer of~~ plans for curing and protecting the fresh concrete *shall be implemented as identified in the QCP* before placing the concrete. ~~Do not place any concrete until the Engineer has approved the proposed methods.~~

~~The Contractor is fully responsible for the quality and strength of the concrete placed in cold weather even if the Engineer approves of the provisions the Contractor employs for protecting the concrete placed during cold weather.~~

Before opening the pavement to traffic, construct an earth berm along each edge. Build the berm to the full height of the pavement and at least 18 inches [0.5 m] wide, and sufficiently compact it to prevent underwash of the pavement. Maintain the berm until completing the final shoulders.

350-~~7~~*6* Placement of Reinforcement.

350-~~7~~6.1 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. ~~Secure the reinforcement in position in advance of concrete placement or, with the Engineer's specific approval, place it in the plastic concrete by mechanical or vibratory means after spreading the concrete.~~ At the time of the concrete placement, ensure that the reinforcing steel is free from dirt, oil, paint, grease, mill scale, and any loose or thick rust which could impair bonding of the steel with the concrete. Place the reinforcement as provided below.

350-~~7~~6.2 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~~6.3 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~~*7* Placing Concrete.

350-87.1 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. ~~and t~~*T*he surface will at no point be below the grade specified for the finished surface~~, after application of the allowable tolerance~~. Deposit the concrete on the subgrade in a manner which will require as little rehandling as possible. ~~Continuously place concrete between transverse joints without using intermediate bulkheads.~~

Deposit concrete as near to expansion and contraction joint assemblies as possible without disturbing them. *Ensure that workers do not walk in the freshly deposited concrete with their boots or shoes coated with earth or other deleterious substances.* ~~Do not dump concrete from the discharge bucket or hopper onto an assembly without centering the bucket or hopper directly over the assembly.~~

350-87.2 Use of Spreader: Place concrete on the subgrade by an approved spreading device. *Do not deposit concrete from the discharge bucket or hopper onto an assembly without centering the bucket or hopper directly over the assembly.* ~~The Engineer will not require the Contractor to use a spreader for areas where the width of slab varies, for intersections, and for 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*). Ensure that workmen *workers* do not walk in the freshly deposited concrete with *their boots or shoes coated with* earth or other deleterious substances coated on their boots or shoes.~~

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).

350-87.3 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. ~~The Engineer will not require the Contractor to alter placement operations where superelevation reverses the pavement cross slope from that shown on the typical section.~~

~~**350-8.4 Hours of Operation:** Stop placing concrete in time to complete finishing operations during daylight hours, or provide adequate approved lighting *as identified in the QCP.*~~

350-~~8~~7.5 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. ~~Do not continue vibration at any one location so long as to produce puddling or the accumulation of excessive grout on the surface.~~

350-~~9~~*8* 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-~~10~~-*9* Striking-off, Consolidating, and Finishing Concrete.

350-~~10~~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 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.

350-~~10~~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. Waste excess mortar beyond the edge of the slab.*

350-~~10~~9.3 Hand Methods:

350-~~10~~9.3.1 Conditions under which Allowed: The Contractor may use hand methods in areas of narrow width or irregular dimensions, where operation of mechanical equipment is impracticable. ~~In the event that mechanical equipment breaks down, the Contractor may use hand methods to finish only that concrete already deposited on the subgrade when the breakdown occurred.~~

350-~~10~~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.

~~In operation, move the screed forward on the forms with a combined longitudinal and transverse shearing motion, moving always in the direction in which the work is progressing, and manipulate it so that neither end is raised from the side forms during the striking-off process. If necessary, repeat this until the surface is of uniform texture, true to grade and cross-section, and free from porous areas.~~

350-~~10~~9.3.3 Consolidation: Use hand-operated spud-type vibrators to consolidate.

350-~~10~~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-~~10~~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.

~~350-11 Supplemental Floating.~~

~~In areas where performing machine strike-off, consolidation, and finishing, further 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. Waste excess mortar beyond the edge of the slab.~~

350-~~12~~ *10* Final Finish.

350-~~12~~*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.

~~After applying the burlap drag finish, apply the final finish with the texturing machine. Control the time of applying this finish and the method of operating the texturing machine so as to minimize tearing of surface and unseating of aggregate particles.~~

~~Provide a final finish that consists of transverse grooves which are 0.08 to 0.12 inch [2 to 3 mm] in width and 0.10 to 0.15 inch [2.5 to 4 mm] in depth, spaced at random intervals between 1/2 to 1 inch [13 to 25 mm]. Operate the texturing machine in a manner that minimizes the overlapping of subsequent passes of the steel comb. Create short gaps in the grooved finish as necessary to avoid overlap between passes.~~

~~In areas of irregular dimensions or narrow widths, where operating the texturing machine is impracticable, the Contractor may apply the finish by approved hand methods that achieve the required finish with a minimum of surface tearing and unseating aggregate particles. Ensure that the surface resulting from this operation is uniform in appearance and free of irregular, rough, or porous areas.~~

350-~~12~~*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-~~13~~*11* Curing.

350-~~13~~*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, the edges of the newly placed concrete in accordance with one or more of the methods described below. In ~~all~~ cases *where*~~in which~~ 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 *QCP will be suspended*~~Engineer will order an immediate suspension of concreting operations~~. 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 50°F [10°C].

350-~~13~~*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}~~0.005 gal/ft^2~~ [~~0.2 L/m^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 manufactures recommendation*~~until the pigment is uniformly dispersed throughout the vehicle~~.

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-~~13~~*11*.3 Burlap Mats: ~~Under this method, cover the surfaces to be cured with 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 ~~so as to cause them to remain in intimate contact with the surface being cured,~~ throughout the curing period *to ensure a contact with the surface being cured.* Maintain the mats fully moist and in position for the entire portion of the required ~~burlap~~ curing period.

350-~~13~~*11*.4 Removal of Forms: Do not remove forms from freshly placed concrete ~~until it has set~~ 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.

~~**350-14 Surface Requirements.**~~

~~After curing, remove the curing material (except for the impervious coating), and thoroughly test the surface for pavement surface smoothness in accordance with 352-4(c). Plainly mark all variations from the required tolerances. Where pavement surfaces do not meet the smoothness requirements, the Engineer will require corrective work and retesting to ensure conformity.~~

~~Eliminate high spots exceeding 1/8 inch in 10 feet [3.2 mm in 3 m], but not in excess of 0.3 inch in 25 feet [7.6 mm in 7.6 m], by grinding either with an approved machine or with a carborundum brick and water. Do not use bush-hammering or other destructive means for removing irregularities. As directed by the Engineer, retexture corrected high areas to give skid resistance comparable to the surrounding area.~~

~~Provide grinding equipment with a power driven self-propelled machine that is specifically designed to grind portland cement concrete pavement, with a minimum of a 3 foot [1 m] wide grinding head and diamond impregnated grinding blades. Produce, by grinding, a pavement surface that is true to grade and uniform in appearance with a longitudinal line type texture. Provide a line type texture that contains parallel longitudinal corrugations that present a narrow ridge corduroy type appearance. Ensure~~

~~that the peaks of ridges are approximately 1/32 inch [0.8 mm] higher than the bottoms of the grooves with approximately 60 evenly spaced grooves per foot [300 mm].~~

~~Operate all milling, cutting, or grinding equipment to produce a reasonably uniform finished surface without spalling the pavement joints within corrected areas. The Engineer will not require extra grinding to eliminate minor depressions in order to provide 100% texturing of the pavement surface. Maintain the cross slope of the pavement as shown in the plans. Repair all joint seals destroyed by grinding at no expense to the Department.~~

~~Remove and replace any area of pavement which, after grinding, still shows a deviation in excess of the allowable tolerance. Ensure that the area removed and replaced is the full length between transverse joints and the full width of the lane involved.~~

~~Saw the area to be removed to a smooth vertical surface. Clean the face of the adjacent (hardened) concrete, and coat it with an epoxy bonding compound before placing the replacement concrete.~~

~~Bear the costs of all surface corrections required and of all required removal and replacement of defective surface concrete.~~.

350-~~15~~-*12* Joints.

350-~~15~~*12*.1 General: Construct joints at the locations and in accordance with the details shown in the ~~Roadway and Traffic~~ Design Standards, Index No. 305 and the Contract Documents.

350-~~15~~*12*.2 Longitudinal Joints:

350-~~15~~*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. ~~Where keyways are required, the Contractor may form them by placing an insert of the proper shape along the inside face of the side form or, when using the slip form method of paving, by an approved extrusion device. Use a method that produces a keyway of the shape and at the location indicated in the plans.~~

350-~~15~~*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*~~within~~ 72 hours after placing the concrete.

350-~~15~~*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.

~~**350-15.2.4 Longitudinal Shoulder Joints (Concrete to Asphalt):** Construct a continuous joint by sawing a groove into the asphalt pavement at the abutment with the concrete pavement. Produce a groove that is 3/4 inch [19 mm] wide and 3/4 inch [19 mm] deep, after sawing and cleaning.~~

~~Seal the joint with hot-poured type sealant.~~

350-~~15~~*12*.3 Transverse Joints:

350-~~15~~*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-~~15~~*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 loadtransfer 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* ~~in general when the concrete is between 4 and~~ 12 hours *after placing the concrete*~~old~~. Make a second saw cut, to provide the joint dimensions indicated in the plans, as soon as there is no danger of further raveling.

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-~~15~~*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 ~~Roadway and Traffic~~ 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 on the ~~Roadway and Traffic~~ Design Standards *Index 306*.

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-~~15~~*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 ~~the free end of~~ each dowel with one coat of approved zinc rich paint (listed on the Qualified Products List), and grease *one end* ~~it~~ with an approved lubricant, to prevent the concrete from bonding to the dowel. Provide the free end of expansion joint dowels with the closest fitting metal cap or sleeve, equipped with a stop to prevent closing during placement operations. Maintain a clearance of 1 inch [25 mm] between the closed end of the cap and the dowel to accommodate future slab movement.

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].

Provide the Engineer with confirmation of the location of the dowel bars. ~~The Contractor shall confirm that the paving operation has not displaced the dowels from their required positions. Perform confirmation checks daily for the first two days of the paving operation and weekly thereafter.~~

350-~~15~~*12*.5 Expansion Joints Around Structures: 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-~~15~~*12*.6 Cleaning Joints and Cracks:

350-~~15~~*12*.6.1 Cleaning Joints in New Pavement:

350-~~15~~*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-~~15~~*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-~~15~~*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-~~15~~*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 350-15.6.2.

350-~~15~~*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.

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 seal 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-~~15~~*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 50°F [10°C] or greater.

Use a heating kettle for hot-poured sealer that is of the indirect heating or double-boiler type, using oil as a heat transfer medium. 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-~~15~~*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 40°F [5°C].

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-~~16~~-*14* Thickness Determinations.

350-~~16~~*14*.1 Core Borings: After completing the concrete pavement, including any corrective work to meet ride requirement, drill cores from the pavement to determine the actual thickness. ~~When the Department is ready to core the finished pavement for thickness, p~~*P*rovide traffic control, coring equipment, and operator to obtain the cores. The Engineer will select the coring locations and make the ~~acceptance~~ measurements *for thickness determination*. Take borings at random intervals and at various points on the cross-section so that each test boring represents an area not exceeding 2,500 yd^2 [2,000 m^2].

Replace the portions of the pavement removed by the borings at no expense to the Department.

350-~~16~~*14*.2 Method of Calculating Average Thickness: The Department will determine the average thickness of pavement *in accordance with ASTM C 174* from the length of all cores taken as indicated above and will calculate it as follows:

(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 as measured by the cores 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-~~17~~*15* Deficient Thickness.

350-~~17~~*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 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-~~17~~*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 deficient area is sufficient to seriously impair the anticipated service life of the pavement, the Contractor shall 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-~~17~~*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 Contractor may elect to leave the pavement in place, but shall receive no compensation for the area of pavement.

350-~~17~~*15*.4 Additional Borings: If the Contractor believes that the number of cores taken is not sufficient to indicate the thickness of the pavement, he may request ~~that the Engineer select~~ additional boring locations *with prior approval by the Engineer and bear all cost for these additional boring locations*. ~~The Department will deduct the cost of these additional borings from any sums due the Contractor, unless such borings indicate that the pavement within the questioned area is of specified or greater thickness.~~

350-~~18~~*16* Opening Pavement to Traffic.

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 50°F [10°C]) 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 ~~AASHTO T 23~~*ASTM C 31* and tested in accordance with ~~AASHTO T 97~~*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. Provide protection that includes the erection and maintenance of signs, lights, barricades, etc., the construction and removal of temporary pavement, bridges, crossovers, etc., and the use of flagmen as may be necessary. Arrange the protective measures so as not to interfere with traffic in lanes being utilized for required maintenance of traffic.

~~Before opening the pavement to traffic, construct an earth berm along each edge. Build the berm to the full height of the pavement and at least 18 inches [0.5 m] wide, and sufficiently compact it to prevent underwash of the pavement. Maintain the berm until completing the final shoulders.~~

350-~~19~~-*17* Method of Measurement.

350-~~19~~*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 350-17.3 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 asphaltic 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~~ic~~ concrete surface course constructed in accordance with Section 33~~1~~*4*. Reinforcing steel, placed and accepted, will be measured and paid for as provided in Section 415.

350-~~19~~*17*.2 Joints and Cracks: The Contractor shall 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 that have been 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-~~20~~-*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.

Florida Department of Transportation

JEB BUSH
GOVERNOR

State Materials Office
5007 Northeast 39th Avenue
Gainesville, FL 32609

JOSÉ ABREU
SECRETARY

MEMORANDUM

DATE: July 8, 2003

TO: Clinton J. Shaw, State Specifications Office

FROM: Charles A. Ishee, P.E., Structural Materials Research Engineer

COPIES: John Owens, Shirley Harvey, Michael Bergin

SUBJECT: **Proposed Modifications To Specification: D3500000 – Cement Concrete Pavement**

Comments reviewed, regarding the subject modification to the Standard Specifications, are attached. If you have any questions, please Email me at RT822CI or charles.ishee@dot.state.fl.us.

Attachment

Responses to Comments Received on Draft Specifications

1. **Specification 350-10.1**
Submitted by: Daniel Haldi – District 5 Concrete Technologist
Comment: Very Last Sectence. "Do not add water to the concrete surface to assist in finishing operations", is a novel idea ... but suppose the contractor has a very stiff concrete that is unfinishable, he will need to do something, that might mean adding something to the surface. If we say no water, then he may add something else. We should say "no fluids" that are deleterious, or better, maybe say if extraneous substances are used to assist finishing, that are not approved in the QCP ... then that portion of the finishing operation is suspended....
Response: Change sentence to "Do not add *any deleterious substances* to the concrete surface to assist in finishing operations *unless previously approved in the Quality Control Plan.*"

2. **Specification 350**
Submitted by: Don Rauch
Comment: For D3500000, the only comment I would have is to add a Section 5 in 350-1 which would read something like: Provide information for all QC inspection that will be done to comply with the various sections in this specification.
Response: All concrete specifications fall into the CQC specifications and the information should be required under specification 105. Disagree – No change

CEMENT CONCRETE PAVEMENT.
(REV 5-13-03)

SECTION 350 (Pages 304-322) 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.

~~For aggregates, proportioning and mixing, and other provisions for the production of the concrete, meet the applicable provisions of Section 346.~~

~~Provide adequate lighting for all work done at night, including finishing, curing, and sawing joints. Unless lighting is provided for finishing, stop construction operations soon enough each day to permit finishing during daylight.~~

~~At least 20 days prior to paving, f~~Furnish the following information ~~for the Engineer's review for specification compliance~~*in the Quality Control Plan (QCP) as required in Section 105*:

1. A detailed sequence and schedule of concrete placement operations including, but not necessarily limited to, width of pavement to be placed, proposed equipment, production rates, working hours, concrete hauling, and placement, curing, sawing, and sealing methods.
2. A detailed staking plan for subgrade controls including offset requirements.
3. A traffic control plan for pavement construction operations *that* ~~which~~ 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. *Identify provisions for adequate lighting for all work done at night, including finishing, curing, and sawing joints.*

350-2 Materials.

Meet the following requirements:

Concrete, Class I *(Pavement)*	Section 346
Curing Materials	Section 925
Embedded Items	Section 931
Joint Seal	Section 932

350-3 Equipment.

350-3.1 General: ~~Obtain the Engineer's approval of the equipment and tools to be used for handling materials and performing all parts of the work, as to their design, capacity, and mechanical condition. Deliver the equipment to the job site sufficiently ahead of the start of construction operations to allow the Engineer to examine it thoroughly for approval.~~

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

~~Equip all equipment which operates on the side forms with scraping devices to clean accumulations from the top of the forms and wheels.~~*Provide equipment and tools to be used that meet the following:*

Capable 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.

350-3.2 Equipment For Trimming of Subgrade: For equipment operating on the subgrade, provide an automatically controlled subgrade trimmer. Use a machine that is capable of trimming the subgrade to proper elevation within the tolerances established herein. Provide grade controls that operate by sensing from a taut line, set true to line and grade. Erect and maintain the taut line.

350-3.3 Forms:

350-3.3.1 Form Material: Provide steel forms, except that on curves with a radius of *150 feet [*45 m*]* or less, provide flexible forms, or wooden forms that bend to the required arc.

350-3.3.2 Dimensions: Use forms with a minimum length of 10 feet [3 m], except where they are used on curves having a radius between 150 and 300 feet [45 and 90 m], in which case use a form length of 5 feet [1.5 m]. Use forms with a height that is equal to the edge thickness of the pavement. Use forms with a height greater than the edge thickness, provided the outer portion of the slab is thickened to equal the depth of the form by tapering at the rate of 1 inch *[25 mm]* of the extra thickness per foot [80 mm of the extra thickness per meter] of width. In such case, the Department will make no allowance for additional concrete. Do not use built-up forms.

350-3.3.3 Steel Forms: Use steel forms fabricated into an approved section and sufficiently strong to ensure rigidity under the impact, thrust, and weight of the heaviest equipment to be carried over the forms. Make the width of the base of the forms which is in direct contact with the soil at least equal to the height of the forms, but not less than 8 inches [200 mm]. Extend the flange braces outward on the base not less than two-thirds the height dimension of the form. Use steel forms of a thickness that is not less than 7/32 inch [5.5 mm]. When tested with a 10 foot [3.048 m] straightedge, ensure that the forms have no vertical variation in a 10 foot [3 m] length that is greater than 1/8 inch [3 mm] from a true plane of the surface on the top of the form, and no lateral variation that is greater than 1/4 inch [6 mm] from a true plane surface on the vertical face of the form. Do not use steel forms if, when tested as a simple beam with a span of 9 feet 6 inches [2.9 m] and a load equal to that exerted by construction equipment placed upon them, the deflection is more than 1/4 inch [6 mm].

350-3.3.4 Form Connections: Provide connections between adjacent sections of the form, that form a lock joint, free from vertical movement in excess of 1/8 inch [3 mm] and from horizontal movement in excess of 1/4 inch [6 mm], under the impact, thrust, and weight of the heaviest machine carried on the forms.

350-3.3.5 Defective Forms: Remove bent, twisted, or broken forms, and forms with ~~battered~~ *damaged* top surfaces, from the work. ~~Do not use repaired forms until they are inspected and approved by the Engineer.~~*The use of repaired forms will be based on the final product meeting all applicable contract requirements.*

350-3.3.6 Form Stakes: Provide at least three steel stakes for each 10 foot [3 m] length of form. Use stakes that are of sufficient size to prevent ~~undue~~ lateral movement of the form during paving operations. Fasten each of the stakes to the form by means of a suitable socket attached to the form. Equip each stake socket with steel wedges for securely keying the forms to the stakes. Locate a stake not more than 12 inches [300 mm] from the end of each section. ~~Do not use forms with broken or badly worn sockets.~~

350-3.3.7 Form Tampers: Use adequate mechanical form tampers, capable of thoroughly compacting the soil under the forms, except when the forms rest on a cement-treated subgrade.

350-3.4 Spreader: Provide a mechanical spreader that is independently powered and capable of spreading the mixed concrete on the subgrade over the entire width and depth of the strip being paved in a manner which will prevent segregation of the materials. Use a spreader designed and constructed to permit the concrete to be struck-off to a uniform thickness.

350-3.5 Strike-Off, Consolidation, and Finishing for Fixed-Form Construction: Provide equipment for these operations that consists of a self-propelled unit, or units, that perform the following functions by mechanical means, in the sequence indicated:

(1) Strike-off.
(2) Vibratory Consolidation.
(3) Screeding.
(4) Floating.

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

350-3.6 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 ~~all of this~~*the* equipment is of such dimensions and arrangement as to cover the full width of the pavement strip being *placed*~~laid~~. 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.

Do not use automatic grade controls on the paver when the tracks of the slip-form paver are operating on ~~econocrete base or~~ 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.

~~The Engineer may allow variation from any specific feature of the slip-form paver as detailed above, provided the industry has generally accepted the proposed variation as an improved feature.~~

350-3.7 Vibratory Units: Consolidate the concrete for the full width of the strip being placed with either surface pan type or internal type vibrators.

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.

350-3.8 Mechanical Floating Equipment: Provide equipment that consists of a supplementary self-propelled machine capable of further smoothing the concrete, removing excess mortar from the surface, and minimizing hand finishing.

~~Use a machine that leaves the surface of the concrete 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.~~

350-3.9 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.

The Contractor may use hand power-spray equipment to apply curing compound to areas where it is impracticable to operate the self-propelled equipment.

350-3.10 Equipment for Sealing Joints: Provide equipment for sealing the joints for each section of pavement. Use a heating kettle for hot-poured sealer that is of the indirect heating or double-boiler type, using oil as a heat transfer medium. 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. Use ~~pouring~~ equipment equipped with nozzles that discharge the seal 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 ~~for pouring,~~ within ~~10°F [5°C]~~*the manufacturer's recommendation.*

350-3.11 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. The Contractor may use such equipment as the Engineer may approve for such areas.

350-3.12 Hand Finishing Tools: Provide straightedges that have a blade length of 10 feet [3~~.048~~ 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].

350-3.13 Texturing Machine: Provide a machine that consists of a supplementary machine capable of applying the final finish to the concrete pavement. Apply the finish by rectangular shaped spring steel tines rigidly mounted in a frame operating on an adjustable track mounted under the main frame of the machine. Use a machine that is constructed so as to provide for adjustment of the downward pressure on the tines as necessary to produce the desired finish under varying conditions of the concrete surface.

The Engineer may allow variation from any specific feature of the Texturing Machine as detailed above, provided that the Contractor can produce an equivalent final finish.

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 moist 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.

Have available at the site, at all times when concrete paving operations are underway, materials for the protection of the surface and edges of the unhardened concrete. For the protection of the pavement edges, use ~~any~~ covering material~~, such as burlap, paper, or plastic sheeting material,~~ suitable for the protection of the pavement surface *as identified in the QCP*.

When rain appears imminent, stop all paving operations, and have all available personnel cover the surface of the unhardened concrete with the protective covering.

During periods when the air temperature may fall below 35°F [1°C], ~~advise the Engineer of~~ plans for curing and protecting the fresh concrete *shall be implemented as identified in the QCP* before placing the concrete. ~~Do not place any concrete until the Engineer has approved the proposed methods. The Contractor is fully responsible for the quality and strength of the concrete placed in cold weather even if the Engineer approves of the provisions the Contractor employs for protecting the concrete placed during cold weather.~~

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.
Secure the reinforcement in position in advance of concrete placement or~~, with the Engineer's specific approval,~~ place it in the plastic concrete by mechanical or vibratory means after spreading the concrete *as identified in the QCP*. At the time of the concrete placement, ensure that the reinforcing steel is free from dirt, oil, paint, grease, mill scale, and any loose or thick rust which could impair bonding of the steel with the concrete. 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. ~~and t~~*T*he surface will at no point be below the grade specified for the finished surface~~, after application of the allowable tolerance~~. Deposit the concrete on the subgrade in a manner which will require as little rehandling as possible. Continuously place concrete between transverse joints without using intermediate bulkheads.

Deposit concrete as near to expansion and contraction joint assemblies as possible without disturbing them. Do not ~~dump~~*deposit* concrete from the discharge bucket or hopper onto an assembly without centering the bucket or hopper directly over the assembly.

350-8.2 Use of Spreader: Place concrete on the subgrade by an approved spreading device. The Engineer will not require the Contractor to use a spreader for areas where the width of slab varies, for intersections, and for 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*). Ensure that ~~workmen~~ *workers* do not walk in the freshly deposited concrete with *their boots or shoes coated with* earth or other deleterious substances ~~coated on their boots or shoes~~.

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. The Engineer will not require the Contractor to alter placement operations where superelevation reverses the pavement cross slope from that shown on the typical section.

350-8.4 Hours of Operation: Stop placing concrete in time to complete finishing operations during daylight hours, or provide adequate ~~approved~~ lighting *as identified in the QCP.*

350-8.5 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. Do not continue vibration at any one location so long as to produce puddling or the accumulation of excessive grout on the surface.

350-9 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.

350-10 Striking-off, Consolidating, and Finishing Concrete.

350-10.1 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.

Provide a concrete surface true to grade and crown, and free of irregularities. Do not add any deleterious substances to the concrete surface to assist in finishing operations unless approved in the Quality Control Plan.

350-10.2 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.

350-10.3 Hand Methods:

350-10.3.1 Conditions under which Allowed: The Contractor may use hand methods in areas of narrow width or irregular dimensions, where operation of mechanical equipment is impracticable. In the event that mechanical equipment breaks down, the Contractor may use hand methods to finish only that concrete already deposited on the subgrade when the breakdown occurred.

350-10.3.2 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.

In operation, move the screed forward on the forms with a combined longitudinal and transverse shearing motion, moving always in the direction in which the work is progressing, and manipulate it so that neither end is raised from the side forms during the striking-off process. If necessary, repeat this until the surface is of uniform texture, true to grade and cross-section, and free from porous areas.

350-10.3.3 Consolidation: Use hand-operated spud-type vibrators to consolidate.

350-10.3.4 Floating: Use long-handled floats to float the concrete. Take the necessary care to avoid creating depressions or ridges during this operation.

350-10.4 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.

350-11 Supplemental Floating.

In areas where performing machine strike-off, consolidation, and finishing, further 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. Waste excess mortar beyond the edge of the slab.

350-12 Final Finish.

350-12.1 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.

After applying the burlap drag finish, apply the final finish with the texturing machine. Control the time of applying this finish and the method of operating the texturing machine so as to minimize tearing of surface and unseating of aggregate particles.

Provide a final finish that consists of transverse grooves which are 0.08 to 0.12 inch [2 to 3 mm] in width and 0.10 to 0.15 inch [2.5 to 4 mm] in depth, spaced at random intervals between 1/2 to 1 inch [13 to 25 mm]. Operate the texturing machine in a manner that minimizes the overlapping of subsequent passes of the steel comb. Create short gaps in the grooved finish as necessary to avoid overlap between passes.

In areas of irregular dimensions or narrow widths, where operating the texturing machine is impracticable, the Contractor may apply the finish by approved hand methods that achieve the required finish with a minimum of surface tearing and unseating aggregate particles. Ensure that the surface resulting from this operation is uniform in appearance and free of irregular, rough, or porous areas.

350-12.2 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.

350-13 Curing.

350-13.1 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, the edges of the newly placed concrete in accordance with one or more of the methods described below. In ~~all~~ cases *where*~~in which~~ 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 *QCP will be suspended*~~Engineer will order an immediate suspension of concreting operations~~. 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 50°F [10°C].

350-13.2 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}~~0.005 gal/ft^2~~ [~~0.2 L/m^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 manufactures recommendation*~~until the pigment is uniformly dispersed throughout the vehicle~~.

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.

350-13.3 Burlap Mats: ~~Under this method, cover the surfaces to be cured with 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 ~~so as to cause them to remain in intimate contact with the surface being cured,~~ throughout the curing period *to ensure a contact with the surface being cured.* Maintain the mats fully moist and in position for the entire portion of the required ~~burlap~~ curing period.

350-13.4 Removal of Forms: Do not remove forms from freshly placed concrete ~~until it has set~~ 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.

350-14 Surface Requirements.

After *the* curing *period,* ~~remove the curing material (except for the impervious coating), and thoroughly~~ test the surface for pavement surface smoothness in accordance with 352-4(c). Plainly mark all variations from the required tolerances. Where pavement surfaces do not meet the smoothness requirements, the Engineer will require corrective work and retesting to ensure conformity.

Eliminate high spots exceeding 1/8 inch in 10 feet [3.2 mm in 3 m], but not in excess of 0.3 inch in 25 feet [7.6 mm in 7.6 m], by grinding either with an approved machine or with a carborundum brick and water. Do not use bush-hammering or other destructive means for removing irregularities. As directed by the Engineer, retexture corrected high areas to give skid resistance comparable to the surrounding area.

Provide grinding equipment with a power driven self-propelled machine that is specifically designed to grind portland cement concrete pavement, with a minimum of a 3- foot [1- m] wide grinding head and diamond impregnated grinding blades. Produce, by grinding, a pavement surface that is true to grade and uniform in appearance with a longitudinal line type texture. Provide a line type texture that contains parallel longitudinal corrugations that present a narrow ridge corduroy type appearance. Ensure that the peaks of ridges are approximately 1/32 inch [0.8 mm] higher than the bottoms of the grooves with approximately 60 evenly spaced grooves per foot [300 mm].

Operate all milling, cutting, or grinding equipment to produce a reasonably uniform finished surface without spalling the pavement joints within corrected areas. The Engineer will not require extra grinding to eliminate minor depressions in order to provide 100% texturing of the pavement surface. Maintain the cross slope of the pavement as shown in the plans. Repair all joint seals destroyed by grinding at no expense to the Department.

Remove and replace any area of pavement which, after grinding, still shows a deviation in excess of the allowable tolerance. Ensure that the area removed and replaced is the full length between transverse joints and the full width of the lane involved.

Saw the area to be removed to a smooth vertical surface. Clean the face of the adjacent (hardened) concrete, and coat it with an epoxy bonding compound before placing the replacement concrete.

Bear the costs of all surface corrections required and of all required removal and replacement of defective surface concrete.

350-15 Joints.

350-15.1 General: Construct joints at the locations and in accordance with the details shown in the Roadway and Traffic Design Standards, Index No. 305 and the Contract Documents.

350-15.2 Longitudinal Joints:

350-15.2.1 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. Where keyways are required, the Contractor may form them by placing an insert of the proper shape along the inside face of the side form or, when using the slip form method of paving, by an approved extrusion device. Use a method that produces a keyway of the shape and at the location indicated in the plans.

350-15.2.2 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 within 72 hours after placing the concrete.

350-15.2.3 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.

350-15.2.4 Longitudinal Shoulder Joints (Concrete to Asphalt): Construct a continuous joint by sawing a groove into the asphalt pavement at the abutment with the concrete pavement. Produce a groove that is 3/4 inch [19 mm] wide and 3/4 inch [19 mm] deep, after sawing and cleaning.

Seal the joint with hot-poured type sealant.

350-15.3 Transverse Joints:

350-15.3.1 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.

350-15.3.2 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 loadtransfer 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 in general when the concrete is between 4 and 12 hours old. Make a second saw cut, to provide the joint dimensions indicated in the plans, as soon as there is no danger of further raveling.

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.

350-15.3.3 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 Roadway and Traffic 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 on the Roadway and Traffic Design Standards.

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.

350-15.4 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 the free end of each dowel with one coat of approved zinc rich paint (listed on the Qualified Products List), and grease it with an approved lubricant, to prevent the concrete from bonding to the dowel. Provide the free end of expansion joint dowels with the closest fitting metal cap or sleeve, equipped with a stop to prevent closing during placement operations. Maintain a clearance of 1 inch [25 mm] between the closed end of the cap and the dowel to accommodate future slab movement.

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].

Provide the Engineer with confirmation of the location of the dowel bars. The Contractor shall confirm that the paving operation has not displaced the dowels from their required positions. Perform confirmation checks daily for the first two days of the paving operation and weekly thereafter.

350-15.5 Expansion Joints Around Structures: 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.

350-15.6 Cleaning Joints and Cracks:

350-15.6.1 Cleaning Joints in New Pavement:

350-15.6.1.1 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.

350-15.6.1.2 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.

350-15.6.2 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.

350-15.6.3 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 350-15.6.2.

350-15.7 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.

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.

350-15.7.1 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 50°F [10°C] or greater.

350-15.7.2 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 40°F [5°C].

350-16 Thickness Determinations.

350-16.1 Core Borings: After completing the concrete pavement, including any corrective work to meet ride requirement, drill cores from the pavement to determine the actual thickness. ~~When the Department is ready to core the finished pavement for thickness, p~~*P*rovide traffic control, coring equipment, and operator to obtain the cores. ~~The Engineer will s~~*S*elect the coring locations and make the ~~acceptance~~ measurements *for thickness determination*. Take borings at random intervals and at various points on the cross-section so that each test boring represents an area not exceeding 2,500 yd^2 [2,000 m^2]. *The Engineer may select the boring locations or measure the thickness for independent verification.*

Replace the portions of the pavement removed by the borings at no expense to the Department.

350-16.2 Method of Calculating Average Thickness: ~~The Department will d~~*D*etermine the average thickness of pavement *in accordance with ASTM C 174* from the length of all cores taken as indicated above and ~~will~~ calculate it as follows:

(a) ~~The Department will~~*Do* 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 as measured by the cores 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 c~~*C*alculate the average thickness for the entire job as a unit.

350-17 Deficient Thickness.

350-17.1 General: The Department will not pay for any pavement which is more than 1/2 inch [13 mm] less than the specified thickness. 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.

350-17.2 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 deficient area is sufficient to seriously impair the anticipated service life of the pavement, the Contractor shall 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.

350-17.3 Deficient Pavement Left in Place: If the Engineer determines that the deficiency will not seriously impair the anticipated service life of the pavement, the Contractor may elect to leave the pavement in place, but shall receive no compensation for the area of pavement.

350-17.4 Additional Borings: If the Contractor believes that the number of cores taken is not sufficient to indicate the thickness of the pavement, he may request ~~that the Engineer select~~ additional boring locations *with prior approval by the Engineer and bear all cost for these additional boring locations*. ~~The Department will deduct the cost of these additional borings from any sums due the Contractor, unless such borings indicate that the pavement within the questioned area is of specified or greater thickness.~~

350-18 Opening Pavement to Traffic.

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 50°F [10°C]) 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 ~~AASHTO T 23~~*ASTM C 31* and tested in accordance with ~~AASHTO T 97~~*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. Provide protection that includes the erection and maintenance of signs, lights, barricades, etc., the construction and removal of temporary pavement, bridges, crossovers, etc., and the use of flagmen as may be necessary. Arrange the protective measures so as not to interfere with traffic in lanes being utilized for required maintenance of traffic.

Before opening the pavement to traffic, construct an earth berm along each edge. Build the berm to the full height of the pavement and at least 18 inches [0.5 m] wide, and sufficiently compact it to prevent underwash of the pavement. Maintain the berm until completing the final shoulders.

350-19 Method of Measurement.

350-19.1 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 350-17.3 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 asphaltic 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 asphaltic 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.

350-19.2 Joints and Cracks: The Contractor shall 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 that have been 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.

350-20 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.

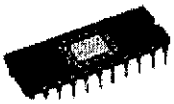
Judy F Frazier

07/01/2003 08:33 AM

To: Charles A Ishee/SM/FDOT
cc: Michael Bergin/SM/FDOT@FDOT
Subject: Proposed Specifications Change-D3500000- Cement Concrete Pavement

Gentlemen, attached is a late comment on D3500000. Please add this one to the others previously sent June 23rd. Thank you.

Judy Frazier
(850) 414-4127, SC 994-4127
judy.frazier@dot.state.fl.us
----- Forwarded by Judy F Frazier/CO/FDOT on 07/01/2003 08:32 AM -----



Mike Johnson

07/01/2003 08:30 AM

To: Judy F Frazier/CO/FDOT@FDOT
cc:
Subject: Proposed Specifications Change-D3500000- Cement Concrete Pavement

Please accept the comment on the above subject. Thanks

Section 350-10.1, Last paragraph, last sentence. In hot weather, or windy conditions to produce a smooth finish on concrete you need to sprinkle the concrete surface to get a good finish with water. This will not affect the strength of the concrete. In fact it will assist in getting a more uniformed and sealed surface. Paul Grochowski

Mike Johnson
Contract Support Specialist
Gainesville Construction
(352) 381-4220, SC 643-4220
jamesm.johnson@dot.state.fl.us

Judy F Frazier

06/23/2003 09:57 AM

To: Charles A Ishee/SM/FDOT,
cc: Michael Bergin/SM/FDOT,
cc:
Subject: D3500000

Attached is a late comment received on the above. The only change/comment was in Article 350-9. Please add this to the previous ones sent earlier today. Thank you.

Abdenour Nazef.doc

Judy Frazier
(850) 414-4127, SC 994-4127
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350-8.4 Hours of Operation: Stop placing concrete in time to complete finishing operations during daylight hours~~,~~ or provide adequate ~~approved~~ lighting *as identified in the QCP*.

350-8.5 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. Do not continue vibration at any one location ~~so~~ long ~~as~~ *enough* to produce puddling or the accumulation of excessive grout on the surface.

350-9 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.

350-10 Striking-off, Consolidating, and Finishing Concrete.

350-10.1 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 ~~C~~*c*ontract ~~D~~*d*ocuments. Perform the sequence of operations as follows: strike-off; vibratory consolidation; screeding; floating; removal of laitance; straightedging; and final surface finish. Except ~~as~~ *when* specified, perform strike-off, consolidation, screeding, and floating by the machine method.

Provide a concrete surface true to grade and crown, and free of irregularities. Do not add water to the concrete surface to assist in finishing operations.

350-10.2 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.

350-10.3 Hand Methods:

350-10.3.1 Conditions under which Allowed: The Contractor may use hand methods in areas of narrow width or irregular dimensions~~,~~ where operation of mechanical equipment is impracticable. In the event that mechanical equipment breaks down, the Contractor may use hand methods to finish only that concrete already deposited on the subgrade when the breakdown occurred.

350-10.3.2 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.

In operation, move the screed forward on the forms with a combined longitudinal and transverse shearing motion~~,~~ moving always in the direction in which the work is progressing~~, and~~ ~~m~~*M*anipulate it so that neither end is raised from the side forms during the striking-off process. If

Judy F Frazier

06/23/2003 09:36 AM

To: Charles A Ishee/SM/FDOT,
cc: Michael Bergin/SM/FDOT, \
cc:
Subject: D3500000

Please review the attached comments from Industry Review and return your response to each by this Friday the 27th so that we may make the necessary changes and forward to FHWA for approval. Thank you.

D3500000.doc

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Florida Department of Transportation

JEB BUSH
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JOSÉ ABREU
SECRETARY

MEMORANDUM

DATE: June 23, 2003

TO: Charles Ishee

FROM: Clinton J. Shaw, State Specifications Office

SUBJECT: **Proposed Modifications To Specification: D3500000**

Comments received, regarding the subject modification to the Standard Specifications, are attached. Please review these comments and advise of any further modifications by June 27, 2003. Also, please submit an electronic summary, of your decisions concerning these comment(s) in memorandum format. This summary will be posted on the State Specifications Office Web Page and included in the Specifications folder for future reference, should someone question your response. Your assistance will be appreciated.

Please Email submittals to SP965CS or clinton.shaw@dot.state.fl.us.

CS/jf

Attachment

CEMENT CONCRETE PAVEMENT.
(REV 5-13-03)

SECTION 350 (Pages 304-322) 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.

~~For aggregates, proportioning and mixing, and other provisions for the production of the concrete, meet the applicable provisions of Section 346.~~

~~Provide adequate lighting for all work done at night, including finishing, curing, and sawing joints. Unless lighting is provided for finishing, stop construction operations soon enough each day to permit finishing during daylight.~~

~~At least 20 days prior to paving, f~~*F*urnish the following information ~~for the Engineer's review for specification compliance~~*in the Quality Control Plan (QCP) as required in Section 105*:

1. A detailed sequence and schedule of concrete placement operations including, but not necessarily limited to, width of pavement to be placed, proposed equipment, production rates, working hours, concrete hauling, and placement, curing, sawing, and sealing methods.
2. A detailed staking plan for subgrade controls including offset requirements.
3. A traffic control plan for pavement construction operations *that* ~~which~~ 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. *Identify provisions for adequate lighting for all work done at night, including finishing, curing, and sawing joints.*

350-2 Materials.

Meet the following requirements:

Concrete, Class I *(Pavement)*	Section 346
Curing Materials	Section 925
Embedded Items	Section 931
Joint Seal	Section 932

350-3 Equipment.

350-3.1 General: ~~Obtain the Engineer's approval of the equipment and tools to be used for handling materials and performing all parts of the work, as to their design, capacity, and mechanical condition. Deliver the equipment to the job site sufficiently ahead of the start of construction operations to allow the Engineer to examine it thoroughly for approval.~~

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

~~Equip all equipment which operates on the side forms with scraping devices to clean accumulations from the top of the forms and wheels.~~*Provide equipment and tools to be used that meet the following:*

Capable 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.

350-3.2 Equipment For Trimming of Subgrade: For equipment operating on the subgrade, provide an automatically controlled subgrade trimmer. Use a machine that is capable of trimming the subgrade to proper elevation within the tolerances established herein. Provide grade controls that operate by sensing from a taut line, set true to line and grade. Erect and maintain the taut line.

350-3.3 Forms:

350-3.3.1 Form Material: Provide steel forms, except that on curves with a radius of *150 feet [*45 m*]* or less, provide flexible forms, or wooden forms that bend to the required arc.

350-3.3.2 Dimensions: Use forms with a minimum length of 10 feet [3 m], except where they are used on curves having a radius between 150 and 300 feet [45 and 90 m], in which case use a form length of 5 feet [1.5 m]. Use forms with a height that is equal to the edge thickness of the pavement. Use forms with a height greater than the edge thickness, provided the outer portion of the slab is thickened to equal the depth of the form by tapering at the rate of 1 inch *[25 mm]* of the extra thickness per foot [80 mm of the extra thickness per meter] of width. In such case, the Department will make no allowance for additional concrete. Do not use built-up forms.

350-3.3.3 Steel Forms: Use steel forms fabricated into an approved section and sufficiently strong to ensure rigidity under the impact, thrust, and weight of the heaviest equipment to be carried over the forms. Make the width of the base of the forms which is in direct contact with the soil at least equal to the height of the forms, but not less than 8 inches [200 mm]. Extend the flange braces outward on the base not less than two-thirds the height dimension of the form. Use steel forms of a thickness that is not less than 7/32 inch [5.5 mm]. When tested with a 10 foot [3.048 m] straightedge, ensure that the forms have no vertical variation in a 10 foot [3 m] length that is greater than 1/8 inch [3 mm] from a true plane of the surface on the top of the form, and no lateral variation that is greater than 1/4 inch [6 mm] from a true plane surface on the vertical face of the form. Do not use steel forms if, when tested as a simple beam with a span of 9 feet 6 inches [2.9 m] and a load equal to that exerted by construction equipment placed upon them, the deflection is more than 1/4 inch [6 mm].

350-3.3.4 Form Connections: Provide connections between adjacent sections of the form, that form a lock joint, free from vertical movement in excess of 1/8 inch [3 mm] and from horizontal movement in excess of 1/4 inch [6 mm], under the impact, thrust, and weight of the heaviest machine carried on the forms.

350-3.3.5 Defective Forms: Remove bent, twisted, or broken forms, and forms with ~~battered~~ *damaged* top surfaces, from the work. ~~Do not use repaired forms until they are inspected and approved by the Engineer.~~*The use of repaired forms will be based on the final product meeting all applicable contract requirements.*

350-3.3.6 Form Stakes: Provide at least three steel stakes for each 10 foot [3 m] length of form. Use stakes that are of sufficient size to prevent ~~undue~~ lateral movement of the form during paving operations. Fasten each of the stakes to the form by means of a suitable socket attached to the form. Equip each stake socket with steel wedges for securely keying the forms to the stakes. Locate a stake not more than 12 inches [300 mm] from the end of each section. ~~Do not use forms with broken or badly worn sockets.~~

350-3.3.7 Form Tampers: Use adequate mechanical form tampers, capable of thoroughly compacting the soil under the forms, except when the forms rest on a cement-treated subgrade.

350-3.4 Spreader: Provide a mechanical spreader that is independently powered and capable of spreading the mixed concrete on the subgrade over the entire width and depth of the strip being paved in a manner which will prevent segregation of the materials. Use a spreader designed and constructed to permit the concrete to be struck-off to a uniform thickness.

350-3.5 Strike-Off, Consolidation, and Finishing for Fixed-Form Construction: Provide equipment for these operations that consists of a self-propelled unit, or units, that perform the following functions by mechanical means, in the sequence indicated:

(1) Strike-off.
(2) Vibratory Consolidation.
(3) Screeding.
(4) Floating.

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

350-3.6 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 ~~all of this~~*the* equipment is of such dimensions and arrangement as to cover the full width of the pavement strip being *placed*~~laid~~. 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.

Do not use automatic grade controls on the paver when the tracks of the slip-form paver are operating on ~~econocrete base or~~ 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.

~~The Engineer may allow variation from any specific feature of the slip-form paver as detailed above, provided the industry has generally accepted the proposed variation as an improved feature.~~

350-3.7 Vibratory Units: Consolidate the concrete for the full width of the strip being placed with either surface pan type or internal type vibrators.

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.

350-3.8 Mechanical Floating Equipment: Provide equipment that consists of a supplementary self-propelled machine capable of further smoothing the concrete, removing excess mortar from the surface, and minimizing hand finishing.

~~Use a machine that leaves the surface of the concrete 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.~~

350-3.9 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.

The Contractor may use hand power-spray equipment to apply curing compound to areas where it is impracticable to operate the self-propelled equipment.

350-3.10 Equipment for Sealing Joints: Provide equipment for sealing the joints for each section of pavement. Use a heating kettle for hot-poured sealer that is of the indirect heating or double-boiler type, using oil as a heat transfer medium. 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. Use ~~pouring~~ equipment equipped with nozzles that discharge the seal 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 ~~for pouring,~~ within ~~10°F [5°C]~~*the manufacturer's recommendation.*

350-3.11 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. The Contractor may use such equipment as the Engineer may approve for such areas.

350-3.12 Hand Finishing Tools: Provide straightedges that have a blade length of 10 feet [3~~.048~~ 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].

350-3.13 Texturing Machine: Provide a machine that consists of a supplementary machine capable of applying the final finish to the concrete pavement. Apply the finish by rectangular shaped spring steel tines rigidly mounted in a frame operating on an adjustable track mounted under the main frame of the machine. Use a machine that is constructed so as to provide for adjustment of the downward pressure on the tines as necessary to produce the desired finish under varying conditions of the concrete surface.

The Engineer may allow variation from any specific feature of the Texturing Machine as detailed above, provided that the Contractor can produce an equivalent final finish.

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 moist 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.

Have available at the site, at all times when concrete paving operations are underway, materials for the protection of the surface and edges of the unhardened concrete. For the protection of the pavement edges, use ~~any~~ covering material~~, such as burlap, paper, or plastic sheeting material,~~ suitable for the protection of the pavement surface *as identified in the QCP*.

When rain appears imminent, stop all paving operations, and have all available personnel cover the surface of the unhardened concrete with the protective covering.

During periods when the air temperature may fall below 35°F [1°C], ~~advise the Engineer of~~ plans for curing and protecting the fresh concrete *shall be implemented as identified in the QCP* before placing the concrete.~~ Do not place any concrete until the Engineer has approved the proposed methods.~~
~~The Contractor is fully responsible for the quality and strength of the concrete placed in cold weather even if the Engineer approves of the provisions the Contractor employs for protecting the concrete placed during cold weather.~~

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.
Secure the reinforcement in position in advance of concrete placement or~~, with the Engineer's specific approval,~~ place it in the plastic concrete by mechanical or vibratory means after spreading the concrete *as identified in the QCP*. At the time of the concrete placement, ensure that the reinforcing steel is free from dirt, oil, paint, grease, mill scale, and any loose or thick rust which could impair bonding of the steel with the concrete. 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. ~~and t~~*T*he surface will at no point be below the grade specified for the finished surface~~, after application of the allowable tolerance~~. Deposit the concrete on the subgrade in a manner which will require as little rehandling as possible. Continuously place concrete between transverse joints without using intermediate bulkheads.

Deposit concrete as near to expansion and contraction joint assemblies as possible without disturbing them. Do not ~~dump~~*deposit* concrete from the discharge bucket or hopper onto an assembly without centering the bucket or hopper directly over the assembly.

350-8.2 Use of Spreader: Place concrete on the subgrade by an approved spreading device. The Engineer will not require the Contractor to use a spreader for areas where the width of slab varies, for intersections, and for 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*). Ensure that ~~workmen~~ *workers* do not walk in the freshly deposited concrete with *their boots or shoes coated with* earth or other deleterious substances ~~coated on their boots or shoes~~.

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. The Engineer will not require the Contractor to alter placement operations where superelevation reverses the pavement cross slope from that shown on the typical section.

350-8.4 Hours of Operation: Stop placing concrete in time to complete finishing operations during daylight hours, or provide adequate ~~approved~~ lighting *as identified in the QCP.*

350-8.5 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. Do not continue vibration at any one location so long as to produce puddling or the accumulation of excessive grout on the surface.

350-9 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.

350-10 Striking-off, Consolidating, and Finishing Concrete.

350-10.1 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.

Provide a concrete surface true to grade and crown, and free of irregularities. Do not add water to the concrete surface to assist in finishing operations.

350-10.2 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.

350-10.3 Hand Methods:

350-10.3.1 Conditions under which Allowed: The Contractor may use hand methods in areas of narrow width or irregular dimensions, where operation of mechanical equipment is impracticable. In the event that mechanical equipment breaks down, the Contractor may use hand methods to finish only that concrete already deposited on the subgrade when the breakdown occurred.

350-10.3.2 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.

In operation, move the screed forward on the forms with a combined longitudinal and transverse shearing motion, moving always in the direction in which the work is progressing, and manipulate it so that neither end is raised from the side forms during the striking-off process. If necessary, repeat this until the surface is of uniform texture, true to grade and cross-section, and free from porous areas.

350-10.3.3 Consolidation: Use hand-operated spud-type vibrators to consolidate.

350-10.3.4 Floating: Use long-handled floats to float the concrete. Take the necessary care to avoid creating depressions or ridges during this operation.

350-10.4 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.

350-11 Supplemental Floating.

In areas where performing machine strike-off, consolidation, and finishing, further 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. Waste excess mortar beyond the edge of the slab.

350-12 Final Finish.

350-12.1 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.

After applying the burlap drag finish, apply the final finish with the texturing machine. Control the time of applying this finish and the method of operating the texturing machine so as to minimize tearing of surface and unseating of aggregate particles.

Provide a final finish that consists of transverse grooves which are 0.08 to 0.12 inch [2 to 3 mm] in width and 0.10 to 0.15 inch [2.5 to 4 mm] in depth, spaced at random intervals between 1/2 to 1 inch [13 to 25 mm]. Operate the texturing machine in a manner that minimizes the overlapping of subsequent passes of the steel comb. Create short gaps in the grooved finish as necessary to avoid overlap between passes.

In areas of irregular dimensions or narrow widths, where operating the texturing machine is impracticable, the Contractor may apply the finish by approved hand methods that achieve the required finish with a minimum of surface tearing and unseating aggregate particles. Ensure that the surface resulting from this operation is uniform in appearance and free of irregular, rough, or porous areas.

350-12.2 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.

350-13 Curing.

350-13.1 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, the edges of the newly placed concrete in accordance with one or more of the methods described below. In ~~all~~ cases *where*~~in which~~ 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 *QCP will be suspended*~~Engineer will order an immediate suspension of concreting operations~~. 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 50°F [10°C].

350-13.2 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}~~0.005 gal/ft^2~~ [~~0.2 L/m^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 manufactures recommendation*~~until the pigment is uniformly dispersed throughout the vehicle~~.

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.

350-13.3 Burlap Mats: ~~Under this method, cover the surfaces to be cured with 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 ~~so as to cause them to remain in intimate contact with the surface being cured,~~ throughout the curing period *to ensure a contact with the surface being cured.* Maintain the mats fully moist and in position for the entire portion of the required ~~burlap~~ curing period.

350-13.4 Removal of Forms: Do not remove forms from freshly placed concrete ~~until it has set~~ 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.

350-14 Surface Requirements.

After *the* curing *period*, ~~remove the curing material (except for the impervious coating), and thoroughly~~ test the surface for pavement surface smoothness in accordance with 352-4(c). Plainly mark all variations from the required tolerances. Where pavement surfaces do not meet the smoothness requirements, the Engineer will require corrective work and retesting to ensure conformity.

Eliminate high spots exceeding 1/8 inch in 10 feet [3.2 mm in 3 m], but not in excess of 0.3 inch in 25 feet [7.6 mm in 7.6 m], by grinding either with an approved machine or with a carborundum brick and water. Do not use bush-hammering or other destructive means for removing irregularities. As directed by the Engineer, retexture corrected high areas to give skid resistance comparable to the surrounding area.

Provide grinding equipment with a power driven self-propelled machine that is specifically designed to grind portland cement concrete pavement, with a minimum of a 3- foot [1- m] wide grinding head and diamond impregnated grinding blades. Produce, by grinding, a pavement surface that is true to grade and uniform in appearance with a longitudinal line type texture. Provide a line type texture that contains parallel longitudinal corrugations that present a narrow ridge corduroy type appearance. Ensure that the peaks of ridges are approximately 1/32 inch [0.8 mm] higher than the bottoms of the grooves with approximately 60 evenly spaced grooves per foot [300 mm].

Operate all milling, cutting, or grinding equipment to produce a reasonably uniform finished surface without spalling the pavement joints within corrected areas. The Engineer will not require extra grinding to eliminate minor depressions in order to provide 100% texturing of the pavement surface. Maintain the cross slope of the pavement as shown in the plans. Repair all joint seals destroyed by grinding at no expense to the Department.

Remove and replace any area of pavement which, after grinding, still shows a deviation in excess of the allowable tolerance. Ensure that the area removed and replaced is the full length between transverse joints and the full width of the lane involved.

Saw the area to be removed to a smooth vertical surface. Clean the face of the adjacent (hardened) concrete, and coat it with an epoxy bonding compound before placing the replacement concrete.

Bear the costs of all surface corrections required and of all required removal and replacement of defective surface concrete.

350-15 Joints.

350-15.1 General: Construct joints at the locations and in accordance with the details shown in the Roadway and Traffic Design Standards, Index No. 305 and the Contract Documents.

350-15.2 Longitudinal Joints:

350-15.2.1 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. Where keyways are required, the Contractor may form them by placing an insert of the proper shape along the inside face of the side form or, when using the slip form method of paving, by an approved extrusion device. Use a method that produces a keyway of the shape and at the location indicated in the plans.

350-15.2.2 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 within 72 hours after placing the concrete.

350-15.2.3 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.

350-15.2.4 Longitudinal Shoulder Joints (Concrete to Asphalt): Construct a continuous joint by sawing a groove into the asphalt pavement at the abutment with the concrete pavement. Produce a groove that is 3/4 inch [19 mm] wide and 3/4 inch [19 mm] deep, after sawing and cleaning.

Seal the joint with hot-poured type sealant.

350-15.3 Transverse Joints:

350-15.3.1 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.

350-15.3.2 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 loadtransfer 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 in general when the concrete is between 4 and 12 hours old. Make a second saw cut, to provide the joint dimensions indicated in the plans, as soon as there is no danger of further raveling.

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.

350-15.3.3 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 Roadway and Traffic 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 on the Roadway and Traffic Design Standards.

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.

350-15.4 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 the free end of each dowel with one coat of approved zinc rich paint (listed on the Qualified Products List), and grease it with an approved lubricant, to prevent the concrete from bonding to the dowel. Provide the free end of expansion joint dowels with the closest fitting metal cap or sleeve, equipped with a stop to prevent closing during placement operations. Maintain a clearance of 1 inch [25 mm] between the closed end of the cap and the dowel to accommodate future slab movement.

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].

Provide the Engineer with confirmation of the location of the dowel bars. The Contractor shall confirm that the paving operation has not displaced the dowels from their required positions. Perform confirmation checks daily for the first two days of the paving operation and weekly thereafter.

350-15.5 Expansion Joints Around Structures: 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.

350-15.6 Cleaning Joints and Cracks:

350-15.6.1 Cleaning Joints in New Pavement:

350-15.6.1.1 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.

350-15.6.1.2 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.

350-15.6.2 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.

350-15.6.3 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 350-15.6.2.

350-15.7 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.

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.

350-15.7.1 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 50°F [10°C] or greater.

350-15.7.2 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 40°F [5°C].

350-16 Thickness Determinations.

350-16.1 Core Borings: After completing the concrete pavement, including any corrective work to meet ride requirement, drill cores from the pavement to determine the actual thickness. ~~When the Department is ready to core the finished pavement for thickness, p~~*P*rovide traffic control, coring equipment, and operator to obtain the cores. ~~The Engineer will s~~*S*elect the coring locations and make the ~~acceptance~~ measurements *for thickness determination*. Take borings at random intervals and at various points on the cross-section so that each test boring represents an area not exceeding 2,500 yd^2 [2,000 m^2]. *The Engineer may select the boring locations or measure the thickness for independent verification.*

Replace the portions of the pavement removed by the borings at no expense to the Department.

350-16.2 Method of Calculating Average Thickness: ~~The Department will d~~*D*etermine the average thickness of pavement *in accordance with ASTM C 174* from the length of all cores taken as indicated above and ~~will~~ calculate it as follows:

(a) ~~The Department will~~*Do* 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 as measured by the cores 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 c~~Calculate the average thickness for the entire job as a unit.

350-17 Deficient Thickness.

350-17.1 General: The Department will not pay for any pavement which is more than 1/2 inch [13 mm] less than the specified thickness. 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.

350-17.2 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 deficient area is sufficient to seriously impair the anticipated service life of the pavement, the Contractor shall 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.

350-17.3 Deficient Pavement Left in Place: If the Engineer determines that the deficiency will not seriously impair the anticipated service life of the pavement, the Contractor may elect to leave the pavement in place, but shall receive no compensation for the area of pavement.

350-17.4 Additional Borings: If the Contractor believes that the number of cores taken is not sufficient to indicate the thickness of the pavement, he may request ~~that the Engineer select~~ additional boring locations *with prior approval by the Engineer and bear all cost for these additional boring locations*. ~~The Department will deduct the cost of these additional borings from any sums due the Contractor, unless such borings indicate that the pavement within the questioned area is of specified or greater thickness.~~

350-18 Opening Pavement to Traffic.

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 50°F [10°C]) 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 ~~AASHTO T 23~~*ASTM C 31* and tested in accordance with ~~AASHTO T 97~~*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. Provide protection that includes the erection and maintenance of signs, lights, barricades, etc., the construction and removal of temporary pavement, bridges, crossovers, etc., and the use of flagmen as may be necessary. Arrange the protective measures so as not to interfere with traffic in lanes being utilized for required maintenance of traffic.

Before opening the pavement to traffic, construct an earth berm along each edge. Build the berm to the full height of the pavement and at least 18 inches [0.5 m] wide, and sufficiently compact it to prevent underwash of the pavement. Maintain the berm until completing the final shoulders.

350-19 Method of Measurement.

350-19.1 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 350-17.3 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 asphaltic 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 asphaltic 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.

350-19.2 Joints and Cracks: The Contractor shall 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 that have been 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.

350-20 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.

File: D3500000 - Cement Concrete Pavement
Username: Daniel F. Haldi
UserEmail: daniel.haldi@dot.state.fl.us
UserTel: 386-740-3516
UserFAX: 386-736-5178
ContactRequested: ContactRequested
Remote Name: 156.75.75.113
Remote User:

Comments:

Section 350-10.1 Very Last Sectence. "Do not add water to the concrete
surface to assist in finishing operations", is a novel idea ... but suppose
the contractor has a very stiff concrete that is unfinishable, he will need
to do something, that might mean adding something to the surface. If we say
no water, then he may add something else. We should say "no fluids" that are deleterious, or better, maybe say if extraneous substances are used to assist
finishing, that are not approved in the QCP ... then that portion of the
finishing operation is suspended....

File: D3500000 - Cement Concrete Pavement
Username: Tracy Witt
UserEmail: tracy.witt@dot.state.fl.us
UserTel: SC 881-7842
UserFAX: SC 881-7849
ContactRequested:
Remote Name: 156.75.19.144
Remote User:

Comments:

Don Rauch - For D3500000, the only comment I would have is to add a
Section 5 in 350-1 which would read something like:

5. Provide information for all QC inspection that will be
done to comply with the various sections in this specification.

POSTED 5/23/2003

Florida Department of Transportation

JEB BUSH
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JOSÉ ABREU
SECRETARY

MEMORANDUM

DATE: May 23, 2003

TO: Specification Review Distribution List

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

SUBJECT: **Proposed Specifications Change: D3500000 - Cement Concrete Pavement**

In accordance with Specification Development Procedures, we are sending you a copy of a proposed specification change to Section 350.

This change was proposed by Charles Ishee of the State Materials Office to bring the specification more in agreement with the Contractor Quality Control Guidelines.

Please share this proposal with others within your responsibility. Review comments are due within four weeks and should be sent to Mail Station 75 or to my attention via e-mail at SP965DB or duane.brautigam@dot.state.fl.us. Comments received after June 20, 2003 may not be considered. Your input is encouraged.

DFB/jf

Attachment

COMMENTS: _____

_____

_____

_____

_____

_____

Submitted by: _____ Phone #: _____

CEMENT CONCRETE PAVEMENT.
(REV 5-13-03)

SECTION 350 (Pages 304-322) 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.

~~For aggregates, proportioning and mixing, and other provisions for the production of the concrete, meet the applicable provisions of Section 346.~~

~~Provide adequate lighting for all work done at night, including finishing, curing, and sawing joints. Unless lighting is provided for finishing, stop construction operations soon enough each day to permit finishing during daylight.~~

~~At least 20 days prior to paving, f~~*F*urnish the following information ~~for the Engineer's review for specification compliance~~*in the Quality Control Plan (QCP) as required in Section 105*:

1. A detailed sequence and schedule of concrete placement operations including, but not necessarily limited to, width of pavement to be placed, proposed equipment, production rates, working hours, concrete hauling, and placement, curing, sawing, and sealing methods.
2. A detailed staking plan for subgrade controls including offset requirements.
3. A traffic control plan for pavement construction operations *that* ~~which~~ 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. *Identify provisions for adequate lighting for all work done at night, including finishing, curing, and sawing joints.*

350-2 Materials.

Meet the following requirements:

Concrete, Class I *(Pavement)*	Section 346
Curing Materials	Section 925
Embedded Items	Section 931
Joint Seal	Section 932

350-3 Equipment.

350-3.1 General: ~~Obtain the Engineer's approval of the equipment and tools to be used for handling materials and performing all parts of the work, as to their design, capacity, and mechanical condition. Deliver the equipment to the job site sufficiently ahead of the start of construction operations to allow the Engineer to examine it thoroughly for approval.~~

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

~~Equip all equipment which operates on the side forms with scraping devices to clean accumulations from the top of the forms and wheels.~~*Provide equipment and tools to be used that meet the following:*

Capable 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.

350-3.2 Equipment For Trimming of Subgrade: For equipment operating on the subgrade, provide an automatically controlled subgrade trimmer. Use a machine that is capable of trimming the subgrade to proper elevation within the tolerances established herein. Provide grade controls that operate by sensing from a taut line, set true to line and grade. Erect and maintain the taut line.

350-3.3 Forms:

350-3.3.1 Form Material: Provide steel forms, except that on curves with a radius of *150 feet [*45 m*]* or less, provide flexible forms, or wooden forms that bend to the required arc.

350-3.3.2 Dimensions: Use forms with a minimum length of 10 feet [3 m], except where they are used on curves having a radius between 150 and 300 feet [45 and 90 m], in which case use a form length of 5 feet [1.5 m]. Use forms with a height that is equal to the edge thickness of the pavement. Use forms with a height greater than the edge thickness, provided the outer portion of the slab is thickened to equal the depth of the form by tapering at the rate of 1 inch *[25 mm]* of the extra thickness per foot [80 mm of the extra thickness per meter] of width. In such case, the Department will make no allowance for additional concrete. Do not use built-up forms.

350-3.3.3 Steel Forms: Use steel forms fabricated into an approved section and sufficiently strong to ensure rigidity under the impact, thrust, and weight of the heaviest equipment to be carried over the forms. Make the width of the base of the forms which is in direct contact with the soil at least equal to the height of the forms, but not less than 8 inches [200 mm]. Extend the flange braces outward on the base not less than two-thirds the height dimension of the form. Use steel forms of a thickness that is not less than 7/32 inch [5.5 mm]. When tested with a 10 foot [3.048 m] straightedge, ensure that the forms have no vertical variation in a 10 foot [3 m] length that is greater than 1/8 inch [3 mm] from a true plane of the surface on the top of the form, and no lateral variation that is greater than 1/4 inch [6 mm] from a true plane surface on the vertical face of the form. Do not use steel forms if, when tested as a simple beam with a span of 9 feet 6 inches [2.9 m] and a load equal to that exerted by construction equipment placed upon them, the deflection is more than 1/4 inch [6 mm].

350-3.3.4 Form Connections: Provide connections between adjacent sections of the form, that form a lock joint, free from vertical movement in excess of 1/8 inch [3 mm] and from horizontal movement in excess of 1/4 inch [6 mm], under the impact, thrust, and weight of the heaviest machine carried on the forms.

350-3.3.5 Defective Forms: Remove bent, twisted, or broken forms, and forms with ~~battered~~ *damaged* top surfaces, from the work. ~~Do not use repaired forms until they are inspected and approved by the Engineer.~~*The use of repaired forms will be based on the final product meeting all applicable contract requirements.*

350-3.3.6 Form Stakes: Provide at least three steel stakes for each 10 foot [3 m] length of form. Use stakes that are of sufficient size to prevent ~~undue~~ lateral movement of the form during paving operations. Fasten each of the stakes to the form by means of a suitable socket attached to the form. Equip each stake socket with steel wedges for securely keying the forms to the stakes. Locate a stake not more than 12 inches [300 mm] from the end of each section. ~~Do not use forms with broken or badly worn sockets.~~

350-3.3.7 Form Tampers: Use adequate mechanical form tampers, capable of thoroughly compacting the soil under the forms, except when the forms rest on a cement-treated subgrade.

350-3.4 Spreader: Provide a mechanical spreader that is independently powered and capable of spreading the mixed concrete on the subgrade over the entire width and depth of the strip being paved in a manner which will prevent segregation of the materials. Use a spreader designed and constructed to permit the concrete to be struck-off to a uniform thickness.

350-3.5 Strike-Off, Consolidation, and Finishing for Fixed-Form Construction: Provide equipment for these operations that consists of a self-propelled unit, or units, that perform the following functions by mechanical means, in the sequence indicated:

(1) Strike-off.
(2) Vibratory Consolidation.
(3) Screeding.
(4) Floating.

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

350-3.6 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 ~~all of this~~*the* equipment is of such dimensions and arrangement as to cover the full width of the pavement strip being *placed*~~laid~~. 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.

Do not use automatic grade controls on the paver when the tracks of the slip-form paver are operating on ~~econcrete base or~~ 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.

~~The Engineer may allow variation from any specific feature of the slip-form paver as detailed above, provided the industry has generally accepted the proposed variation as an improved feature.~~

350-3.7 Vibratory Units: Consolidate the concrete for the full width of the strip being placed with either surface pan type or internal type vibrators.

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.

350-3.8 Mechanical Floating Equipment: Provide equipment that consists of a supplementary self-propelled machine capable of further smoothing the concrete, removing excess mortar from the surface, and minimizing hand finishing.

~~Use a machine that leaves the surface of the concrete 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.~~

350-3.9 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.

The Contractor may use hand power-spray equipment to apply curing compound to areas where it is impracticable to operate the self-propelled equipment.

350-3.10 Equipment for Sealing Joints: Provide equipment for sealing the joints for each section of pavement. Use a heating kettle for hot-poured sealer that is of the indirect heating or double-boiler type, using oil as a heat transfer medium. 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. Use ~~pouring~~ equipment equipped with nozzles that discharge the seal 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 ~~for pouring,~~ within ~~10°F [5°C]~~*the manufacturer's recommendation.*

350-3.11 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. The Contractor may use such equipment as the Engineer may approve for such areas.

350-3.12 Hand Finishing Tools: Provide straightedges that have a blade length of 10 feet [3~~.048~~ 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].

350-3.13 Texturing Machine: Provide a machine that consists of a supplementary machine capable of applying the final finish to the concrete pavement. Apply the finish by rectangular shaped spring steel tines rigidly mounted in a frame operating on an adjustable track mounted under the main frame of the machine. Use a machine that is constructed so as to provide for adjustment of the downward pressure on the tines as necessary to produce the desired finish under varying conditions of the concrete surface.

The Engineer may allow variation from any specific feature of the Texturing Machine as detailed above, provided that the Contractor can produce an equivalent final finish.

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 moist 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.

Have available at the site, at all times when concrete paving operations are underway, materials for the protection of the surface and edges of the unhardened concrete. For the protection of the pavement edges, use ~~any~~ covering material~~, such as burlap, paper, or plastic sheeting material,~~ suitable for the protection of the pavement surface *as identified in the QCP*.

When rain appears imminent, stop all paving operations, and have all available personnel cover the surface of the unhardened concrete with the protective covering.

During periods when the air temperature may fall below 35°F [1°C], ~~advise the Engineer of~~ plans for curing and protecting the fresh concrete *shall be implemented as identified in the QCP* before placing the concrete.~~ Do not place any concrete until the Engineer has approved the proposed methods.~~
~~The Contractor is fully responsible for the quality and strength of the concrete placed in cold weather even if the Engineer approves of the provisions the Contractor employs for protecting the concrete placed during cold weather.~~

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.
Secure the reinforcement in position in advance of concrete placement or~~, with the Engineer's specific approval,~~ place it in the plastic concrete by mechanical or vibratory means after spreading the concrete *as identified in the QCP*. At the time of the concrete placement, ensure that the reinforcing steel is free from dirt, oil, paint, grease, mill scale, and any loose or thick rust which could impair bonding of the steel with the concrete. 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. ~~and t~~*T*he surface will at no point be below the grade specified for the finished surface~~, after application of the allowable tolerance~~. Deposit the concrete on the subgrade in a manner which will require as little rehandling as possible. Continuously place concrete between transverse joints without using intermediate bulkheads.

Deposit concrete as near to expansion and contraction joint assemblies as possible without disturbing them. Do not ~~dump~~*deposit* concrete from the discharge bucket or hopper onto an assembly without centering the bucket or hopper directly over the assembly.

350-8.2 Use of Spreader: Place concrete on the subgrade by an approved spreading device. The Engineer will not require the Contractor to use a spreader for areas where the width of slab varies, for intersections, and for 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*). Ensure that ~~workmen~~ *workers* do not walk in the freshly deposited concrete with *their boots or shoes coated with* earth or other deleterious substances ~~coated on their boots or shoes~~.

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. The Engineer will not require the Contractor to alter placement operations where superelevation reverses the pavement cross slope from that shown on the typical section.

350-8.4 Hours of Operation: Stop placing concrete in time to complete finishing operations during daylight hours, or provide adequate ~~approved~~ lighting *as identified in the QCP*.

350-8.5 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. Do not continue vibration at any one location so long as to produce puddling or the accumulation of excessive grout on the surface.

350-9 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.

350-10 Striking-off, Consolidating, and Finishing Concrete.

350-10.1 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.

Provide a concrete surface true to grade and crown, and free of irregularities. Do not add water to the concrete surface to assist in finishing operations.

350-10.2 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.

350-10.3 Hand Methods:

350-10.3.1 Conditions under which Allowed: The Contractor may use hand methods in areas of narrow width or irregular dimensions, where operation of mechanical equipment is impracticable. In the event that mechanical equipment breaks down, the Contractor may use hand methods to finish only that concrete already deposited on the subgrade when the breakdown occurred.

350-10.3.2 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.

In operation, move the screed forward on the forms with a combined longitudinal and transverse shearing motion, moving always in the direction in which the work is progressing, and manipulate it so that neither end is raised from the side forms during the striking-off process. If necessary, repeat this until the surface is of uniform texture, true to grade and cross-section, and free from porous areas.

350-10.3.3 Consolidation: Use hand-operated spud-type vibrators to consolidate.

350-10.3.4 Floating: Use long-handled floats to float the concrete. Take the necessary care to avoid creating depressions or ridges during this operation.

350-10.4 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.

350-11 Supplemental Floating.

In areas where performing machine strike-off, consolidation, and finishing, further 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. Waste excess mortar beyond the edge of the slab.

350-12 Final Finish.

350-12.1 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.

After applying the burlap drag finish, apply the final finish with the texturing machine. Control the time of applying this finish and the method of operating the texturing machine so as to minimize tearing of surface and unseating of aggregate particles.

Provide a final finish that consists of transverse grooves which are 0.08 to 0.12 inch [2 to 3 mm] in width and 0.10 to 0.15 inch [2.5 to 4 mm] in depth, spaced at random intervals between 1/2 to 1 inch [13 to 25 mm]. Operate the texturing machine in a manner that minimizes the overlapping of subsequent passes of the steel comb. Create short gaps in the grooved finish as necessary to avoid overlap between passes.

In areas of irregular dimensions or narrow widths, where operating the texturing machine is impracticable, the Contractor may apply the finish by approved hand methods that achieve the required finish with a minimum of surface tearing and unseating aggregate particles. Ensure that the surface resulting from this operation is uniform in appearance and free of irregular, rough, or porous areas.

350-12.2 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.

350-13 Curing.

350-13.1 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, the edges of the newly placed concrete in accordance with one or more of the method*s* described below. In ~~all~~ cases *where*~~in which~~ 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 *QCP will be suspended*~~Engineer will order an immediate suspension of concreting operations~~. 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 50°F [10°C].

350-13.2 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}~~0.005 gal/ft^2~~ [~~0.2 L/m^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 manufactures recommendation*~~until the pigment is uniformly dispersed throughout the vehicle~~.

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.

350-13.3 Burlap Mats: ~~Under this method, cover the surfaces to be cured with 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 ~~so as to cause them to remain in intimate contact with the surface being cured,~~ throughout the curing period *to ensure a contact with the surface being cured.* Maintain the mats fully moist and in position for the entire portion of the required ~~burlap~~ curing period.

350-13.4 Removal of Forms: Do not remove forms from freshly placed concrete ~~until it has set~~ 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.

350-14 Surface Requirements.

After *the* curing *period*, ~~remove the curing material (except for the impervious coating), and thoroughly~~ test the surface for pavement surface smoothness in accordance with 352-4(c). Plainly mark all variations from the required tolerances. Where pavement surfaces do not meet the smoothness requirements, the Engineer will require corrective work and retesting to ensure conformity.

Eliminate high spots exceeding 1/8 inch in 10 feet [3.2 mm in 3 m], but not in excess of 0.3 inch in 25 feet [7.6 mm in 7.6 m], by grinding either with an approved machine or with a carborundum brick and water. Do not use bush-hammering or other destructive means for removing irregularities. As directed by the Engineer, retexture corrected high areas to give skid resistance comparable to the surrounding area.

Provide grinding equipment with a power driven self-propelled machine that is specifically designed to grind portland cement concrete pavement, with a minimum of a 3- foot [1- m] wide grinding head and diamond impregnated grinding blades. Produce, by grinding, a pavement surface that is true to grade and uniform in appearance with a longitudinal line type texture. Provide a line type texture that contains parallel longitudinal corrugations that present a narrow ridge corduroy type appearance. Ensure that the peaks of ridges are approximately 1/32 inch [0.8 mm] higher than the bottoms of the grooves with approximately 60 evenly spaced grooves per foot [300 mm].

Operate all milling, cutting, or grinding equipment to produce a reasonably uniform finished surface without spalling the pavement joints within corrected areas. The Engineer will not require extra grinding to eliminate minor depressions in order to provide 100% texturing of the pavement surface. Maintain the cross slope of the pavement as shown in the plans. Repair all joint seals destroyed by grinding at no expense to the Department.

Remove and replace any area of pavement which, after grinding, still shows a deviation in excess of the allowable tolerance. Ensure that the area removed and replaced is the full length between transverse joints and the full width of the lane involved.

Saw the area to be removed to a smooth vertical surface. Clean the face of the adjacent (hardened) concrete, and coat it with an epoxy bonding compound before placing the replacement concrete.

Bear the costs of all surface corrections required and of all required removal and replacement of defective surface concrete.

350-15 Joints.

350-15.1 General: Construct joints at the locations and in accordance with the details shown in the Roadway and Traffic Design Standards, Index No. 305 and the Contract Documents.

350-15.2 Longitudinal Joints:

350-15.2.1 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. Where keyways are required, the Contractor may form them by placing an insert of the proper shape along the inside face of the side form or, when using the slip form method of paving, by an approved extrusion device. Use a method that produces a keyway of the shape and at the location indicated in the plans.

350-15.2.2 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 within 72 hours after placing the concrete.

350-15.2.3 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.

350-15.2.4 Longitudinal Shoulder Joints (Concrete to Asphalt): Construct a continuous joint by sawing a groove into the asphalt pavement at the abutment with the concrete pavement. Produce a groove that is 3/4 inch [19 mm] wide and 3/4 inch [19 mm] deep, after sawing and cleaning.

Seal the joint with hot-poured type sealant.

350-15.3 Transverse Joints:

350-15.3.1 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.

350-15.3.2 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 loadtransfer 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 in general when the concrete is between 4 and 12 hours old. Make a second saw cut, to provide the joint dimensions indicated in the plans, as soon as there is no danger of further raveling.

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.

350-15.3.3 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 Roadway and Traffic 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 on the Roadway and Traffic Design Standards.

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.

350-15.4 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 the free end of each dowel with one coat of approved zinc rich paint (listed on the Qualified Products List), and grease it with an approved lubricant, to prevent the concrete from bonding to the dowel. Provide the free end of expansion joint dowels with the closest fitting metal cap or sleeve, equipped with a stop to prevent closing during placement operations. Maintain a clearance of 1 inch [25 mm] between the closed end of the cap and the dowel to accommodate future slab movement.

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].

Provide the Engineer with confirmation of the location of the dowel bars. The Contractor shall confirm that the paving operation has not displaced the dowels from their required positions. Perform confirmation checks daily for the first two days of the paving operation and weekly thereafter.

350-15.5 Expansion Joints Around Structures: 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.

350-15.6 Cleaning Joints and Cracks:

350-15.6.1 Cleaning Joints in New Pavement:

350-15.6.1.1 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.

350-15.6.1.2 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.

350-15.6.2 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.

350-15.6.3 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 350-15.6.2.

350-15.7 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.

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.

350-15.7.1 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 50°F [10°C] or greater.

350-15.7.2 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 40°F [5°C].

350-16 Thickness Determinations.

350-16.1 Core Borings: After completing the concrete pavement, including any corrective work to meet ride requirement, drill cores from the pavement to determine the actual thickness. ~~When the Department is ready to core the finished pavement for thickness, p~~*P*rovide traffic control, coring equipment, and operator to obtain the cores. ~~The Engineer will s~~*S*elect the coring locations and make the ~~acceptance~~ measurements *for thickness determination*. Take borings at random intervals and at various points on the cross-section so that each test boring represents an area not exceeding 2,500 yd^2 [2,000 m^2]. *The Engineer may select the boring locations or measure the thickness for independent verification.*

Replace the portions of the pavement removed by the borings at no expense to the Department.

350-16.2 Method of Calculating Average Thickness: ~~The Department will d~~*D*etermine the average thickness of pavement *in accordance with ASTM C 174* from the length of all cores taken as indicated above and ~~will~~ calculate it as follows:

(a) ~~The Department will~~*Do* 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 as measured by the cores 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 c~~Calculate the average thickness for the entire job as a unit.

350-17 Deficient Thickness.

350-17.1 General: The Department will not pay for any pavement which is more than 1/2 inch [13 mm] less than the specified thickness. 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.

350-17.2 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 deficient area is sufficient to seriously impair the anticipated service life of the pavement, the Contractor shall 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.

350-17.3 Deficient Pavement Left in Place: If the Engineer determines that the deficiency will not seriously impair the anticipated service life of the pavement, the Contractor may elect to leave the pavement in place, but shall receive no compensation for the area of pavement.

350-17.4 Additional Borings: If the Contractor believes that the number of cores taken is not sufficient to indicate the thickness of the pavement, he may request ~~that the Engineer select~~ additional boring locations *with prior approval by the Engineer and bear all cost for these additional boring locations*. ~~The Department will deduct the cost of these additional borings from any sums due the Contractor, unless such borings indicate that the pavement within the questioned area is of specified or greater thickness.~~

350-18 Opening Pavement to Traffic.

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 50°F [10°C]) 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 ~~AASHTO T 23~~*ASTM C 31* and tested in accordance with ~~AASHTO T 97~~*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. Provide protection that includes the erection and maintenance of signs, lights, barricades, etc., the construction and removal of temporary pavement, bridges, crossovers, etc., and the use of flagmen as may be necessary. Arrange the protective measures so as not to interfere with traffic in lanes being utilized for required maintenance of traffic.

Before opening the pavement to traffic, construct an earth berm along each edge. Build the berm to the full height of the pavement and at least 18 inches [0.5 m] wide, and sufficiently compact it to prevent underwash of the pavement. Maintain the berm until completing the final shoulders.

350-19 Method of Measurement.

350-19.1 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 350-17.3 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 asphaltic 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 asphaltic 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.

350-19.2 Joints and Cracks: The Contractor shall 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 that have been 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.

350-20 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.

Judy F Frazier

05/19/2003 11:18 AM

To: bburleson@ftba.com, David Sadler/CO/FDOT, Brian A Blanchard/CO/FDOT, William N Nickas/CO/FDOT, Bruce Dietrich/CO/FDOT, Phillip G Davis/CO/FDOT,
cc: Charles A Ishee/SM/FDOT,
cc:
Subject: D3500000

Please review the attached draft specification and return your approval/comments within one week so that we may continue with the review process. Thank you.

D3500000.doc

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Florida Department of Transportation

JEB BUSH
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JOSE ABREU
SECRETARY

MEMORANDUM

DATE: May 19, 2003

TO: Bob Burleson, FTBA, David Sadler, State Construction Office, Brian Blanchard, State Roadway Design Office, William N. Nickas, State Structures Design Office, Bruce Dietrich, State Pavement Management Office, Greg Davis, State Estimates Office

FROM: Clinton J. Shaw, State Specifications Office

SUBJECT: **Proposed Specification: D3500000**

Attached for your review and comments is a copy of the subject Special Provision for Cement Concrete Pavement.

This change was proposed by Charles Ishee to be more compliant with the Contractor Quality Control guidelines.

Please review and offer your comments.

CS/jf
Attachment

CEMENT CONCRETE PAVEMENT.
(REV 5-13-03)

SECTION 350 (Pages 304-322) 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.

~~For aggregates, proportioning and mixing, and other provisions for the production of the concrete, meet the applicable provisions of Section 346.~~

~~Provide adequate lighting for all work done at night, including finishing, curing, and sawing joints. Unless lighting is provided for finishing, stop construction operations soon enough each day to permit finishing during daylight.~~

~~At least 20 days prior to paving, f~~*F*urnish the following information ~~for the Engineer's review for specification compliance~~*in the Quality Control Plan (QCP) as required in Section 105*:

1. A detailed sequence and schedule of concrete placement operations including, but not necessarily limited to, width of pavement to be placed, proposed equipment, production rates, working hours, concrete hauling, and placement, curing, sawing, and sealing methods.
2. A detailed staking plan for subgrade controls including offset requirements.
3. A traffic control plan for pavement construction operations *that* ~~which~~ 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. *Identify provisions for adequate lighting for all work done at night, including finishing, curing, and sawing joints.*

350-2 Materials.

Meet the following requirements:

Concrete, Class I *(Pavement)*	Section 346
Curing Materials	Section 925
Embedded Items	Section 931
Joint Seal	Section 932

350-3 Equipment.

350-3.1 General: ~~Obtain the Engineer's approval of the equipment and tools to be used for handling materials and performing all parts of the work, as to their design, capacity, and mechanical condition. Deliver the equipment to the job site sufficiently ahead of the start of construction operations to allow the Engineer to examine it thoroughly for approval.~~

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

~~Equip all equipment which operates on the side forms with scraping devices to clean accumulations from the top of the forms and wheels.~~*Provide equipment and tools to be used that meet the following:*

Capable 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.

350-3.2 Equipment For Trimming of Subgrade: For equipment operating on the subgrade, provide an automatically controlled subgrade trimmer. Use a machine that is capable of trimming the subgrade to proper elevation within the tolerances established herein. Provide grade controls that operate by sensing from a taut line, set true to line and grade. Erect and maintain the taut line.

350-3.3 Forms:

350-3.3.1 Form Material: Provide steel forms, except that on curves with a radius of *150 feet [*45 m*]* or less, provide flexible forms, or wooden forms that bend to the required arc.

350-3.3.2 Dimensions: Use forms with a minimum length of 10 feet [3 m], except where they are used on curves having a radius between 150 and 300 feet [45 and 90 m], in which case use a form length of 5 feet [1.5 m]. Use forms with a height that is equal to the edge thickness of the pavement. Use forms with a height greater than the edge thickness, provided the outer portion of the slab is thickened to equal the depth of the form by tapering at the rate of 1 inch *[25 mm]* of the extra thickness per foot [80 mm of the extra thickness per meter] of width. In such case, the Department will make no allowance for additional concrete. Do not use built-up forms.

350-3.3.3 Steel Forms: Use steel forms fabricated into an approved section and sufficiently strong to ensure rigidity under the impact, thrust, and weight of the heaviest equipment to be carried over the forms. Make the width of the base of the forms which is in direct contact with the soil at least equal to the height of the forms, but not less than 8 inches [200 mm]. Extend the flange braces outward on the base not less than two-thirds the height dimension of the form. Use steel forms of a thickness that is not less than 7/32 inch [5.5 mm]. When tested with a 10 foot [3.048 m] straightedge, ensure that the forms have no vertical variation in a 10 foot [3 m] length that is greater than 1/8 inch [3 mm] from a true plane of the surface on the top of the form, and no lateral variation that is greater than 1/4 inch [6 mm] from a true plane surface on the vertical face of the form. Do not use steel forms if, when tested as a simple beam with a span of 9 feet 6 inches [2.9 m] and a load equal to that exerted by construction equipment placed upon them, the deflection is more than 1/4 inch [6 mm].

350-3.3.4 Form Connections: Provide connections between adjacent sections of the form, that form a lock joint, free from vertical movement in excess of 1/8 inch [3 mm] and from horizontal movement in excess of 1/4 inch [6 mm], under the impact, thrust, and weight of the heaviest machine carried on the forms.

350-3.3.5 Defective Forms: Remove bent, twisted, or broken forms, and forms with ~~battered~~ *damaged* top surfaces, from the work. ~~Do not use repaired forms until they are inspected and approved by the Engineer.~~*The use of repaired forms will be based on the final product meeting all applicable contract requirements.*

350-3.3.6 Form Stakes: Provide at least three steel stakes for each 10 foot [3 m] length of form. Use stakes that are of sufficient size to prevent ~~undue~~ lateral movement of the form during paving operations. Fasten each of the stakes to the form by means of a suitable socket attached to the form. Equip each stake socket with steel wedges for securely keying the forms to the stakes. Locate a stake not more than 12 inches [300 mm] from the end of each section. ~~Do not use forms with broken or badly worn sockets.~~

350-3.3.7 Form Tampers: Use adequate mechanical form tampers, capable of thoroughly compacting the soil under the forms, except when the forms rest on a cement-treated subgrade.

350-3.4 Spreader: Provide a mechanical spreader that is independently powered and capable of spreading the mixed concrete on the subgrade over the entire width and depth of the strip being paved in a manner which will prevent segregation of the materials. Use a spreader designed and constructed to permit the concrete to be struck-off to a uniform thickness.

350-3.5 Strike-Off, Consolidation, and Finishing for Fixed-Form Construction: Provide equipment for these operations that consists of a self-propelled unit, or units, that perform the following functions by mechanical means, in the sequence indicated:

(1) Strike-off.
(2) Vibratory Consolidation.
(3) Screeding.
(4) Floating.

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

350-3.6 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 ~~all of this~~*the* equipment is of such dimensions and arrangement as to cover the full width of the pavement strip being *placed*~~laid~~. 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.

Do not use automatic grade controls on the paver when the tracks of the slip-form paver are operating on ~~econocrete base or~~ 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.

~~The Engineer may allow variation from any specific feature of the slip-form paver as detailed above, provided the industry has generally accepted the proposed variation as an improved feature.~~

350-3.7 Vibratory Units: Consolidate the concrete for the full width of the strip being placed with either surface pan type or internal type vibrators.

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.

350-3.8 Mechanical Floating Equipment: Provide equipment that consists of a supplementary self-propelled machine capable of further smoothing the concrete, removing excess mortar from the surface, and minimizing hand finishing.

~~Use a machine that leaves the surface of the concrete 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.~~

350-3.9 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.

The Contractor may use hand power-spray equipment to apply curing compound to areas where it is impracticable to operate the self-propelled equipment.

350-3.10 Equipment for Sealing Joints: Provide equipment for sealing the joints for each section of pavement. Use a heating kettle for hot-poured sealer that is of the indirect heating or double-boiler type, using oil as a heat transfer medium. 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. Use ~~pouring~~ equipment equipped with nozzles that discharge the seal 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 ~~for pouring,~~ within ~~10°F [5°C]~~*the manufacturer's recommendation.*

350-3.11 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. The Contractor may use such equipment as the Engineer may approve for such areas.

350-3.12 Hand Finishing Tools: Provide straightedges that have a blade length of 10 feet [3~~.048~~ 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].

350-3.13 Texturing Machine: Provide a machine that consists of a supplementary machine capable of applying the final finish to the concrete pavement. Apply the finish by rectangular shaped spring steel tines rigidly mounted in a frame operating on an adjustable track mounted under the main frame of the machine. Use a machine that is constructed so as to provide for adjustment of the downward pressure on the tines as necessary to produce the desired finish under varying conditions of the concrete surface.

The Engineer may allow variation from any specific feature of the Texturing Machine as detailed above, provided that the Contractor can produce an equivalent final finish.

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 moist 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.

Have available at the site, at all times when concrete paving operations are underway, materials for the protection of the surface and edges of the unhardened concrete. For the protection of the pavement edges, use ~~any~~ covering material~~, such as burlap, paper, or plastic sheeting material,~~ suitable for the protection of the pavement surface *as identified in the QCP*.

When rain appears imminent, stop all paving operations, and have all available personnel cover the surface of the unhardened concrete with the protective covering.

During periods when the air temperature may fall below 35°F [1°C], ~~advise the Engineer of~~ plans for curing and protecting the fresh concrete *shall be implemented as identified in the QCP* before placing the concrete.~~ Do not place any concrete until the Engineer has approved the proposed methods.~~
~~The Contractor is fully responsible for the quality and strength of the concrete placed in cold weather even if the Engineer approves of the provisions the Contractor employs for protecting the concrete placed during cold weather.~~

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.
Secure the reinforcement in position in advance of concrete placement or~~, with the Engineer's specific approval,~~ place it in the plastic concrete by mechanical or vibratory means after spreading the concrete *as identified in the QCP*. At the time of the concrete placement, ensure that the reinforcing steel is free from dirt, oil, paint, grease, mill scale, and any loose or thick rust which could impair bonding of the steel with the concrete. 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. ~~and t~~*T*he surface will at no point be below the grade specified for the finished surface~~, after application of the allowable tolerance~~. Deposit the concrete on the subgrade in a manner which will require as little rehandling as possible. Continuously place concrete between transverse joints without using intermediate bulkheads.

Deposit concrete as near to expansion and contraction joint assemblies as possible without disturbing them. Do not ~~dump~~*deposit* concrete from the discharge bucket or hopper onto an assembly without centering the bucket or hopper directly over the assembly.

350-8.2 Use of Spreader: Place concrete on the subgrade by an approved spreading device. The Engineer will not require the Contractor to use a spreader for areas where the width of slab varies, for intersections, and for 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*). Ensure that ~~workmen~~ *workers* do not walk in the freshly deposited concrete with *their boots or shoes coated with* earth or other deleterious substances ~~coated on their boots or shoes~~.

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. The Engineer will not require the Contractor to alter placement operations where superelevation reverses the pavement cross slope from that shown on the typical section.

350-8.4 Hours of Operation: Stop placing concrete in time to complete finishing operations during daylight hours, or provide adequate ~~approved~~ lighting *as identified in the QCP*.

350-8.5 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. Do not continue vibration at any one location so long as to produce puddling or the accumulation of excessive grout on the surface.

350-9 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.

350-10 Striking-off, Consolidating, and Finishing Concrete.

350-10.1 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.

Provide a concrete surface true to grade and crown, and free of irregularities. Do not add water to the concrete surface to assist in finishing operations.

350-10.2 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.

350-10.3 Hand Methods:

350-10.3.1 Conditions under which Allowed: The Contractor may use hand methods in areas of narrow width or irregular dimensions, where operation of mechanical equipment is impracticable. In the event that mechanical equipment breaks down, the Contractor may use hand methods to finish only that concrete already deposited on the subgrade when the breakdown occurred.

350-10.3.2 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.

In operation, move the screed forward on the forms with a combined longitudinal and transverse shearing motion, moving always in the direction in which the work is progressing, and manipulate it so that neither end is raised from the side forms during the striking-off process. If necessary, repeat this until the surface is of uniform texture, true to grade and cross-section, and free from porous areas.

350-10.3.3 Consolidation: Use hand-operated spud-type vibrators to consolidate.

350-10.3.4 Floating: Use long-handled floats to float the concrete. Take the necessary care to avoid creating depressions or ridges during this operation.

350-10.4 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.

350-11 Supplemental Floating.

In areas where performing machine strike-off, consolidation, and finishing, further 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. Waste excess mortar beyond the edge of the slab.

350-12 Final Finish.

350-12.1 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.

After applying the burlap drag finish, apply the final finish with the texturing machine. Control the time of applying this finish and the method of operating the texturing machine so as to minimize tearing of surface and unseating of aggregate particles.

Provide a final finish that consists of transverse grooves which are 0.08 to 0.12 inch [2 to 3 mm] in width and 0.10 to 0.15 inch [2.5 to 4 mm] in depth, spaced at random intervals between 1/2 to 1 inch [13 to 25 mm]. Operate the texturing machine in a manner that minimizes the overlapping of subsequent passes of the steel comb. Create short gaps in the grooved finish as necessary to avoid overlap between passes.

In areas of irregular dimensions or narrow widths, where operating the texturing machine is impracticable, the Contractor may apply the finish by approved hand methods that achieve the required finish with a minimum of surface tearing and unseating aggregate particles. Ensure that the surface resulting from this operation is uniform in appearance and free of irregular, rough, or porous areas.

350-12.2 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.

350-13 Curing.

350-13.1 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, the edges of the newly placed concrete in accordance with one or more of the method*s* described below. In ~~all~~ cases *where*~~in which~~ 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 *QCP will be suspended*~~Engineer will order an immediate suspension of concreting operations~~. 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 50°F [10°C].

350-13.2 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}~~0.005 gal/ft^2~~ [~~0.2 L/m^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 manufactures recommendation*~~until the pigment is uniformly dispersed throughout the vehicle~~.

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.

350-13.3 Burlap Mats: ~~Under this method, cover the surfaces to be cured with 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 ~~so as to cause them to remain in intimate contact with the surface being cured,~~ throughout the curing period *to ensure a contact with the surface being cured*. Maintain the mats fully moist and in position for the entire portion of the required ~~burlap~~ curing period.

350-13.4 Removal of Forms: Do not remove forms from freshly placed concrete ~~until it has set~~ 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.

350-14 Surface Requirements.

After *the* curing *period*, ~~remove the curing material (except for the impervious coating), and thoroughly~~ test the surface for pavement surface smoothness in accordance with 352-4(c). Plainly mark all variations from the required tolerances. Where pavement surfaces do not meet the smoothness requirements, the Engineer will require corrective work and retesting to ensure conformity.

Eliminate high spots exceeding 1/8 inch in 10 feet [3.2 mm in 3 m], but not in excess of 0.3 inch in 25 feet [7.6 mm in 7.6 m], by grinding either with an approved machine or with a carborundum brick and water. Do not use bush-hammering or other destructive means for removing irregularities. As directed by the Engineer, retexture corrected high areas to give skid resistance comparable to the surrounding area.

Provide grinding equipment with a power driven self-propelled machine that is specifically designed to grind portland cement concrete pavement, with a minimum of a 3- foot [1- m] wide grinding head and diamond impregnated grinding blades. Produce, by grinding, a pavement surface that is true to grade and uniform in appearance with a longitudinal line type texture. Provide a line type texture that contains parallel longitudinal corrugations that present a narrow ridge corduroy type appearance. Ensure that the peaks of ridges are approximately 1/32 inch [0.8 mm] higher than the bottoms of the grooves with approximately 60 evenly spaced grooves per foot [300 mm].

Operate all milling, cutting, or grinding equipment to produce a reasonably uniform finished surface without spalling the pavement joints within corrected areas. The Engineer will not require extra grinding to eliminate minor depressions in order to provide 100% texturing of the pavement surface. Maintain the cross slope of the pavement as shown in the plans. Repair all joint seals destroyed by grinding at no expense to the Department.

Remove and replace any area of pavement which, after grinding, still shows a deviation in excess of the allowable tolerance. Ensure that the area removed and replaced is the full length between transverse joints and the full width of the lane involved.

Saw the area to be removed to a smooth vertical surface. Clean the face of the adjacent (hardened) concrete, and coat it with an epoxy bonding compound before placing the replacement concrete.

Bear the costs of all surface corrections required and of all required removal and replacement of defective surface concrete.

350-15 Joints.

350-15.1 General: Construct joints at the locations and in accordance with the details shown in the Roadway and Traffic Design Standards, Index No. 305 and the Contract Documents.

350-15.2 Longitudinal Joints:

350-15.2.1 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. Where keyways are required, the Contractor may form them by placing an insert of the proper shape along the inside face of the side form or, when using the slip form method of paving, by an approved extrusion device. Use a method that produces a keyway of the shape and at the location indicated in the plans.

350-15.2.2 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 within 72 hours after placing the concrete.

350-15.2.3 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.

350-15.2.4 Longitudinal Shoulder Joints (Concrete to Asphalt): Construct a continuous joint by sawing a groove into the asphalt pavement at the abutment with the concrete pavement. Produce a groove that is 3/4 inch [19 mm] wide and 3/4 inch [19 mm] deep, after sawing and cleaning.

Seal the joint with hot-poured type sealant.

350-15.3 Transverse Joints:

350-15.3.1 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.

350-15.3.2 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 loadtransfer 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 in general when the concrete is between 4 and 12 hours old. Make a second saw cut, to provide the joint dimensions indicated in the plans, as soon as there is no danger of further raveling.

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.

350-15.3.3 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 Roadway and Traffic 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 on the Roadway and Traffic Design Standards.

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.

350-15.4 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 the free end of each dowel with one coat of approved zinc rich paint (listed on the Qualified Products List), and grease it with an approved lubricant, to prevent the concrete from bonding to the dowel. Provide the free end of expansion joint dowels with the closest fitting metal cap or sleeve, equipped with a stop to prevent closing during placement operations. Maintain a clearance of 1 inch [25 mm] between the closed end of the cap and the dowel to accommodate future slab movement.

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].

Provide the Engineer with confirmation of the location of the dowel bars. The Contractor shall confirm that the paving operation has not displaced the dowels from their required positions. Perform confirmation checks daily for the first two days of the paving operation and weekly thereafter.

350-15.5 Expansion Joints Around Structures: 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.

350-15.6 Cleaning Joints and Cracks:

350-15.6.1 Cleaning Joints in New Pavement:

350-15.6.1.1 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.

350-15.6.1.2 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.

350-15.6.2 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.

350-15.6.3 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 350-15.6.2.

350-15.7 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.

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.

350-15.7.1 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 50°F [10°C] or greater.

350-15.7.2 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 40°F [5°C].

350-16 Thickness Determinations.

350-16.1 Core Borings: After completing the concrete pavement, including any corrective work to meet ride requirement, drill cores from the pavement to determine the actual thickness. ~~When the Department is ready to core the finished pavement for thickness, p~~*P*rovide traffic control, coring equipment, and operator to obtain the cores. ~~The Engineer will s~~*S*elect the coring locations and make the ~~acceptance~~ measurements *for thickness determination*. Take borings at random intervals and at various points on the cross-section so that each test boring represents an area not exceeding 2,500 yd^2 [2,000 m^2]. *The Engineer may select the boring locations or measure the thickness for independent verification.*

Replace the portions of the pavement removed by the borings at no expense to the Department.

350-16.2 Method of Calculating Average Thickness: ~~The Department will d~~*D*etermine the average thickness of pavement *in accordance with ASTM C 174* from the length of all cores taken as indicated above and ~~will~~ calculate it as follows:

(a) ~~The Department will~~*Do* 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 as measured by the cores 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 c~~Calculate the average thickness for the entire job as a unit.

350-17 Deficient Thickness.

350-17.1 General: The Department will not pay for any pavement which is more than 1/2 inch [13 mm] less than the specified thickness. 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.

350-17.2 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 deficient area is sufficient to seriously impair the anticipated service life of the pavement, the Contractor shall 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.

350-17.3 Deficient Pavement Left in Place: If the Engineer determines that the deficiency will not seriously impair the anticipated service life of the pavement, the Contractor may elect to leave the pavement in place, but shall receive no compensation for the area of pavement.

350-17.4 Additional Borings: If the Contractor believes that the number of cores taken is not sufficient to indicate the thickness of the pavement, he may request ~~that the Engineer select~~ additional boring locations *with prior approval by the Engineer and bear all cost for these additional boring locations*. ~~The Department will deduct the cost of these additional borings from any sums due the Contractor, unless such borings indicate that the pavement within the questioned area is of specified or greater thickness.~~

350-18 Opening Pavement to Traffic.

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 50°F [10°C]) 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 ~~AASHTO T 23~~*ASTM C 31* and tested in accordance with ~~AASHTO T 97~~*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. Provide protection that includes the erection and maintenance of signs, lights, barricades, etc., the construction and removal of temporary pavement, bridges, crossovers, etc., and the use of flagmen as may be necessary. Arrange the protective measures so as not to interfere with traffic in lanes being utilized for required maintenance of traffic.

Before opening the pavement to traffic, construct an earth berm along each edge. Build the berm to the full height of the pavement and at least 18 inches [0.5 m] wide, and sufficiently compact it to prevent underwash of the pavement. Maintain the berm until completing the final shoulders.

350-19 Method of Measurement.

350-19.1 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 350-17.3 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 asphaltic 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 asphaltic 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.

350-19.2 Joints and Cracks: The Contractor shall 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 that have been 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.

350-20 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.

Charles A Ishee
05/18/2003 11:08 AM

To: Judy F Frazier/CO/FDOT@FDOT
cc:
Subject: Re: D3500000

Judy:

The attached file looks great to me and I approve. Thank you so much...

Charles A. Ishee, P.E.
Structural Materials Research Engineer
Telephone: 352-337-3254 Cell: 352-339-2376
Email: charles.ishee@dot.state.fl.us
Judy F Frazier

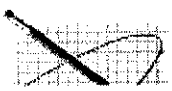
Judy F Frazier
05/13/2003 04:12 PM

To: Charles A Ishee/SM/FDOT@FDOT
cc:
Subject: D3500000

Please review the attached draft specification and return your approval/comments so that we may continue with the review process. Thank you.

D3500000.doc

Judy Frazier
(850) 414-4127, SC 994-4127
judy.frazier@dot.state.fl.us



Clinton Shaw

05/13/2003 01:57 PM

To: Judy F Frazier/CO/FDOT@FDOT
cc: Shirley Harvey/CO/FDOT@FDOT
Subject: D3500000

This change is to update Section 350, to bring it more in agreement with the Contractor Quality Control guidelines

The information is in the develop folder.

Thanks

Clinton J. Shaw
(850) 414-4129 SC 994-4129
Clinton.Shaw@dot.state.fl.us

Judy F Frazier

05/13/2003 03:52 PM

To: Charles A Ishee/SM/FDOT,
cc:
cc:
Subject: D3500000

Please review the attached draft specification and return your approval/comments so that we may continue with the review process. Thank you.

D3500000.doc

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Florida Department of Transportation

JEB BUSH
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

JOSÉ ABREU
SECRETARY

MEMORANDUM

DATE: May 13, 2003

TO: Charles Ishee

FROM: Clinton J. Shaw, State Specifications Office

SUBJECT: **Proposed Specification: D3500000 - Cement Concrete Pavement**

Your proposed specification has been formatted and entered for processing. As the originator for this specification, please review the formatted draft and make any necessary changes.

Additionally, please verify the condition under which this specification is to be used (see usage note under specification number).

If you have any questions, please contact Clinton Shaw at (850) 414-4110 or Suncom 994-4110. Your response within two weeks will be appreciated, as further processing is dependent upon your response. We will continue to update you as we process this request for implementation.

CS/jf
Attachment

CEMENT CONCRETE PAVEMENT.
(REV 5-13-03)

SECTION 350 (Pages 304-322) 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.

~~For aggregates, proportioning and mixing, and other provisions for the production of the concrete, meet the applicable provisions of Section 346.~~

~~Provide adequate lighting for all work done at night, including finishing, curing, and sawing joints. Unless lighting is provided for finishing, stop construction operations soon enough each day to permit finishing during daylight.~~

~~At least 20 days prior to paving, f~~*F*urnish the following information ~~for the Engineer's review for specification compliance~~*in the Quality Control Plan (QCP) as required in Section 105*:

1. A detailed sequence and schedule of concrete placement operations including, but not necessarily limited to, width of pavement to be placed, proposed equipment, production rates, working hours, concrete hauling, and placement, curing, sawing, and sealing methods.
2. A detailed staking plan for subgrade controls including offset requirements.
3. A traffic control plan for pavement construction operations *that* ~~which~~ 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. *Identify provisions for adequate lighting for all work done at night, including finishing, curing, and sawing joints.*

350-2 Materials.

Meet the following requirements:

Concrete, Class I *(Pavement)*	Section 346
Curing Materials	Section 925
Embedded Items	Section 931
Joint Seal	Section 932

350-3 Equipment.

350-3.1 General: ~~Obtain the Engineer's approval of the equipment and tools to be used for handling materials and performing all parts of the work, as to their design, capacity, and mechanical condition. Deliver the equipment to the job site sufficiently ahead of the start of construction operations to allow the Engineer to examine it thoroughly for approval.~~

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

~~Equip all equipment which operates on the side forms with scraping devices to clean accumulations from the top of the forms and wheels.~~*Provide equipment and tools to be used that meet the following:*

Capable 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.

350-3.2 Equipment For Trimming of Subgrade: For equipment operating on the subgrade, provide an automatically controlled subgrade trimmer. Use a machine that is capable of trimming the subgrade to proper elevation within the tolerances established herein. Provide grade controls that operate by sensing from a taut line, set true to line and grade. Erect and maintain the taut line.

350-3.3 Forms:

350-3.3.1 Form Material: Provide steel forms, except that on curves with a radius of *150 feet [*45 m*]* or less, provide flexible forms, or wooden forms that bend to the required arc.

350-3.3.2 Dimensions: Use forms with a minimum length of 10 feet [3 m], except where they are used on curves having a radius between 150 and 300 feet [45 and 90 m], in which case use a form length of 5 feet [1.5 m]. Use forms with a height that is equal to the edge thickness of the pavement. Use forms with a height greater than the edge thickness, provided the outer portion of the slab is thickened to equal the depth of the form by tapering at the rate of 1 inch *[25 mm]* of the extra thickness per foot [80 mm of the extra thickness per meter] of width. In such case, the Department will make no allowance for additional concrete. Do not use built-up forms.

350-3.3.3 Steel Forms: Use steel forms fabricated into an approved section and sufficiently strong to ensure rigidity under the impact, thrust, and weight of the heaviest equipment to be carried over the forms. Make the width of the base of the forms which is in direct contact with the soil at least equal to the height of the forms, but not less than 8 inches [200 mm]. Extend the flange braces outward on the base not less than two-thirds the height dimension of the form. Use steel forms of a thickness that is not less than 7/32 inch [5.5 mm]. When tested with a 10 foot [3.048 m] straightedge, ensure that the forms have no vertical variation in a 10 foot [3 m] length that is greater than 1/8 inch [3 mm] from a true plane of the surface on the top of the form, and no lateral variation that is greater than 1/4 inch [6 mm] from a true plane surface on the vertical face of the form. Do not use steel forms if, when tested as a simple beam with a span of 9 feet 6 inches [2.9 m] and a load equal to that exerted by construction equipment placed upon them, the deflection is more than 1/4 inch [6 mm].

350-3.3.4 Form Connections: Provide connections between adjacent sections of the form, that form a lock joint, free from vertical movement in excess of 1/8 inch [3 mm] and from horizontal movement in excess of 1/4 inch [6 mm], under the impact, thrust, and weight of the heaviest machine carried on the forms.

350-3.3.5 Defective Forms: Remove bent, twisted, or broken forms, and forms with ~~battered~~ *damaged* top surfaces, from the work. ~~Do not use repaired forms until they are inspected and approved by the Engineer.~~*The use of repaired forms will be based on the final product meeting all applicable contract requirements.*

350-3.3.6 Form Stakes: Provide at least three steel stakes for each 10 foot [3 m] length of form. Use stakes that are of sufficient size to prevent ~~undue~~ lateral movement of the form during paving operations. Fasten each of the stakes to the form by means of a suitable socket attached to the form. Equip each stake socket with steel wedges for securely keying the forms to the stakes. Locate a stake not more than 12 inches [300 mm] from the end of each section. ~~Do not use forms with broken or badly worn sockets.~~

350-3.3.7 Form Tampers: Use adequate mechanical form tampers, capable of thoroughly compacting the soil under the forms, except when the forms rest on a cement-treated subgrade.

350-3.4 Spreader: Provide a mechanical spreader that is independently powered and capable of spreading the mixed concrete on the subgrade over the entire width and depth of the strip being paved in a manner which will prevent segregation of the materials. Use a spreader designed and constructed to permit the concrete to be struck-off to a uniform thickness.

350-3.5 Strike-Off, Consolidation, and Finishing for Fixed-Form Construction: Provide equipment for these operations that consists of a self-propelled unit, or units, that perform the following functions by mechanical means, in the sequence indicated:

(1) Strike-off.
(2) Vibratory Consolidation.
(3) Screeding.
(4) Floating.

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

350-3.6 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 ~~all of this~~*the* equipment is of such dimensions and arrangement as to cover the full width of the pavement strip being *placed*~~laid~~. 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.

Do not use automatic grade controls on the paver when the tracks of the slip-form paver are operating on ~~econocrete base or~~ 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.

~~The Engineer may allow variation from any specific feature of the slip-form paver as detailed above, provided the industry has generally accepted the proposed variation as an improved feature.~~

350-3.7 Vibratory Units: Consolidate the concrete for the full width of the strip being placed with either surface pan type or internal type vibrators.

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.

350-3.8 Mechanical Floating Equipment: Provide equipment that consists of a supplementary self-propelled machine capable of further smoothing the concrete, removing excess mortar from the surface, and minimizing hand finishing.

~~Use a machine that leaves the surface of the concrete 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.~~

350-3.9 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.

The Contractor may use hand power-spray equipment to apply curing compound to areas where it is impracticable to operate the self-propelled equipment.

350-3.10 Equipment for Sealing Joints: Provide equipment for sealing the joints for each section of pavement. Use a heating kettle for hot-poured sealer that is of the indirect heating or double-boiler type, using oil as a heat transfer medium. 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. Use ~~pouring~~ equipment equipped with nozzles that discharge the seal 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 ~~for pouring,~~ within ~~10ºF [5ºC]~~*the manufacturer's recommendation*.

350-3.11 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. The Contractor may use such equipment as the Engineer may approve for such areas.

350-3.12 Hand Finishing Tools: Provide straightedges that have a blade length of 10 feet [3~~.048~~ 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].

350-3.13 Texturing Machine: Provide a machine that consists of a supplementary machine capable of applying the final finish to the concrete pavement. Apply the finish by rectangular shaped spring steel tines rigidly mounted in a frame operating on an adjustable track mounted under the main frame of the machine. Use a machine that is constructed so as to provide for adjustment of the downward pressure on the tines as necessary to produce the desired finish under varying conditions of the concrete surface.

The Engineer may allow variation from any specific feature of the Texturing Machine as detailed above, provided that the Contractor can produce an equivalent final finish.

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 moist 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.

Have available at the site, at all times when concrete paving operations are underway, materials for the protection of the surface and edges of the unhardened concrete. For the protection of the pavement edges, use ~~any~~ covering material~~, such as burlap, paper, or plastic sheeting material,~~ suitable for the protection of the pavement surface *as identified in the QCP*.

When rain appears imminent, stop all paving operations, and have all available personnel cover the surface of the unhardened concrete with the protective covering.

During periods when the air temperature may fall below 35°F [1°C], ~~advise the Engineer of~~ plans for curing and protecting the fresh concrete *shall be implemented as identified in the QCP* before placing the concrete.~~ Do not place any concrete until the Engineer has approved the proposed methods.~~
~~The Contractor is fully responsible for the quality and strength of the concrete placed in cold weather even if the Engineer approves of the provisions the Contractor employs for protecting the concrete placed during cold weather.~~

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.
Secure the reinforcement in position in advance of concrete placement or~~, with the Engineer's specific approval,~~ place it in the plastic concrete by mechanical or vibratory means after spreading the concrete *as identified in the QCP*. At the time of the concrete placement, ensure that the reinforcing steel is free from dirt, oil, paint, grease, mill scale, and any loose or thick rust which could impair bonding of the steel with the concrete. 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. ~~and t~~*T*he surface will at no point be below the grade specified for the finished surface~~, after application of the allowable tolerance~~. Deposit the concrete on the subgrade in a manner which will require as little rehandling as possible. Continuously place concrete between transverse joints without using intermediate bulkheads.

Deposit concrete as near to expansion and contraction joint assemblies as possible without disturbing them. Do not ~~dump~~*deposit* concrete from the discharge bucket or hopper onto an assembly without centering the bucket or hopper directly over the assembly.

350-8.2 Use of Spreader: Place concrete on the subgrade by an approved spreading device. The Engineer will not require the Contractor to use a spreader for areas where the width of slab varies, for intersections, and for 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*). Ensure that ~~workmen~~ *workers* do not walk in the freshly deposited concrete with *their boots or shoes coated with* earth or other deleterious substances ~~coated on their boots or shoes~~.

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. The Engineer will not require the Contractor to alter placement operations where superelevation reverses the pavement cross slope from that shown on the typical section.

350-8.4 Hours of Operation: Stop placing concrete in time to complete finishing operations during daylight hours, or provide adequate ~~approved~~ lighting *as identified in the QCP.*

350-8.5 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. Do not continue vibration at any one location so long as to produce puddling or the accumulation of excessive grout on the surface.

350-9 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.

350-10 Striking-off, Consolidating, and Finishing Concrete.

350-10.1 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.

Provide a concrete surface true to grade and crown, and free of irregularities. Do not add water to the concrete surface to assist in finishing operations.

350-10.2 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.

350-10.3 Hand Methods:

350-10.3.1 Conditions under which Allowed: The Contractor may use hand methods in areas of narrow width or irregular dimensions, where operation of mechanical equipment is impracticable. In the event that mechanical equipment breaks down, the Contractor may use hand methods to finish only that concrete already deposited on the subgrade when the breakdown occurred.

350-10.3.2 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.

In operation, move the screed forward on the forms with a combined longitudinal and transverse shearing motion, moving always in the direction in which the work is progressing, and manipulate it so that neither end is raised from the side forms during the striking-off process. If necessary, repeat this until the surface is of uniform texture, true to grade and cross-section, and free from porous areas.

350-10.3.3 Consolidation: Use hand-operated spud-type vibrators to consolidate.

350-10.3.4 Floating: Use long-handled floats to float the concrete. Take the necessary care to avoid creating depressions or ridges during this operation.

350-10.4 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.

350-11 Supplemental Floating.

In areas where performing machine strike-off, consolidation, and finishing, further 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. Waste excess mortar beyond the edge of the slab.

350-12 Final Finish.

350-12.1 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.

After applying the burlap drag finish, apply the final finish with the texturing machine. Control the time of applying this finish and the method of operating the texturing machine so as to minimize tearing of surface and unseating of aggregate particles.

Provide a final finish that consists of transverse grooves which are 0.08 to 0.12 inch [2 to 3 mm] in width and 0.10 to 0.15 inch [2.5 to 4 mm] in depth, spaced at random intervals between 1/2 to 1 inch [13 to 25 mm]. Operate the texturing machine in a manner that minimizes the overlapping of subsequent passes of the steel comb. Create short gaps in the grooved finish as necessary to avoid overlap between passes.

In areas of irregular dimensions or narrow widths, where operating the texturing machine is impracticable, the Contractor may apply the finish by approved hand methods that achieve the required finish with a minimum of surface tearing and unseating aggregate particles. Ensure that the surface resulting from this operation is uniform in appearance and free of irregular, rough, or porous areas.

350-12.2 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.

350-13 Curing.

350-13.1 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, the edges of the newly placed concrete in accordance with one or more of the methods described below. In ~~all~~ cases *where* ~~in which~~ 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 *QCP will be suspended* ~~Engineer will order an immediate suspension of concreting operations~~. 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 50°F [10°C].

350-13.2 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} ~~0.005 gal/ft^2~~ [~~0.2 L/m^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 manufactures recommendation* ~~until the pigment is uniformly dispersed throughout the vehicle~~.

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.

350-13.3 Burlap Mats: ~~Under this method, cover the surfaces to be cured with 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 ~~so as to cause them to remain in intimate contact with the surface being cured,~~ throughout the curing period *to ensure a contact with the surface being cured.* Maintain the mats fully moist and in position for the entire portion of the required ~~burlap~~ curing period.

350-13.4 Removal of Forms: Do not remove forms from freshly placed concrete ~~until it has set~~ 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.

350-14 Surface Requirements.

After *the* curing *period,* ~~remove the curing material (except for the impervious coating), and thoroughly~~ test the surface for pavement surface smoothness in accordance with 352-4(c). Plainly mark all variations from the required tolerances. Where pavement surfaces do not meet the smoothness requirements, the Engineer will require corrective work and retesting to ensure conformity.

Eliminate high spots exceeding 1/8 inch in 10 feet [3.2 mm in 3 m], but not in excess of 0.3 inch in 25 feet [7.6 mm in 7.6 m], by grinding either with an approved machine or with a carborundum brick and water. Do not use bush-hammering or other destructive means for removing irregularities. As directed by the Engineer, retexture corrected high areas to give skid resistance comparable to the surrounding area.

Provide grinding equipment with a power driven self-propelled machine that is specifically designed to grind portland cement concrete pavement, with a minimum of a 3- foot [1- m] wide grinding head and diamond impregnated grinding blades. Produce, by grinding, a pavement surface that is true to grade and uniform in appearance with a longitudinal line type texture. Provide a line type texture that contains parallel longitudinal corrugations that present a narrow ridge corduroy type appearance. Ensure that the peaks of ridges are approximately 1/32 inch [0.8 mm] higher than the bottoms of the grooves with approximately 60 evenly spaced grooves per foot [300 mm].

Operate all milling, cutting, or grinding equipment to produce a reasonably uniform finished surface without spalling the pavement joints within corrected areas. The Engineer will not require extra grinding to eliminate minor depressions in order to provide 100% texturing of the pavement surface. Maintain the cross slope of the pavement as shown in the plans. Repair all joint seals destroyed by grinding at no expense to the Department.

Remove and replace any area of pavement which, after grinding, still shows a deviation in excess of the allowable tolerance. Ensure that the area removed and replaced is the full length between transverse joints and the full width of the lane involved.

Saw the area to be removed to a smooth vertical surface. Clean the face of the adjacent (hardened) concrete, and coat it with an epoxy bonding compound before placing the replacement concrete.

Bear the costs of all surface corrections required and of all required removal and replacement of defective surface concrete.

350-15 Joints.

350-15.1 General: Construct joints at the locations and in accordance with the details shown in the Roadway and Traffic Design Standards, Index No. 305 and the Contract Documents.

350-15.2 Longitudinal Joints:

350-15.2.1 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. Where keyways are required, the Contractor may form them by placing an insert of the proper shape along the inside face of the side form or, when using the slip form method of paving, by an approved extrusion device. Use a method that produces a keyway of the shape and at the location indicated in the plans.

350-15.2.2 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 within 72 hours after placing the concrete.

350-15.2.3 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.

350-15.2.4 Longitudinal Shoulder Joints (Concrete to Asphalt): Construct a continuous joint by sawing a groove into the asphalt pavement at the abutment with the concrete pavement. Produce a groove that is 3/4 inch [19 mm] wide and 3/4 inch [19 mm] deep, after sawing and cleaning.

Seal the joint with hot-poured type sealant.

350-15.3 Transverse Joints:

350-15.3.1 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.

350-15.3.2 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 loadtransfer 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 in general when the concrete is between 4 and 12 hours old. Make a second saw cut, to provide the joint dimensions indicated in the plans, as soon as there is no danger of further raveling.

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.

350-15.3.3 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 Roadway and Traffic 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 on the Roadway and Traffic Design Standards.

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.

350-15.4 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 the free end of each dowel with one coat of approved zinc rich paint (listed on the Qualified Products List), and grease it with an approved lubricant, to prevent the concrete from bonding to the dowel. Provide the free end of expansion joint dowels with the closest fitting metal cap or sleeve, equipped with a stop to prevent closing during placement operations. Maintain a clearance of 1 inch [25 mm] between the closed end of the cap and the dowel to accommodate future slab movement.

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].

Provide the Engineer with confirmation of the location of the dowel bars. The Contractor shall confirm that the paving operation has not displaced the dowels from their required positions. Perform confirmation checks daily for the first two days of the paving operation and weekly thereafter.

350-15.5 Expansion Joints Around Structures: 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.

350-15.6 Cleaning Joints and Cracks:

350-15.6.1 Cleaning Joints in New Pavement:

350-15.6.1.1 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.

350-15.6.1.2 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.

350-15.6.2 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.

350-15.6.3 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 350-15.6.2.

350-15.7 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.

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.

350-15.7.1 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 50°F [10°C] or greater.

350-15.7.2 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 40°F [5°C].

350-16 Thickness Determinations.

350-16.1 Core Borings: After completing the concrete pavement, including any corrective work to meet ride requirement, drill cores from the pavement to determine the actual thickness. ~~When the Department is ready to core the finished pavement for thickness, p~~*P*rovide traffic control, coring equipment, and operator to obtain the cores. ~~The Engineer will s~~*S*elect the coring locations and make the ~~acceptance~~ measurements *for thickness determination*. Take borings at random intervals and at various points on the cross-section so that each test boring represents an area not exceeding 2,500 yd^2 [2,000 m^2]. *The Engineer may select the boring locations or measure the thickness for independent verification.*

Replace the portions of the pavement removed by the borings at no expense to the Department.

350-16.2 Method of Calculating Average Thickness: ~~The Department will d~~*D*etermine the average thickness of pavement *in accordance with ASTM C 174* from the length of all cores taken as indicated above and ~~will~~ calculate it as follows:

(a) ~~The Department will~~*Do* 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 as measured by the cores 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 c~~Calculate the average thickness for the entire job as a unit.

350-17 Deficient Thickness.

350-17.1 General: The Department will not pay for any pavement which is more than 1/2 inch [13 mm] less than the specified thickness. 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.

350-17.2 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 deficient area is sufficient to seriously impair the anticipated service life of the pavement, the Contractor shall 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.

350-17.3 Deficient Pavement Left in Place: If the Engineer determines that the deficiency will not seriously impair the anticipated service life of the pavement, the Contractor may elect to leave the pavement in place, but shall receive no compensation for the area of pavement.

350-17.4 Additional Borings: If the Contractor believes that the number of cores taken is not sufficient to indicate the thickness of the pavement, he may request ~~that the Engineer select~~ additional boring locations *with prior approval by the Engineer and bear all cost for these additional boring locations*. ~~The Department will deduct the cost of these additional borings from any sums due the Contractor, unless such borings indicate that the pavement within the questioned area is of specified or greater thickness.~~

350-18 Opening Pavement to Traffic.

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 50°F [10°C]) 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 ~~AASHTO T 23~~*ASTM C 31* and tested in accordance with ~~AASHTO T 97~~*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. Provide protection that includes the erection and maintenance of signs, lights, barricades, etc., the construction and removal of temporary pavement, bridges, crossovers, etc., and the use of flagmen as may be necessary. Arrange the protective measures so as not to interfere with traffic in lanes being utilized for required maintenance of traffic.

Before opening the pavement to traffic, construct an earth berm along each edge. Build the berm to the full height of the pavement and at least 18 inches [0.5 m] wide, and sufficiently compact it to prevent underwash of the pavement. Maintain the berm until completing the final shoulders.

350-19 Method of Measurement.

350-19.1 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 350-17.3 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 asphaltic 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 asphaltic 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.

350-19.2 Joints and Cracks: The Contractor shall 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 that have been 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.

350-20 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.

ORIGINATION FORM

THE INFORMATION BELOW IS TO BE PROVIDED BY THE ORIGINATOR
(The person who receives or originates the issue and needs to forward the issue for action.)

■ Modify Specification 350.
Section/File number

☐ New Section _____.
Section number

Subject: Cement Concrete Pavement

Origination date: April 24, 2003

Originator: Charles A. Ishee
Office/Phone: State Materials Office/352-337-3254
Email address/ Userid: charles.ishee@dot.state.fl.us

Problem statement: Section 350 needs to be more in agreement with the Contractor Quality Control guidelines.

Information source: Information for this section was provided from Pavement Evaluation, Concrete Field Operations and Physical Laboratory at the State Materials Office. State Construction Office provided additional information.

Background data: With the Department's move toward having the Contractor ensure a higher level of materials and quality of control on those materials, many specifications have be updated in recent years to meet this requirement. This Section is being updated to meet those requirements to get a better quality control of materials on Department projects.

Desired implementation date: Beginning with the January 2004 letting.

SPECIFICATION PROCESSING AND STATUS FORM

Begin date: May 13, 2003

File Number: D3500000

Projected completion date: August 12, 2003.

Implementation team member: Judy Frazier.

Schedule of activities: Internal, Industry and FHWA reviews.

Resource needs: None identified at this time.

Implementation schedule: Beginning with the January 2004 letting.

Proposed solution: Modify Section 350 to bring it more in agreement with the Contractor Quality Control guidelines.

Recommended Usage Note: Jobs with cement concrete pavement.

Progress report: What is the current status of the issue? Detail problems encountered, that hinders the process.

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.

~~For aggregates, proportioning and mixing, and other provisions for the production of the concrete, meet the applicable provisions of Section 346.~~

~~Provide adequate lighting for all work done at night, including finishing, curing, and sawing joints. Unless lighting is provided for finishing, stop construction operations soon enough each day to permit finishing during daylight.~~

~~At least 20 days prior to paving, f~~Furnish the following information ~~for the Engineer's review for specification compliance~~*in the Quality Control Plan (QCP) as required in Section 105*:

1. A detailed sequence and schedule of concrete placement operations including, but not necessarily limited to, width of pavement to be placed, proposed equipment, production rates, working hours, concrete hauling, and placement, curing, sawing, and sealing methods.
2. A detailed staking plan for subgrade controls including offset requirements.
3. A traffic control plan for pavement construction operations *that* ~~*which*~~ 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. *Identify provisions for adequate lighting for all work done at night, including finishing, curing, and sawing joints.*

350-2 Materials.

Meet the following requirements:

Concrete, Class I *(Pavement)*.....

Section 346

Curing Materials..... Section 925
Embedded Items..... Section 931
Joint Seal..... Section 932

350-3 Equipment.

350-3.1 General: ~~Obtain the Engineer's approval of the equipment and tools to be used for handling materials and performing all parts of the work, as to their design, capacity, and mechanical condition. Deliver the equipment to the job site sufficiently ahead of the start of construction operations to allow the Engineer to examine it thoroughly for approval.~~

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

~~Equip all equipment which operates on the side forms with scraping devices to clean accumulations from the top of the forms and wheels.~~

Provide equipment and tools to be used that meet the following:

1. *Capable of handling materials and performing all parts of the work.*
2. *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.*

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

350-3.2 Equipment For Trimming of Subgrade: For equipment operating on the subgrade, provide an automatically controlled subgrade trimmer. Use a machine that is capable of trimming the subgrade to proper elevation within the tolerances established herein. Provide grade controls that operate by sensing from a taut line, set true to line and grade. Erect and maintain the taut line.

350-3.3 Forms:

350-3.3.1 Form Material: Provide steel forms, except that on curves with a radius of *150 feet [*45 m*]* or less, provide flexible forms, or wooden forms that bend to the required arc.

350-3.3.2 Dimensions: Use forms with a minimum length of 10 feet [3 m], except where they are used on curves having a radius between 150 and 300 feet [45 and 90 m], in which case use a form length of 5 feet [1.5 m]. Use forms with a height that is equal to the edge thickness of the pavement. Use forms with a height greater than the edge thickness, provided the outer portion of the slab is thickened to equal the depth of the form by tapering at the rate of 1 inch *[25 mm]* of the extra thickness per foot [80 mm of the extra thickness per meter] of width. In such case, the Department will make no allowance for additional concrete. Do not use built-up forms.

350-3.3.3 Steel Forms: Use steel forms fabricated into an approved section and sufficiently strong to ensure rigidity under the impact, thrust, and weight of the heaviest equipment to be carried over the forms. Make the width of the base of the forms which is in direct contact with the soil at least equal to the height of the forms, but not less than 8 inches [200 mm]. Extend the flange braces outward on the base not less than two-thirds the height dimension of the form. Use steel forms of a thickness that is not less than 7/32 inch [5.5 mm]. When tested with a 10 foot [3.048 m] straightedge, ensure that the forms have no vertical variation in a 10 foot [3 m] length that is greater than 1/8 inch [3 mm] from a true plane of the surface on the top of the form, and no lateral variation that is greater than 1/4 inch [6 mm] from a true plane surface on the vertical face of the form. Do not use steel forms if, when tested as a simple beam with a span of 9 feet 6 inches [2.9 m] and a load equal to that exerted by construction equipment placed upon them, the deflection is more than 1/4 inch [6 mm].

350-3.3.4 Form Connections: Provide connections between adjacent sections of the form, that form a lock joint, free from vertical movement in excess of 1/8 inch [3 mm] and from horizontal movement in excess of 1/4 inch [6 mm], under the impact, thrust, and weight of the heaviest machine carried on the forms.

350-3.3.5 Defective Forms: Remove bent, twisted, or broken forms, and forms with ~~battered~~ *damaged* top surfaces, from the work. ~~Do not use repaired forms until they are inspected and approved by the Engineer.~~*The use of repaired forms will be based on the final product meeting all applicable contract requirements.*

350-3.3.6 Form Stakes: Provide at least three steel stakes for each 10 foot [3 m] length of form. Use stakes that are of sufficient size to prevent ~~undue~~ lateral movement of the form during paving operations. Fasten each of the stakes to the form by means of a suitable socket attached to the form. Equip each stake socket with steel wedges for securely keying the forms to the stakes. Locate a stake not more than 12 inches [300 mm] from the end of each section. ~~Do not use forms with broken or badly worn sockets.~~

350-3.3.7 Form Tampers: Use adequate mechanical form tampers, capable of thoroughly compacting the soil under the forms, except when the forms rest on a cement-treated subgrade.

350-3.4 Spreader: Provide a mechanical spreader that is independently powered and capable of spreading the mixed concrete on the subgrade over the entire width and depth of the strip being paved in a manner which will prevent segregation of the materials. Use a spreader designed and constructed to permit the concrete to be struck-off to a uniform thickness.

350-3.5 Strike-Off, Consolidation, and Finishing for Fixed-Form Construction: Provide equipment for these operations that consists of a self-propelled unit, or units, that perform the following functions by mechanical means, in the sequence indicated:

(1) Strike-off.
(2) Vibratory Consolidation.
(3) Screeding.
(4) Floating.

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

350-3.6 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 ~~all of this~~*the* equipment is of such dimensions and arrangement as to cover the full width of the pavement strip being *placed*~~laid~~. 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.

Do not use automatic grade controls on the paver when the tracks of the slip-form paver are operating on ~~econocrete base or~~ 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.

~~The Engineer may allow variation from any specific feature of the slip-form paver as detailed above, provided the industry has generally accepted the proposed variation as an improved feature.~~

350-3.7 Vibratory Units: Consolidate the concrete for the full width of the strip being placed with either surface pan type or internal type vibrators.

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.

350-3.8 Mechanical Floating Equipment: Provide equipment that consists of a supplementary self-propelled machine capable of further smoothing the concrete, removing excess mortar from the surface, and minimizing hand finishing.

~~Use a machine that leaves the surface of the concrete 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.~~

350-3.9 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.

The Contractor may use hand power-spray equipment to apply curing compound to areas where it is impracticable to operate the self-propelled equipment.

350-3.10 Equipment for Sealing Joints: Provide equipment for sealing the joints for each section of pavement. Use a heating kettle for hot-poured sealer that is of the indirect heating or double-boiler type, using oil as a heat transfer medium. 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. Use ~~pouring~~ equipment equipped with nozzles that discharge the seal 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 ~~for pouring,~~ within ~~10°F [5°C]~~*the manufacturer's recommendation*.

350-3.11 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. The Contractor may use such equipment as the Engineer may approve for such areas.

350-3.12 Hand Finishing Tools: Provide straightedges that have a blade length of 10 feet [3~~.048~~ 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].

350-3.13 Texturing Machine: Provide a machine that consists of a supplementary machine capable of applying the final finish to the concrete pavement. Apply the finish by rectangular shaped spring steel tines rigidly mounted in a frame operating on an adjustable track mounted under the main frame of the machine. Use a machine that is constructed so as to provide for adjustment of the downward pressure on the tines as necessary to produce the desired finish under varying conditions of the concrete surface.

The Engineer may allow variation from any specific feature of the Texturing Machine as detailed above, provided that the Contractor can produce an equivalent final finish.

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 moist 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.

Have available at the site, at all times when concrete paving operations are underway, materials for the protection of the surface and edges of the unhardened concrete. For the protection of the pavement edges, use ~~any~~ covering material~~, such as burlap, paper, or plastic sheeting material,~~ suitable for the protection of the pavement surface *as identified in the QCP*.

When rain appears imminent, stop all paving operations, and have all available personnel cover the surface of the unhardened concrete with the protective covering.

During periods when the air temperature may fall below 35°F [1°C], ~~*advise the Engineer of*~~ plans for curing and protecting the fresh concrete *shall be implemented as identified in the QCP* before placing the concrete. ~~*Do not place any concrete until the Engineer has approved the proposed methods*~~.

~~The Contractor is fully responsible for the quality and strength of the concrete placed in cold weather even if the Engineer approves of the provisions the Contractor employs for protecting the concrete placed during cold weather.~~

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.

Secure the reinforcement in position in advance of concrete placement or~~, with the Engineer's specific approval,~~ place it in the plastic concrete by mechanical or vibratory means after spreading the concrete *as identified in the QCP*. At the time of the concrete placement, ensure that the reinforcing steel is free from dirt, oil, paint, grease, mill scale, and any loose or thick rust which could impair bonding of the steel with the concrete. 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. ~~and t~~*T*he surface will at no point be below the grade specified for the finished surface~~, after application of the allowable tolerance~~. Deposit the concrete on the subgrade in a manner which will require as little rehandling as possible. Continuously place concrete between transverse joints without using intermediate bulkheads.

Deposit concrete as near to expansion and contraction joint assemblies as possible without disturbing them. Do not ~~dump~~*deposit* concrete from the discharge bucket or hopper onto an assembly without centering the bucket or hopper directly over the assembly.

350-8.2 Use of Spreader: Place concrete on the subgrade by an approved spreading device. The Engineer will not require the Contractor to use a spreader for areas where the width of slab varies, for intersections, and for 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*). Ensure that ~~*workmen*~~ *workers* do not walk in the freshly deposited concrete with *their boots or shoes coated with* earth or other deleterious substances ~~*coated on their boots or shoes*~~.

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. The Engineer will not require the Contractor to alter placement operations where superelevation reverses the pavement cross slope from that shown on the typical section.

350-8.4 Hours of Operation: Stop placing concrete in time to complete finishing operations during daylight hours, or provide adequate ~~*approved*~~ lighting *as identified in the QCP*.

350-8.5 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. Do not continue vibration at any one location so long as to produce puddling or the accumulation of excessive grout on the surface.

350-9 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.

350-10 Striking-off, Consolidating, and Finishing Concrete.

350-10.1 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.

Provide a concrete surface true to grade and crown, and free of irregularities. Do not add water to the concrete surface to assist in finishing operations.

350-10.2 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.

350-10.3 Hand Methods:

350-10.3.1 Conditions under which Allowed: The Contractor may use hand methods in areas of narrow width or irregular dimensions, where operation of mechanical equipment is impracticable. In the event that mechanical equipment breaks down, the Contractor may use hand methods to finish only that concrete already deposited on the subgrade when the breakdown occurred.

350-10.3.2 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.

In operation, move the screed forward on the forms with a combined longitudinal and transverse shearing motion, moving always in the direction in which the work is progressing, and manipulate it so that neither end is raised from the side forms during the striking-off process. If necessary, repeat this until the surface is of uniform texture, true to grade and cross-section, and free from porous areas.

350-10.3.3 Consolidation: Use hand-operated spud-type vibrators to consolidate.

350-10.3.4 Floating: Use long-handled floats to float the concrete. Take the necessary care to avoid creating depressions or ridges during this operation.

350-10.4 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.

350-11 Supplemental Floating.

In areas where performing machine strike-off, consolidation, and finishing, further 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. Waste excess mortar beyond the edge of the slab.

350-12 Final Finish.

350-12.1 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.

After applying the burlap drag finish, apply the final finish with the texturing machine. Control the time of applying this finish and the method of operating the texturing machine so as to minimize tearing of surface and unseating of aggregate particles.

Provide a final finish that consists of transverse grooves which are 0.08 to 0.12 inch [2 to 3 mm] in width and 0.10 to 0.15 inch [2.5 to 4 mm] in depth, spaced at random intervals between 1/2 to 1 inch [13 to 25 mm]. Operate the texturing machine in a manner that minimizes the overlapping of subsequent passes of the steel comb. Create short gaps in the grooved finish as necessary to avoid overlap between passes.

In areas of irregular dimensions or narrow widths, where operating the texturing machine is impracticable, the Contractor may apply the finish by approved hand methods that achieve the required finish with a minimum of surface tearing and unseating aggregate particles. Ensure that the surface resulting from this operation is uniform in appearance and free of irregular, rough, or porous areas.

350-12.2 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.

350-13 Curing.

350-13.1 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, the edges of the newly placed concrete in accordance with one or more of the methods described below. In ~~all~~ cases *where* ~~in which~~ 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 *QCP will be suspended* ~~Engineer will order an immediate suspension of concreting operations~~. 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 50°F [10°C].

350-13.2 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 *1gallon to every 200 ft²*~~0.005 gal/ft²~~ [~~0.2 L/m²~~*1 liter to every 5 m²*], by a mechanical sprayer.

At the time of use, thoroughly mix the compound *in accordance with the manufactures recommendation*~~until the pigment is uniformly dispersed throughout the vehicle~~.

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.

350-13.3 Burlap Mats: ~~Under this method, cover the surfaces to be cured with 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 ~~so as to cause them to remain in intimate contact with the surface being cured,~~ throughout the curing period *to ensure a contact with the surface being cured.* Maintain the mats fully moist and in position for the entire portion of the required ~~burlap~~ curing period.

350-13.4 Removal of Forms: Do not remove forms from freshly placed concrete ~~until it has set~~ 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.

350-14 Surface Requirements.

After *the* curing *period,* ~~remove the curing material (except for the impervious coating), and thoroughly~~ test the surface for pavement surface smoothness in accordance with 352-4(c). Plainly mark all variations from the required tolerances. Where pavement surfaces do not meet the smoothness requirements, the Engineer will require corrective work and retesting to ensure conformity.

Eliminate high spots exceeding 1/8 inch in 10 feet [3.2 mm in 3 m], but not in excess of 0.3 inch in 25 feet [7.6 mm in 7.6 m], by grinding either with an approved machine or with a carborundum brick and water. Do not use bush-hammering or other destructive means for removing irregularities. As directed by the Engineer, retexture corrected high areas to give skid resistance comparable to the surrounding area.

Provide grinding equipment with a power driven self-propelled machine that is specifically designed to grind portland cement concrete pavement, with a minimum of a 3 foot [1 m] wide grinding head and diamond impregnated grinding blades. Produce, by grinding, a pavement surface that is true to grade and uniform in appearance with a longitudinal line type texture. Provide a line type texture that contains parallel longitudinal corrugations that present a narrow ridge corduroy type appearance. Ensure that the peaks of ridges are approximately 1/32 inch [0.8 mm] higher than the bottoms of the grooves with approximately 60 evenly spaced grooves per foot [300 mm].

Operate all milling, cutting, or grinding equipment to produce a reasonably uniform finished surface without spalling the pavement joints within corrected areas. The Engineer will not require extra grinding to eliminate minor depressions in order to provide 100% texturing of the pavement surface. Maintain the cross slope of the pavement as shown in the plans. Repair all joint seals destroyed by grinding at no expense to the Department.

Remove and replace any area of pavement which, after grinding, still shows a deviation in excess of the allowable tolerance. Ensure that the area removed and replaced is the full length between transverse joints and the full width of the lane involved.

Saw the area to be removed to a smooth vertical surface. Clean the face of the adjacent (hardened) concrete, and coat it with an epoxy bonding compound before placing the replacement concrete.

Bear the costs of all surface corrections required and of all required removal and replacement of defective surface concrete.

350-15 Joints.

350-15.1 General: Construct joints at the locations and in accordance with the details shown in the Roadway and Traffic Design Standards, Index No. 305 and the Contract Documents.

350-15.2 Longitudinal Joints:

350-15.2.1 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. Where keyways are required, the Contractor may form them by placing an insert of the proper shape along the inside face of the side form or, when using the slip form method of paving, by an approved extrusion device. Use a method that produces a keyway of the shape and at the location indicated in the plans.

350-15.2.2 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 within 72 hours after placing the concrete.

350-15.2.3 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.

350-15.2.4 Longitudinal Shoulder Joints (Concrete to Asphalt): Construct a continuous joint by sawing a groove into the asphalt pavement at the abutment with the concrete pavement. Produce a groove that is 3/4 inch [19 mm] wide and 3/4 inch [19 mm] deep, after sawing and cleaning.

Seal the joint with hot-poured type sealant.

350-15.3 Transverse Joints:

350-15.3.1 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.

350-15.3.2 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 loadtransfer 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 in general when the concrete is between 4 and 12 hours old. Make a second saw cut, to provide the joint dimensions indicated in the plans, as soon as there is no danger of further raveling.

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.

350-15.3.3 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 Roadway and Traffic 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 on the Roadway and Traffic Design Standards.

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.

350-15.4 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 the free end of each dowel with one coat of approved zinc rich paint (listed on the Qualified Products List), and grease it with an approved lubricant, to prevent the concrete from bonding to the dowel. Provide the free end of expansion joint dowels with the closest fitting metal cap or sleeve, equipped with a stop to prevent closing during placement operations. Maintain a clearance of 1 inch [25 mm] between the closed end of the cap and the dowel to accommodate future slab movement.

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].

Provide the Engineer with confirmation of the location of the dowel bars. The Contractor shall confirm that the paving operation has not displaced the dowels from their required positions. Perform confirmation checks daily for the first two days of the paving operation and weekly thereafter.

350-15.5 Expansion Joints Around Structures: 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.

350-15.6 Cleaning Joints and Cracks:

350-15.6.1 Cleaning Joints in New Pavement:

350-15.6.1.1 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.

350-15.6.1.2 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.

350-15.6.2 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.

350-15.6.3 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 350-15.6.2.

350-15.7 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.

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.

350-15.7.1 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 50°F [10°C] or greater.

350-15.7.2 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 40°F [5°C].

350-16 Thickness Determinations.

350-16.1 Core Borings: After completing the concrete pavement, including any corrective work to meet ride requirement, drill cores from the pavement to determine the actual thickness. ~~When the *Department* is ready to core the finished pavement for thickness, p~~*P*rovide traffic control, coring equipment, and operator to obtain the cores. ~~The Engineer will s~~*S*elect the coring locations and make the ~~acceptance~~ measurements *for thickness determination*. Take borings at random intervals and at various points on the cross-section so that each test boring represents an area not exceeding 2,500 yd^2 [2,000 m^2]. *The Engineer may select the boring locations or measure the thickness for independent verification.*

Replace the portions of the pavement removed by the borings at no expense to the Department.

350-16.2 Method of Calculating Average Thickness: ~~The Department will d~~*D*etermine the average thickness of pavement *in accordance with ASTM C 174* from the length of all cores taken as indicated above and ~~will~~ calculate it as follows:

(a) ~~The Department will~~*Do* 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 as measured by the cores 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 e~~*C*alculate the average thickness for the entire job as a unit.

350-17 Deficient Thickness.

350-17.1 General: The Department will not pay for any pavement which is more than 1/2 inch [13 mm] less than the specified thickness. 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.

350-17.2 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 deficient area is sufficient to seriously impair the anticipated service life of the pavement, the Contractor shall 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.

350-17.3 Deficient Pavement Left in Place: If the Engineer determines that the deficiency will not seriously impair the anticipated service life of the pavement, the Contractor may elect to leave the pavement in place, but shall receive no compensation for the area of pavement.

350-17.4 Additional Borings: If the Contractor believes that the number of cores taken is not sufficient to indicate the thickness of the pavement, he may request ~~that the Engineer select~~ additional boring locations *with prior approval by the Engineer and bear all cost for these additional boring locations.* ~~The Department will deduct the cost of these additional borings from any sums due the Contractor, unless such borings indicate that the pavement within the questioned area is of specified or greater thickness.~~

350-18 Opening Pavement to Traffic.

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 50°F [10°C]) 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 ~~AASHTO T 23~~*ASTM C 31* and tested in accordance with ~~AASHTO T 97~~*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. Provide protection that includes the erection and maintenance of signs, lights, barricades, etc., the construction and removal of temporary pavement, bridges, crossovers, etc., and the use of flagmen as may be necessary. Arrange the protective measures so as not to interfere with traffic in lanes being utilized for required maintenance of traffic.

Before opening the pavement to traffic, construct an earth berm along each edge. Build the berm to the full height of the pavement and at least 18 inches [0.5 m] wide, and sufficiently compact it to prevent underwash of the pavement. Maintain the berm until completing the final shoulders.

350-19 Method of Measurement.

350-19.1 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 350-17.3 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 asphaltic 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~~ic~~ concrete surface course constructed in accordance with Section 33*14*. Reinforcing steel, placed and accepted, will be measured and paid for as provided in Section 415.

350-19.2 Joints and Cracks: The Contractor shall 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 that have been 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.

350-20 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.