

SECTION 02651**PLAIN AND REINFORCED PORTLAND CEMENT CONCRETE PAVEMENTS****02651.01 GENERAL****A. Description**

Plain and reinforced Portland cement concrete pavements shall include, but not necessarily be limited to, the construction of Portland cement concrete pavements on a prepared subgrade or base in accordance with the Contract Documents.

B. Related Work Included Elsewhere

1. Subgrade preparation; Section 02610.
2. Aggregate base and subbase courses; Section 02621.
3. Stabilized aggregate base course; Section 02622.
4. Portland cement concrete; Section 03310.

C. Quality Assurance

1. Materials

The Engineer will inspect all material and equipment to ensure compliance with the Contract Documents.

2. Field Tests

a. Concrete Tests

The Engineer will conduct normal concrete job control tests, i.e., slump and air content, on the plastic concrete and will prepare test cylinders in accordance with Section 03310.01.

b. Forms

The Engineer will inspect all forms prior to the placing of concrete in accordance with Section 02651.03.

c. Finished Surface

The finished surface of the slab shall be checked in the longitudinal and transverse directions with a 10 foot straightedge, equipped with a 1/8 inch high block on each end. (For slabs on vertical curves, the longitudinal checking template shall be advanced longitudinally in steps not greater than 5 feet.) If any portion of the slab deviates more than the 1/8 inch

tolerance previously stipulated, the corrective work shall be done at the Contractor's expense. Any slabs which are found to have less thickness than that shown on the Plans may be rejected. Also see Section 02651.03, Article L.

d. Thickness Tolerance

- 1) Slab thickness shown on the Plans shall not be reduced, and no deviation greater than 1/8 inch from the road surface diagram on the Plans will be permitted. Furthermore, the surface shall not deviate in a longitudinal direction more than 1/8 inch per 10 feet from a straight line for tangent grades. For roadways on vertical curves, the deviation (from the curve specified) shall not exceed 1/8 inch per 10 feet in a longitudinal direction.
- 2) After the paving is placed and before final acceptance, the thickness will be determined by the Engineer by use of cores cut from the paving in accordance with AASHTO T 24 and measured in accordance with AASHTO T 148.
- 3) The County will not be liable for excess thickness. When the thickness of a pavement is deficient by more than 1.00 inch, the full section between limits established by the Engineer shall be removed and replaced by the Contractor at the Contractor's expense. Core drilling and repairing of the replaced pavement shall be at the Contractor's expense.

D. Submittals

1. Shop Drawings

Shop drawings for Portland cement concrete shall be submitted as specified in Section 03310.01.

2. Certified Load Tickets

Certified load tickets shall be furnished by the Portland cement concrete producer and delivered to the Engineer. The certified ticket shall state that all materials comply with pertinent specifications and the mix is proportioned in accordance with the specified mix design.

3. Certified Test Results

a. High Range Water Reducing Admixture

The manufacturer shall supply the actual laboratory test results conducted in accordance with these specifications. For control purposes, the manufacturer shall also furnish curves giving the fluid ounces of high

range water reducer per 100 pounds of cement as related to water reduction and strength gain for 12 hours when used with a cement factor of a minimum of 700 pounds.

b. Joint Filler

The manufacturer shall submit a complete certified analysis for all hot applied joint fillers.

c. Epoxy Resin Adhesives

The Contractor shall provide a certificate containing the pot life and actual test results showing the material meets the requirements of the specification. Should the manufacturing process or materials change, a new sample and certification are required for approval of the system.

d. Waterstops

The Contractor shall furnish without charge a test sample for each lot or shipment of waterstop. The supplier of the waterstop shall furnish a certified copy of the actual test results showing that the material meets the specification requirements.

e. Bituminous Sealer

The supplier shall furnish a certified copy of the test results showing that the bituminous sealer meets the following requirements:

<u>Test and Method</u>	<u>Specification Limits</u>
Residue by evaporation, nonvolatile matter, ASTM D 2939, % min.	70
Inorganic filler on ignition, ash content, ASTM D 2939, %	15-45

02651.02 MATERIALS

A. Materials Furnished by the County

1. The County will not furnish any materials for Portland cement concrete pavements.
2. The Contractor may obtain water from the County's potable water system in accordance with current County policies and procedures. The Contractor shall contact the Bureau of Utilities, Meter Section, for requirements.

B. Contractor's Options

1. The Contractor may cure the finished concrete slab by any one or more of the methods specified in Section 02651.03, Article M.
2. The Contractor may use either hot or cold applied joint sealing compound. The Contractor shall designate his selection by letter and shall use the chosen material for the entire Contract.

C. Detailed Material Requirements

1. Aggregate Gradations

TABLE 02651-1

<u>Sieve Sizes</u> <u>U.S. Standard</u>	<u>Mass Percent Passing</u>			<u>FA, PCC</u>
	<u>AASHTO M 43</u>	<u>AASHTO M 6*</u>		
	<u>No. 57</u>	<u>No. 67</u>	<u>No. 7</u>	
1 1/2 inch	100	-	-	-
1 inch	95-100	100	-	-
3/4 inch	-	90-100	100	-
1/2 inch	25-60	-	90-100	-
3/8 inch	-	20-55	85-100	100
No. 4	0-10	0-10	0-15	95-100
No. 8	0-5	0-5	0-5	-
No. 16	-	-	-	45-85
No. 50	-	-	-	10-30
No. 100	-	-	-	0-10

*Modified

2. Fine Aggregate

Fine aggregate shall meet the gradation requirements contained in Table 02651-1 and shall be in accordance with the quality requirements of AASHTO M 6 except:

- a. The maximum permissible limits for deleterious substances apply.
- b. The uniformity of grading requirements is deleted.
- c. In areas exposed to traffic, only natural sand shall be used.

3. Coarse Aggregate

Coarse aggregate shall be in accordance with the Class A quality requirements of AASHTO M 80 using sodium sulfate to determine the soundness. Grading of aggregate shall be in accordance with AASHTO M 43, No. 57, 67, or 7, Table 02651-1.

4. Portland Cement

Portland cement shall be in accordance with AASHTO M 85 with the fineness determined in accordance with AASHTO T 153 and the time of setting determined in accordance with AASHTO T 131.

5. Water

Water shall be as specified in Section 02611.02.

6. Portland Cement Concrete Curing Materials

Curing materials shall be burlap cloth, sheet materials, liquid membrane-forming compounds, or cotton mats.

a. Burlap

Burlap cloth shall be made from jute or kenaf and shall be in accordance with AASHTO M 182, Class 1, 2, or 3.

b. Burlap Polyethylene Sheeting

Sheet material shall be in accordance with AASHTO M 171 except that tensile strength and elongation requirements are waived. White burlap polyethylene sheeting shall have a finished product weight of not less than 10 ounces per square yard.

c. Liquid Membrane

Liquid membrane-forming compounds shall be in accordance with AASHTO M 148.

Field control testing of the white pigmented curing compounds will be on the basis of weight per gallon. The samples shall not deviate more than plus or minus 0.3 pounds per gallon from the original source sample.

d. Cotton Mats

Cotton mats shall consist of a filling material of cotton bats or bats covered with unsized cloth and tufted or stitched to maintain the shape and stability of the unit under job conditions of handling.

The covering shall be either cotton cloth, burlap, or jute having the following properties:

- 1) Cotton cloth covering shall weigh not less than 6.0 ounces per square yard and shall have an average of not less than 32 threads per inch in warp and not less than 28 threads per inch in filling.

The raw material used in the manufacture of the cotton cloth shall be raw cotton, cotton comber waste, cotton card strip waste, or combinations thereof.

- 2) Burlap or jute covering for cotton mats shall weigh not less than 6.4 ounces per square yard and shall have not less than 8 threads per inch of warp and not less than 8 threads per inch of filling. It shall be the grade known commercially as "firsts" and shall be free from avoidable imperfections in manufacture and from defects or blemishes affecting the serviceability.

The filling material for the mats shall be cotton bat, or bats made of raw cotton, cotton waste, cotton linters, or combinations thereof, and shall weigh not less than 12 ounces per square yard.

Mats shall have a suitable flap extending along one longitudinal edge of the mat. The length of mats shall be 2.5 feet greater than the width of pavement slab to be cured.

The cotton filling material in the form of a bat or bats shall be held in place between the coverings by sewing or tufting. The sewing or tufting shall be sufficiently loose to permit substantially all of the surface of the mat to come in contact with a flat surface when in use but not so loose to permit the filling material to shift.

7. Joint Materials

a. Joint Fillers

The hot applied material shall be in accordance with AASHTO M 173. Manufacturers' recommendations regarding pouring temperature will be used when testing this material. If a range of temperatures is recommended, the midpoint will be used as the pour point. The cold applied type shall meet the requirements of ASTM D 1850. One sample per each 50 containers, or fraction thereof, shall be required for either type of material.

b. Preformed Joint Fillers

The cork type shall be in accordance with AASHTO M 153. The bituminous fiber type shall be in accordance with AASHTO M 213, with the bitumen content determined by AASHTO T 164. The weathering test shall be deleted for either type of material.

c. Roofing Paper

Roofing paper to be used in expansion joints shall be composed of roofing felt saturated and coated on both sides with an asphaltic material. It shall

not weigh less than 39.8 pounds per 100 square feet and shall not crack when bent 90 degrees over a 1/2 inch radius at room temperature.

d. Waterstops

Waterstops shall be made of rubber or polyvinyl chloride. The rubber type may be natural rubber, suitable synthetic rubber, or a combination of natural and suitable synthetic rubber. The polyvinyl chloride shall contain at least 90% polyvinyl chloride. The remaining 10% may include one or more monomers copolymerized with vinyl chloride or consist of other resins mechanically blended with polyvinyl.

The waterstop shall be of the shape and dimensions shown on the Plans. The cross section shall be uniform along the length and transversely symmetrical so that the thickness at any given distance from either edge of the waterstop shall be uniform. The waterstop shall be dense, homogeneous, and free from holes and other imperfections.

The waterstop shall meet the following requirements:

<u>Test and Method</u>	<u>Specification Limits</u>
Tensile Strength, ASTM D 412, min	2000 psi
Elongation at Break, ASTM D 412, % min	300
Hardness, Rubber, Type A Durometer, ASTM D 2240	55 ± 5
Hardness, PVC, Type A Durometer, ASTM D 2240	75 ± 5

e. Preformed Elastomeric Joint Seals

The material shall be the open cell compression type in accordance with ASTM D 2628. It shall be marked with the name or trademark of the manufacturer and the date of production at intervals of not more than 4 feet. A clear and durable mark shall be placed on the top surface of the seal at every 12 ±0.05 inch.

Roadway seals shall have the following Force Deflection characteristics when tested in accordance with MSMT 521:

- 1) The seal when compressed to 80% of its specified width shall yield a pressure of not less than 4 pounds per inch.
- 2) The seal when compressed to 50% of its specified width shall yield a pressure of not more than 24 pounds per inch.

The containers used in shipment shall be marked with the name of the manufacturer and the date of manufacture.

f. Lubricant-adhesive

The lubricant-adhesive shall be compatible with the preformed joint seals and concrete and unaffected by normal moisture. The Engineer will determine that consistency is suitable at the time of installation.

<u>Test and Method</u>	<u>Specification Limits</u>
Solids, ASTM D 553, % min	22
Film Strength, ASTM D 412, psi min	2000
Elongation, ASTM D 412, % min	250

No lubricant-adhesive shall be used after nine months from the date of manufacture. Each container shall be plainly marked with the manufacturer's name or trademark, lot number, and date of manufacture.

g. Load Transfer Assemblies

Load transfer assemblies, including ends, shall be epoxy coated and constructed in accordance with the Standard Details.

h. Silicone Joint Sealant

Silicone joint sealant shall be a low modulus, one component compound which may or may not require a primer for bonding to concrete. If a primer is required, it shall be as recommended by the sealant manufacturer and shall be placed on the joint faces following the insertion of the back-up material.

Silicone joint sealant, when tested at $73 \pm 3^{\circ}\text{F}$ and 45-55 rH, shall meet the following requirements:

TEST	METHOD	SPECIFICATION LIMITS
Shore A Hardness	ASTM D 2240	10-25 at 7 Days
Tensile Strength and Elongation	ASTM D 412 Die C	50-200 psi 1200 % max.
Adhesion in Peel	Fed. Spec. TT-S-00230	20 lb/in. min.
Flow	AASHTO T 187	0.3 in. max.
Tack-Free Time	ASTM D 2377	20-75 minutes

8. Graphite Grease

Graphite grease shall be a smooth homogeneous mixture of mineral oil and a water insoluble soap containing a minimum of 6% of colloidal graphite by weight.

The colloidal graphite used in the manufacturer of the grease shall contain at least 80% graphite carbon. The fineness shall be such that the grease will leave a continuous protective film of graphite when applied.

The consistency of the graphite grease shall meet the requirements of the National Lubricating Grease Institute, Grade 2.

9. Adhesives

Epoxy resin bonding material shall consist of a thermosetting epoxy resin and a hardener. The individual components or mixed epoxy shall not settle or skin and contain no volatile solvents, lumps, or foreign materials. The epoxy resin shall meet the following requirements when tested in accordance with ASTM C 881.

<u>Requirement</u>	<u>Type I</u>	<u>Type II</u>	<u>Type III</u>
Bond Strength, psi, min 2 days, dry cure	2000	---	300
14 days, moist cure	2000	1500	300
Gel time, minutes, min	30	30	30
Consistency, in., Grade 3, max	1/4	1/4	1/4

NOTE: Type II, Class C material may be approved after 7 days provided the bond strength meets the 1500 psi minimum requirement.

Each container shall be clearly labeled with the manufacturer's name, batch number, component designation, mixing ratios by volume, gel time, date manufactured, and directions for use. In addition, each container shall be labeled showing the epoxy system type, grade, class, and color.

10. Fine Aggregate for Epoxies

Fine aggregate for epoxies will be tested in accordance with AASHTO T 27. The grading shall yield 100% passing the No. 8 sieve and a maximum of 1% passing the No. 200 sieve. Aggregate shall be dry.

11. Steel Reinforcement

All items specified in this Section shall be of domestic manufacturer.

a. Bar Reinforcement

Bar reinforcement shall consist of deformed bars meeting the requirements of AASHTO M 31, Grade 40 or 60.

b. Tie or Dowel Bars

Tie or dowel bars shall be plain round steel bars meeting the requirements of AASHTO M 31, Grade 40 or 60, or ASTM A 36.

Sleeves for dowel bars shall be of sheet metal capable of sliding over $2 \pm 1/4$ inch of the dowel and shall have a closed end with a stop to hold the end of the sleeve at a minimum distance of 1 inch from the end of the dowel bar.

c. Welded Steel Wire Fabric

Welded steel wire fabric shall be in accordance with AASHTO M 55. Fabric used in pavement construction shall be furnished in flat sheets. When galvanizing is specified, the fabric shall be galvanized after fabrication.

d. Welded Deformed Steel Wire Fabric

Welded deformed steel wire fabric shall be in accordance AASHTO M 221.

e. Fabricated Steel Bar Mats

Fabricated steel bar mats shall consist of steel meeting the requirements of AASHTO M 31 fabricated to meet the requirements of AASHTO M 54.

f. Cold Drawn Steel Wire

Cold drawn steel wire for concrete reinforcement shall be in accordance with AASHTO M 32.

g. Tie Devices

Tie devices for use in securing contiguous traffic lanes of Portland cement concrete pavement or a traffic lane and concrete curb or combination curb and gutter shall be of malleable iron or steel. The tie devices shall meet the dimensions specified and produce a frictional force of at least 160 pounds per foot per foot of spacing when tested in accordance with MSMT 512.

12. Proportioning

Proportioning shall be as specified in Section 03310.

02651.03 EXECUTION

A. General

1. Equipment necessary for handling materials and performing the work will be approved by the Engineer as to design, capacity, and mechanical condition. The equipment shall be at the job site sufficiently ahead of the start of construction operations to be examined thoroughly and approved. The equipment and methods used shall provide means to obtain the prescribed weights within the allowable tolerances, to obtain the consistency specified with a minimum amount of water, to obtain proper placing of the mixture in a condition of maximum density with no segregation, and to finish and cure the pavement in accordance with the requirements herein.
2. No concrete shall be mixed, placed or finished when natural light is insufficient, unless an adequate and approved artificial lighting system is operated.
3. Cold Weather Concreting

A written authorization, which under very special circumstances, may be issued by the Engineer will be required for concreting between November 15 through March 15. In addition to the Engineer's formal permission, the Contractor is required to conform to all the other requirements of this Section.

The concrete pavement work shall neither begin nor continue if the air temperature in the shade and away from artificial heat is 40°F or less. This requirement may be waived for incidental construction.

Whenever concrete is to be placed when the air temperature is 40°F or lower, the concrete shall be deposited in its final position at temperatures between 60°F and 80°F. This shall be accomplished by heating the water and/or the aggregates. The water shall not be above 170°F. Aggregates may be heated by steam coils or other dry heat but not by discharging live steam or hot water into them. Heating by means of a flamethrower in the mixing drum will not be permitted. No cement or aggregates containing frost, frozen lumps, or crusts of hard material shall be used. No concrete shall be placed on a frosted or frozen subgrade.

For at least five days after the placement, the concrete shall be kept protected if the temperature drops below 40°F. Protection material consisting of hay, straw, or similar insulation shall be provided along the line of work. This material shall be spread to a sufficient depth to prevent freezing during the period of protection. Hay or straw shall not be used in lieu of burlap or other covering specified but shall be applied in addition to the covering and maintaining the proper method of curing of the concrete.

If the concrete will be exposed to the direct rays of the sun and the air temperature is over 70°F, the forms, reinforcing steel, and base shall be sprinkled with cool water just before concrete placement.

B. Conditioning of Subgrade

After the subgrade has been brought to line and grade and immediately prior to placing the forms, the foundation shall be conditioned and trimmed to the exact shape, grade, and cross section required by the Plans. Such conditioning and shaping shall be to the proposed width between side forms plus 1 foot wider on each side. The foundation shall be compacted by rolling at least 1 foot wider on each side than the proposed width of the concrete. The use of a fine grading machine of an approved type will be permitted in which event the forms can be placed directly on the prepared subgrade in advance of the exact conditioning and trimming.

C. Forms

Side forms shall be made of steel not less than 7/32 inch thick and be of an approved pattern having a depth equal to the prescribed edge thickness of the pavement without a horizontal joint. Built-up forms shall not be used. Forms shall be free from warp and of sufficient strength to resist, without visible springing or settlement, all loads applied in the paving process. Forms shall have a base equal to their height and a flat-flanged tread or top surface not less than 2 inches wide. They shall be not less than 10 feet long except for installation along curves on which the radius of the form line is less than 200 feet. When the curve radius is less than 200 feet, the forms shall not be more than 6 feet long or shall be curved. Stake sockets to accommodate a 1 inch diameter steel stake shall be provided, and there shall be at least three such sockets in each section of form 10 feet or more in length and at least two such sockets in each section of form less than 10 feet long. Each section of form shall be provided with a positive locking device that will secure it tightly to the adjoining section.

Forms for keyways shall be of metal or plastic and shall be rigidly and permanently fastened to the road form by bolting or welding. They shall be the full length of the road form to which they are attached, of the size and shape specified and sufficiently strong to maintain their original size and shape at all times.

Holes shall be provided through both forms and keyways to accommodate tie bars or dowels when such are required. They shall be the proper size and at the spacing and location as required for the tie bars specified.

When tested with a straightedge, no forms shall show a variation of more than 1/8 inch per 10 foot length from the true plane of the top or from the true plane of the face; and this allowable variation shall not be exceeded for shorter forms such as used on curves. Forms that are bent, deformed, or broken in any way shall be immediately removed from the paving site; and if repaired, they shall not be used until they have been accepted by the Engineer.

Forms shall be joined neatly and tightly and staked securely with stakes in every socket. All wedge locks or other stake fastening devices shall be tight. All locking devices at form joints shall be driven up fully so as to produce a smooth fitting rigid joint. Forms shall maintain proper grade and alignment under all working conditions. The entire base of the forms shall bear directly and in full contact with the finished foundation. Building of pedestals of earth or other materials upon which to rest the forms is not permitted. Forms shall be set to final line and grade at least 400 feet in advance of the point of placing concrete and shall be thoroughly cleaned and coated with form release compound before concrete is placed. After forms have been set, the top surface or tread shall be checked for trueness; and any variations from a smooth and uniform surface shall be corrected.

The Engineer may approve wooden forms for use in exceptional cases, such as on curves of very short radius or when a nonstandard length of straight form is required. They shall be the full depth of the pavement edge, of a design and construction acceptable to the Engineer, and shall be rigidly braced and held to the proper line and grade.

D. Final Check

Following the placement of the forms, an approved scratchboard shall be used as a final check, and any deviations shall be corrected. When corrections necessitate the addition or removal of material, this material shall be rolled with a roller weighing not less than 500 pounds. Following such correction, the scratchboard shall again be used. When the foundation is dry, it shall be sprinkled with as much water as can be readily absorbed immediately in advance of placing concrete.

E. Placing Concrete

The concrete shall be deposited on the grade in such manner as to require as little rehandling as possible. Unless truck mixers, truck agitators, or non-agitating hauling equipment is equipped with means for discharge of concrete without segregation of the materials or displacement of the underlying material, the concrete shall be unloaded into an approved spreading device and mechanically spread in such manner as to prevent segregation of the materials. Placing shall be continuous between transverse joints without the use of intermediate bulkheads. Necessary hand spreading shall be done with shovels, not rakes.

Where concrete is to be placed adjoining a previously constructed lane of pavement and mechanical spreading and finishing equipment will be operated upon the existing lane of pavement, that lane shall have attained the specified split tensile strength of 300 psi. The wheels of the finishing machine, which rests on the previously completed concrete, shall be flat, without flanges; and the inside edge of the tread of the wheels shall not operate so close to the edge of the slab as to cause spalling or damage. The tread of the wheels on the opposite side, which operate on the steel side forms, shall have flanges on both sides.

Concrete shall be thoroughly consolidated against and along the faces of all forms and along the full length and on both sides of all joint assemblies, by means of vibrators

inserted in the concrete. Vibrators shall not be permitted to come in contact with a joint assembly, underlying material, or a side form. In no case shall the vibrator be operated longer than 5 seconds in any one location.

Following the placement of the concrete, it shall be struck off to be in accordance with the cross section shown on the Plans. Should any concrete material fall on or be worked into the surface of a completed slab, it shall be removed immediately by approved methods.

F. Reinforcement

When reinforcement is required, it shall be placed as shown on the Plans.

All dowel bar assemblies for lateral joints, if required, shall be installed in place on finished subgrade ahead of the placement of the slab reinforcement and concrete. The portion of each dowel intended to slip shall be thoroughly coated with asphalt, grade MC-70, material or an approved lubricant, to prevent the concrete from bonding to that portion of the dowel.

All reinforcing metal shall be kept clean and free from foreign material that will prevent the proper bond with the concrete. Welded sheet fabric and welded or clipped bar mats shall be furnished in flat sheets and shall be handled carefully during the placing and kept straight.

The reinforcement shall be placed so that the extreme longitudinal member will be located not more than 3 inches from the edges of the slab section, and the ends of all longitudinal members shall extend to within 2 inches of the ends of the slab sections. Adjacent sheets of welded fabric and welded or clipped bar mats shall be lapped not less than 12 inches when the lap is made at a right angle to the center line of the pavement. When sheets are permitted to be lapped parallel to the centerline, the lap shall be not less than 12 inches. The wire fabric or bar mats shall be wired together at all laps. The spacing between the wiring shall not exceed 24 inches.

Reinforcement for multiple lane construction shall consist of bar mats or sheets of welded wire mesh of the same weight and size as though the paving were constructed in single lane widths, and these mats or sheets shall be installed so as to leave an unreinforced longitudinal gap 6 inches wide, parallel to and centered on the lane lines, as indicated on the Plans.

When installing welded wire fabric, or welded or clipped mats of reinforcing bars, one of the following methods shall be used:

1. The concrete shall be placed in two layers. The entire width of the bottom layer shall be struck to such length and depth so that the wire fabric or bar mat can be laid full length on the concrete in its final position and to its proper elevation below the finished roadway surface, as indicated in the Plans. After the steel has

been placed, the top layer of concrete shall be placed and struck off at once before the bottom layer becomes non-plastic.

When wire fabric is specified and the slip-form method of paving is used, the only approved manner of placement will be this method.

2. The concrete shall be placed in one layer. The wire fabric or bar mats shall be placed in the plastic concrete by approved mechanical or vibratory means after the concrete has been spread. After the initial set of the concrete, the wire fabric or bar mats shall be at proper elevation below the finished grade, as indicated on the Plans.

Tie bars for longitudinal construction joints may be placed in metal chairs or machine placed so that upon the initial set of the concrete they shall be at right angles to the center line of the pavement. Metal chairs or machine placement devices shall be approved by the Engineer prior to use.

When using the slip-form method of paving, tied reinforcing bars or prefabricated mats may also be installed ahead of the placement of concrete by being supported on chairs set upon the underlying material. Reinforcement installed in this manner shall be in place for a distance ahead of the paver equal to at least 500 feet or a 2 hour run of the paver before any paving may begin. Paving shall be stopped and a bulkhead construction joint shall be installed whenever it comes to within 100 feet of the end of such steel placement. All reinforcement shall be adequately secured against displacement or movement.

G. Slip-Form Paving

The Contractor may elect to use the slip-form method of constructing the concrete pavement, which must be approved at least 30 days prior to the start of any such operations. If the slip-form method is used, a compacted foundation widening shall extend a minimum of 4 inches beyond the outermost edge of any wheel or crawler tracks that are to be operated on it. No additional compensation will be allowed for the extra width. All fine grading on widened track area of the foundation under the pavement slab, shall be done by machine methods. The machine used for this work shall be automatically controlled for alignment and grade by sensors activated by preset string or wire lines on both sides and supported at intervals not in excess of 25 feet.

A close tolerance on the surface of the foundation is essential in order to get a pavement which is smooth and of uniform and correct thickness. Any corrections to the foundation during fine grading operations, either under the pavement area or the track area or both, involving either the addition or removal of material, any disturbance of the material or change in its density, such as scarifying, blading, etc., shall always be followed by additional rolling.

The fine grading of the foundation shall be completed for a distance ahead of the paver of at least 1000 feet before any paving may begin. Paving shall be stopped whenever it

comes to within 200 feet of the farthest point to which fine grading of the foundation is completed and a bulkhead construction joint installed.

The concrete pavement slab shall be shaped, consolidated, and finished by an approved slip-form paver. This machine shall be self-propelled, on crawler tracks, and no other tractive force or effort, other than that which is provided and controlled by the paving machine itself, shall be applied. The slip-form paver shall be capable of being automatically controlled for both alignment and grade by sensors activated by a preset string line or other acceptable methods. When placing concrete adjacent to an existing pavement, the portion of the equipment which is supported on the existing pavement shall be equipped with rubber tired wheels or protective pads on crawler treads, either of which shall be sufficiently offset laterally so as to run far enough from the edge to prevent damage to the existing pavement.

The slip-forms shall be of a length sufficient to prevent harmful slumping or sagging of the sides and top edges of the pavement slab being cast. They shall be spaced and braced to a uniform and constant width by means of adequate cross-bracing frames. They shall also be held rigidly vertical. Tie bars and keyways which may be required in the slip joined edge shall be placed and secured in proper position in the concrete before the edge of the pavement slab is free of the slip-form.

In the event that slumping or sloughing occurs behind the machine or any other defects occur which, in the opinion of the Engineer, cannot be corrected to permissible tolerances, or if the reinforcing materials or load transfer units are displaced by action of the machine, the Engineer will halt paving operations until proper corrective action has been taken.

Paving found to be defective in surface smoothness, thickness, edge slumping, strength or any other characteristics shall be removed and replaced if in the opinion of the Engineer the defects cannot be satisfactorily resolved.

H. Sequence of Operations

The sequence of operations shall be placing, strike off and consolidating, floating and removal of laitance, straight edging, final surface finishing, and curing. Work bridges or other devices necessary to provide access to the pavement surface for the purpose of finishing straight edging, and making corrections as hereinafter specified, shall be provided by the Contractor.

I. Machine Finishing

The finishing machine shall be an approved type of screed machine having two transverse screeds. A mechanical spreader of an approved type and design will be required which will move the volume of freshly deposited concrete transversely, thereby accomplishing the necessary spreading of the material. Special attention shall be given to spading or vibrating the concrete adjacent to roadway forms and joints, but the concrete shall not be subjected to excessive vibration such as might produce segregation of its

various components. When hand methods are permitted in lieu of the mechanical spreading, not less than three men shall be at work at all times leveling, spading, and spreading the concrete in front of the finishing machine. Rakes shall not be used for handling concrete. The screed shall be adjusted so as to produce a complete concrete pavement of the crown and cross section indicated on the Plans. An experienced operator shall be employed to operate the finishing machine.

Following the transverse finishing machine, the concrete shall be screeded longitudinally with a power operated longitudinal finishing machine of an approved type. This longitudinal screed shall be worked with a side-to-side motion so as to level any irregularities in the surface. The width of the working face of the screed shall not be less than 6 inches.

In lieu of the longitudinal screed, an approved model of a chevron or "V" type finishing float or of a combination finishing float of the lateral type may be used. Such devices shall have the float suspended from a frame so that it does not ride directly on the forms, and the float shall be nonreciprocating. Any such float shall be preceded by at least one additional reciprocating screed.

Following the longitudinal screed or finishing float, a scraping straightedge, 10 foot in length, equipped with a long handle, shall be used for removing any accumulation of excess mortar or inert material from the surface and bringing the pavement to the correct plane.

When the finishing machine is run back over previously placed concrete after the concreting operation has been suspended for a sufficient time to permit the concrete to set, the finishing machine shall be supported by steel strips not less than 2 feet long placed on the forms in such a manner that the wheel flanges will not touch or damage the concrete. In operating all surface finishing equipment, the least number of passes is desirable in order that over manipulation may be avoided.

J. Texturing

The concrete roadway surface shall be given a final textured finish. Any free water on the surface prior to the commencement of the texturing operation shall be removed by a burlap drag. The textured finish shall have transverse corrugations that are variably spaced from 5/8 inch to 7/8 inch apart. Each corrugation shall be tined 1/8 inch wide, 1/8 inch plus or minus 1/32 inch in depth. The method of texturing must be approved by the Engineer prior to placing the concrete.

A sample slab 4 feet x 8 feet and 4 inches high using concrete having the required mix design shall be constructed in the presence of the Engineer at least 48 hours in advance of placement of the concrete for the purpose of demonstrating the Contractor's intended method of meeting the required finish specification. Upon completion and acceptance of the work, the sample slab shall be removed and disposed of in its entirety and no measurement or payment will be made for its construction or removal and disposal.

The texturing shall begin when the concrete surface is of such a plasticity as to allow texturing to the depth specified but dry enough to prevent the plastic concrete from flowing back into the grooves being formed. Care shall be exercised to avoid overlaps and the tearing of the concrete in the texturing operation. Texturing on open sections will be uniform for the full width of pavement, on closed sections at the least 12 inches of the roadway to the curb shall be left untextured to facilitate drainage. The completed textured finish shall be uniform in appearance.

After the texturing has been completed and the concrete has taken its initial set, and edging tool with 1/4 inch radius shall be used along each edge of the surface to prevent chipping of the edges in the removal of the forms. The longitudinal edge of any concrete surface adjoining previously placed pavement shall also be tooled in the same manner to avoid subsequent spalling. The edging of the joints shall be done at the same time and shall be done from the bridges. Particular care shall be taken to keep the surface of the concrete in the same plane on both sides of each joint wall thus edged.

K. Hand Finishing

Where permitted by the Engineer, hand finishing may be substituted for a finishing machine, according to the following method:

The surface of the concrete shall be struck off immediately after placement and leveled by means of an adjustable steel template 10 inches wide and 2 feet longer than the width of the pavement. A second adjustable steel template 8 inches wide and 2 feet longer than the width of the pavement shall be used directly behind this template. The templates shall be moved forward with a combined longitudinal and side-to-side motion fully resting at all times on the forms. During the operation, the distance between the two templates shall at no time exceed 10 feet. The templates shall be used until a true surface is obtained. While the concrete is being struck off with the first template, three or more men shall be at work leveling, spading, and tamping the concrete in front of the template.

After the concrete has been struck off with hand templates, finishing operations will be continued as specified for machine finishing.

L. Surface Check

The entire surface shall be checked with an approved metal straightedge 10 feet in length following the belting, and any deviation from the general surface shall be corrected at once. The surface shall be checked again after the expiration of the curing period. The 10 foot straightedge shall be equipped with blocks at each end exactly 1/8 inch in height, so as to support the checking edge above the concrete pavement. The straightedge shall be placed at several points across the pavement parallel to the centerline and shall be advanced in 5-foot increments. If at any point the concrete touches the straightedge when supported on blocks, the high spot shall be corrected by grinding or rubbing the surface. This grinding or rubbing shall be conducted carefully so as to avoid loosening coarse aggregate or otherwise damaging the slab.

Deviations which cannot be corrected by grinding or rubbing shall be removed and replaced by and at the expense of the Contractor, and in no case shall such section to be removed be less than full width of the traffic lane in which the deviation occurs and the entire length of the slab between joints.

M. Curing

Concrete curing for a period of 72 hours immediately following the placement operations shall be accomplished by one or more of the following methods. The Contractor may select the method to be used.

Regardless of the method selected, it shall be maintained continuously throughout this period at the expense of the Contractor.

1. White-pigmented liquid membrane-forming curing compound shall be applied to the finished surfaces by means of approved automatic spraying machine as soon as the free water has disappeared. The spraying machine shall be self-propelled and shall ride on the side forms of previously constructed pavement, straddling the newly paved lane. The machine shall be equipped with one or more spraying nozzles which can be controlled and operated so as to completely and uniformly cover the pavement surface with the required amount of curing compound. The curing compound in the storage drum being used for the spraying operation shall be thoroughly and continuously agitated during the application. Spraying pressure shall be sufficient to produce a fine spray and cover the surface thoroughly and completely with a uniform film. Spray equipment shall be maintained in first class mechanical condition, and the spray nozzle shall be provided with an adequate wind guard. The curing compound shall be applied with an overlapping coverage which will give a two-coat application at a coverage of not more than 200 square feet per gallon for both coats.

The application of curing compound by hand operated pressure sprayers will be permitted only on odd widths or shapes of slabs and on concrete surfaces exposed by the removal of forms, as authorized by the Engineer. When application is made by hand operated sprayers, the second coat shall be applied in a direction approximately at right angles to the direction of the first coat. The compound shall form a uniform, continuous, coherent film that shall not check, crack, or peel and shall be free from pinholes and other imperfections. If pinholes or discontinuities exist, an additional coat shall be applied within 30 minutes to the affected areas.

Concrete surfaces which are subjected to heavy rainfall within 3 hours after the curing compound has been applied shall be resprayed by the method and at the coverage specified above, at no additional cost to the County.

Necessary precautions shall be taken to ensure that none of the curing compound enters joints which are to be sealed. Rope of moistened paper, fiber, or other suitable material shall be used to seal the top of the joint opening, and the

concrete in the region of the joint shall be sprayed with curing compounds immediately after the rope seal is installed. Other methods of protecting the joints may be used when approved by the Engineer.

Approved standby facilities or approved alternate methods for curing concrete pavement shall be provided at a readily accessible location at the site of the work for use in event of mechanical failure of the spraying equipment or any other conditions which may prevent correct application of the membrane curing compound at the proper time. In the event of a failure of the regular spraying equipment, the standby or alternate curing method shall be used only on the remaining portion of the paving already placed and the paving operations suspended.

Concrete surfaces to which membrane-curing compounds have been applied shall be adequately protected for the duration of the entire curing period from pedestrian and vehicular traffic, except as required for joint sawing operations and surface tests, and from any other cause that will disrupt the continuity of the membrane.

Any area covered with curing compound which is damaged by subsequent construction operations within the curing period shall be resprayed.

2. Burlap shall be placed as soon as it may be done without injury to the concrete. It shall be overlapped in half widths of strips so as to provide a double thickness throughout its coverage. It shall be saturated prior to placement and placed wet. It shall be kept wet continuously throughout the curing period.
3. Cotton mats shall be placed as soon as it may be done without injury to the concrete. The mats shall be saturated prior to placement and placed wet. They shall be kept wet continuously throughout the curing period.
4. Waterproof paper or white polyethylene sheeting shall be placed as soon as it may be done without injury to the finished concrete. Sheeting units shall be lapped a minimum of 12 inches and extended to outside the forms. All edges or laps shall be held in place securely by a continuous windrow of earth or some other approved means. It is required with either sheeting material that it be maintained in close proximity to the surfaces of the pavement,

N. Form Removal

Unless otherwise provided, forms shall not be removed before concrete has set at least 12 hours. Forms shall be removed carefully so as to avoid damage to the pavement.

If the curing period has not expired, the sides of the slabs requiring no repair shall continue to be cured by one of the approved methods for the unexpired time.

Any damaged edges or honeycombed areas shall be repaired immediately and cured for 72 hours.

O. Joints

Joints shall be constructed of the type and dimensions and at locations indicated by the Plans. All joints shall be constructed perpendicular to the surface of the pavement. Care shall be exercised to maintain the surface of the concrete in the same plane on each side of the joint. All joints shall be protected from the intrusion of injurious material.

Longitudinal joints shall be created by full depth forming of individual lane widths or by sawing of multilane monolithic widths. No single lane width shall exceed 16 feet.

Longitudinal tie bars of a type specified must be submitted for test and approved prior to use. The Contractor shall provide the Engineer with a statement designating the source of supply, type, and proposed spacing of the tie bars. No material is to be used or installed prior to written acceptance by the Engineer.

When adjacent lanes of pavement are constructed by full depth forming, a screw type tie device shall be used. When the longitudinal joint is created by developing a plane of weakness, deformed bars of appropriate grade, size and spacing will be permitted. The method of placement shall also be established and approved prior to the commencement of paving. Where the slip-form paving method of placement is elected, the required deformed steel tie bars shall be placed and secured in their proper final position in the concrete before the edge of the pavement slab is free of the slip-form.

Contraction joints shall be constructed at locations and spacing as specified or shown on the Plans. In the case of placement adjacent to existing pavement, a match of existing joint spacing and type shall be made. Contraction joints shall contain load transfer dowels supported by a device as specified or shown on the Plans. Dowels shall be maintained parallel to the surface and longitudinal joint or centerline of the pavement.

The creation of a weakened plane joint by sawing shall be done in the following manner. Initially, accurate markings shall be made to reference the proper point over the load transfer devices to serve as a guide during the sawing operations.

Power concrete saws shall be equipped with suitable blades, guides, and depth controls, capable of marking a straight and perpendicular cut of not less than the prescribed depth. Sufficient equipment shall be on hand for the volume of sawing to be done and to ensure against mechanical failure. A minimum of two saws in operating condition shall be maintained at the job site.

It is the responsibility of the Contractor to have sawing done at the time which will positively control cracking yet not cause excessive raveling of the surface aggregate. Sawing shall commence as soon as possible after finishing has been completed and curing begun. In no event shall sawing of contraction joints commence later than 8 hours after placement of pavement.

Sawing shall be completed in 24 hours in the case of contraction joints and 84 hours in the case of longitudinal joints after placement of the pavement involved. Sealing shall be

done as soon as possible since no traffic will be permitted to use the pavement until after the sealing operations are completed.

All dummy contraction and dummy longitudinal joints shall be sawed except where gravel aggregate is used. These gravel aggregate joints shall be tooled or formed as sawing will not be permitted.

Contraction joints created by methods other than above will be permitted only when approved by the Engineer in writing.

The width and depth of the created joint shall be as specified or as shown on the Plans.

When concrete placement is interrupted longer than 45 minutes, or at the end of a day's run, a bulkhead or header form shall be placed. This form shall be of a type which when stripped will not disturb the dowel assembly. Bulkhead joints may preferably be made at normal contraction joint but shall not be set so as to result in a slab of less than 10 feet in length.

An edging tool with a 1/4-inch radius shall be used along the bulkhead across the surface of the pavement. When work is resumed, the freshly laid surface shall match the previously placed pavement.

P. Sealing Joints

All joints, lateral, longitudinal, and between surfacing and curb and gutter shall be sealed before any traffic is allowed on the surfacing.

Prior to placement of any joint sealing materials, the joints shall be cleaned of dirt or other foreign material. Joints may be cleaned with compressed air jets provided that the air in such jets is entirely free of oil or water. No joints shall be filled when there is any free water in or adjacent to the joints. Joint walls and all surfaces to which the sealing material is to adhere shall be surface dry for at least 3 hours prior to sealing.

The Engineer will inspect the joints immediately prior to the placement of the sealing compound, and no sealing material shall be used until the joints have been approved as being clean in accordance with the foregoing provisions.

The sealing of the joints shall be done in a neat, workmanlike manner.

Joints formed by pouring one slab against the other and transverse construction joints formed as a result of sequential daily pours shall be sawed a minimum of 1 inch deep and 3/16 to 5/16 inch in width and sealed.

Cold applied joint sealing compound shall be applied with approved pressurized equipment only.

Hot applied joint sealing compound shall be heated and applied with devices approved by the County. Hot poured joint sealing material shall not be placed when air temperature is less than 50°F unless approved by the Engineer.

Sufficient sealing material shall be placed in the joints so that upon completion of the work the surface of the sealing compound shall not be more than 1/8 inch below the level of the pavement surface. Extreme care shall be exercised in the sealing of joints to make them impervious to water and to prevent excessive spreading of the sealing compound over the surface of the pavement.

All sawed joints, except the longitudinal construction and the transverse construction joint sawed 1 inch deep, shall be sealed with preformed elastomeric compression seals.

After the joints are constructed and all foreign material has been removed, the joint grooves shall be inspected for spalling. Any spalling which increases the specified size of the joint groove beyond the following limits shall be repaired by patching with epoxy mortar:

1. spalls over 1/4 inch wide and over 1/2 inch below the surface of the pavement;
2. spalls over 1/4 inch wide and 2 inches or more in length, regardless of the depth of spall below the surface of the pavement.

The epoxy mortar shall be composed of an epoxy adhesive and sand.

Patching of spalls shall be done only when the air and pavement temperatures are over 50 °F and rising. The concrete shall be cleaned and dry at the time of placing the epoxy adhesive mortar. After the epoxy adhesive is thoroughly mixed, the dry sand shall be blended into the mixture to give an epoxy mortar of stiff or trowelable consistency. All loose concrete shall be removed from the spalled area and the surface thoroughly cleaned by sandblasting. A suitable insert shall be placed in the joint groove or against the pavement edge to form the face of the spalled patch. After cleaning, the spalled surface shall be primed with a brush application of freshly mixed epoxy adhesive. Immediately after priming, the epoxy mortar of troweling consistency shall be placed in the spalled area and finished as the original pavement surface. Dry sand shall be sprinkled onto the fresh epoxy mortar surface to eliminate any gloss. After the epoxy mortar has cured sufficiently to prevent damage during sealing operations, the insert shall be carefully removed using an abrasive blade to bring the repaired section to the proper width.

After the final cleaning of the joints, the preformed elastomeric compression seal as shown on the Contract Drawings shall be placed in the joint grooves by a machine of an approved design. The machine shall apply the lubricant-adhesive to the sealer or sides of the joint and compress the material before placing the material in the joint grooves. The lubricant-adhesive shall be applied evenly to both sides of the sealer. Care shall be taken to assure that the proper amount of lubricant-adhesive is used. The joint sealer shall be free from any curling or twisting during the installation in the joint grooves. All longitudinal joints shall be sealed first, followed by the sealing of the transverse joints.

Prior to installation of the transverse joint sealer, the longitudinal sealer shall be cut to permit installation of the transverse sealer. No gaps will be permitted at any intersections of longitudinal and transverse joint sealer. Splicing of transverse joint material will not be permitted. The transverse joint sealer shall be installed extending approximately 1 inch beyond the edges of the pavement. Extreme care must be taken in the installation of joint sealers to prevent stretching during installation. Provisions shall be made for determining the length of the sealer in a given length of joint. If stretching occurs in excess of 5 percent, the seal shall be removed and replaced. Any lubricant-adhesive on the top of the installed joint shall be carefully removed. The method of joining longitudinal joint sealer will be approved by the Engineer.

Q. Protection of Pavement

The Contractor shall erect and maintain suitable barricades and employ watchpersons, as required, to exclude traffic from the newly constructed pavement for the period herein prescribed. These barriers shall be arranged so that they will not interfere with or impede public traffic on any lane intended to be kept open, and necessary signs shall be maintained by the Contractor clearly indicating the open lanes to the public. When it is necessary to provide for traffic across the pavement, the Contractor shall construct at his entire expense immediately after the finishing of the concrete the necessary bridges over the pavement, clear of the forms and at least 3 inches clear of the concrete and sufficiently strong to carry the traffic. He shall maintain these bridges for a period of 3 days after which time he can remove same and cover the concrete with a 6 inch mat of earth which must be maintained for the full depth until the concrete has attained the required strength.

The Contractor shall have on hand at the paving site sufficient plastic or curing paper to cover at least 6000 square feet of freshly laid pavement as a protection against sudden thundershowers or heavy downpours of rain.

The Contractor shall protect the pavement against damage from all causes, including public traffic or traffic produced by his own equipment or employees.

Heavy grading equipment shall not be operated on the finished pavement at any time, except that the Engineer may grant special permission for the equipment to cross over the pavement at designated locations; and at those locations, the pavements shall be covered with a layer of earth free from rocks and large stones and having a minimum thickness of 6 inches. The grading equipment shall be operated only on the earth covered sections. The construction and use of the crossings will not be permitted until after the pavement concrete has attained the strength required.

Any part of the pavement damaged by traffic or other causes prior to its final acceptance shall be repaired or replaced by and at the expense of the Contractor in a manner satisfactory to the Engineer.

R. Opening to Traffic

The pavement may be used for vehicular traffic after having attained a splitting tensile strength of 300 psi. If this criterion is not used, the pavement shall not be opened to traffic until 28 days after the concrete is placed.

When traffic is to be allowed on newly constructed pavement, the construction of the shoulders shall follow the completion of the pavement as closely as practicable.

02651.04 METHOD OF MEASUREMENT

Measurement of plain or reinforced Portland cement concrete pavement will be made of the area completed and accepted by the Engineer. The width measurement will be the width of the pavement shown on the Plans, and the length will be measured along the centerline of the pavement. From the area so calculated will be deducted the area of all pavement which will be accepted only at a reduced price for scant thickness, which area will be paid for as specified in Section 02651.05.

02651.05 BASIS OF PAYMENT

A. General

1. Payment for plain or reinforced Portland cement concrete pavement will be made at the unit prices bid. The prices bid shall include furnishing all labor, tools, materials, and incidentals necessary to satisfactorily complete the work shown and specified in strict accordance with the Contract Documents, and accepted by the Engineer.
2. Payment will be made for contingent items when ordered by the Engineer. Payment will be made as specified in Sections 02951, 02952, 02953, 02954, 02955, 02956, and 02957.

B. Plain or Reinforced Portland Cement Concrete Pavements

1. Payment for plain or reinforced Portland cement concrete pavements will be made at the price bid per square yard.
2. Areas that are accepted at a reduced price for scant thickness will be adjusted by the factors shown in the following table. These factors are to be used only where areas of pavement are found to be deficient in thickness by the procedures set forth in Section 02651.01, Article C, Paragraph 2.

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<u>Pavement Thickness Deficiency in Inches</u>	<u>Percent Payment Contract Unit Price</u>
0.00 to 0.20	100
0.21 to 0.30	80
0.31 to 0.40	72
0.41 to 0.50	68
0.51 to 0.75	57
0.76 to 1.00	50
Greater than 1.00	0*

The percent payment of the bid price will be full compensation for furnishing and placing all materials and all labor necessary to complete this item.

* See Section 02651.01, Article C, Paragraph 2.

END OF SECTION