

PART D RIGID PAVEMENT

PORTLAND CEMENT CONCRETE PAVEMENT

380

380.1 DESCRIPTION

This work consists of constructing Portland Cement Concrete Pavement on a prepared surface.

380.2 MATERIALS

Materials shall conform to the requirements specified in the following Sections:

- A. **Cement:** Section 750. Type II cement shall be used for all concrete pavement.
- B. **Admixtures:** Sections 751 and 752.
- C. **Water:** Section 790.
- D. **Fine Aggregate:** Section 800.
- E. **Coarse Aggregate:** Section 820.
- F. **Reinforcing Steel:** Section 1010.
- G. **Joint Filler:** Section 860.
- H. **Joint Sealer:** Section 870.
- I. **Curing Materials:** Section 821.
- J. **Dowel Bar Assemblies:** Section 1010.
- K. **Fly Ash:** Sections 605 and 753.

380.3 CONSTRUCTION REQUIREMENTS

- A. **Quality of Concrete and Proportioning:** When the Contractor proposes to use aggregate from sources not previously tested by the Department, the Contractor shall submit preliminary samples to the Laboratory to determine its acceptability.

For determining a laboratory design mix, the Contractor shall submit samples of materials proposed for use, excluding water, to the Laboratory at least 40 days prior to their use. Aggregate samples shall be obtained from stockpiles of material to be used in the work.

A maximum of two laboratory mix designs per contract will be made by the Department without charge. Should the Contractor desire additional mix designs, the costs involved shall be at the Contractor's expense.

The concrete paving mix shall be proportioned as set forth in the design mix. On small areas, the Engineer may permit the substitution of Class A40 (A28) concrete for concrete paving mix. Class A40 (A28) concrete shall meet the requirements of Section 460, except the slump shall meet Section 380.3 A.

If satisfactory plasticity, workability or strength are not secured using the designated design mix, the Engineer may alter proportions as necessary. Adjustment, other than for cement, will not be made in the compensation due the Contractor because of design mix alterations. When Class A40 (A28) concrete is used, adjustment in the compensation due to the contractor for additional cement will not be made.

For the stationary side form method, the slump of the concrete shall be between one inch and three inches (25 mm and 75 mm).

For the slip-form method, concrete shall have a uniform consistency, with a slump of not more than two inches (50 mm).

The concrete shall contain 6.5% entrained air with an allowable tolerance of +1% to -1.5%. Air shall be entrained by an approved air-entraining admixture.

B. Equipment:

- 1. Batching Equipment:** Batching equipment shall be automatic. Manual operation will be permitted when automatic controls fail provided concrete meeting specified results is produced, however, the automatic operation shall be restored before work may commence the day following the failure.

Computerized Batching Equipment: The following provisions shall apply to all concrete batched by computerized batching equipment:

A printed, computer generated, ticket shall be automatically produced for each load of concrete batched. The printed computer ticket shall accompany each load of concrete to the project and shall be presented to the Engineer prior to discharging the load at the project site unless the Engineer approves an alternate procedure.

The printed ticket must contain the following minimum information:

Truck Number
 Date and Time Batched
 Total volume of the load, in cubic yards (cubic meters)
 Mix Identification [ID]
 Actual weight (mass) or volume of each component of the mix:
 Coarse aggregate
 Fine aggregate
 Cement
 Fly Ash
 Water

W/C ratio
Admixtures
 Air Entraining Admixtures
 Water Reducers
 Retarders
 Accelerators
 Others

When automated concrete batching equipment with moisture sensing capabilities is used, the batch ticket shall show the percent of moisture for the coarse and the fine aggregate.

The above information must be automatically printed in such a manner that the Engineer may verify that the mix adheres to the proportions specified by the design mix.

The Contractor shall provide satisfactory means for obtaining material samples from the batching plant.

Batching plant structures shall be leveled so the accuracy of the weighing mechanism is maintained.

Hoppers shall fully discharge without jarring the scales.

Clearances between scale parts, hoppers, and bin structure shall be maintained to avoid displacement of, or friction between, parts due to material accumulations, vibration, or other cause. Pivot mountings shall be designed so the parts will not jar loose and constructed to assure unchanging spacing of knife edges. Exposed fulcrums, clevises, and similar working parts shall be kept clean.

To maintain accuracy, weighing hoppers, and other parts which are affected by wind action shall be protected by shelters or wind breaks.

The scale dials shall be completely enclosed in weatherproof cases and provided with a glass opening to permit observation and reading.

Dial scales shall be provided with markers, which indicate the position of the dial indicator for predetermined loads.

Beam scales shall be equipped with an over and under indicator, which will show the beam in balance at zero load at any beam setting. The indicator shall have an over and under travel equal to not more than five percent of the capacity of the beam.

The scales for weighing aggregates, cement, water, and admixtures shall be an integral part of the batching equipment. The scales shall be accurate within 0.5 percent at any point throughout the range of the scale. Scale graduations shall be not greater than 0.1 percent of the capacity of the scale. The scales shall be sensitive to the weight indicated by one graduation.

The following controls shall apply to the aggregate batching equipment where each aggregate is weighed separately:

The hopper inlet mechanism shall be interlocked against opening when the discharge gate is open.

The hopper discharge mechanism shall be interlocked against opening while the hopper is being charged.

The hopper discharge mechanism shall be interlocked against opening if the material in the hopper is either overweight or underweight by more than one percent of the specified weight.

The following applies when aggregates are weighed accumulatively into one hopper:

Hopper inlet mechanisms shall be interlocked against opening when the hopper discharge gate is open.

The hopper inlet mechanism for any ingredient shall be interlocked against opening if the previous ingredients already in the hopper are overweight or underweight by more than 0.5 percent of the net weight of the total aggregate batch.

The hopper discharge mechanism shall be interlocked against opening while the hopper is being charged or if the batch in the hopper is overweight or underweight by more than 0.5 percent of the net weight of the total aggregate batch.

The cement batching equipment shall operate within a delivery tolerance of one percent of the net weight of the cement per batch. The cementitious material (cement and flyash) batching equipment shall also operate within a delivery tolerance of one percent of the net weight of the total cementitious material per batch.

Water may be measured by volume or weight. The measuring equipment shall operate within a delivery tolerance of one percent of the net weight or volume of water.

When water is measured by volume, means for determining the accuracy of the measuring device shall be provided.

Air-entraining or other admixtures may be measured by volume or by weight. The measuring equipment shall operate within a delivery tolerance of three percent of the net weight or volume per batch.

- 2. Mixing and Hauling Equipment:** Mixers and agitators shall have attached in a prominent place, the manufacturer's plate showing the various uses for which the equipment is designed and the capacity of the drum in terms of volume of mixed concrete.

The pick-up and throw-over blades in the drum shall be restored or replaced when any part or section is worn 3/4" (20 mm) or more below the original height of the manufacturer's design. The Contractor shall maintain a copy of the manufacturer's design, showing dimensions and arrangement of blades in reference to the original height and depth. Mixers that have an accumulation of hard concrete or mortar shall not be used.

Mixers, except truck mixers, shall be equipped with a timing device that automatically locks the discharge lever when the drum has been charged and releases the lock at the end of the mixing period. The timing device shall be equipped with a bell or other suitable warning device adjusted to give a signal each time the lock is released.

Truck mixers shall be equipped with counters to record the number of revolutions of the drum or blades. The counters shall be automatically actuated at the time mixing at mixing speed begins.

Mixers shall be capable of combining the concrete ingredients into a thoroughly mixed and uniform mass and uniformly discharging the concrete.

The hauling bodies of non-agitating equipment shall be smooth, mortar-tight metal containers equipped with gates that will permit uniform control of the discharge of the concrete.

- 3. Spreading and Finishing Equipment:** The spreading equipment shall consist of a mechanized device to place and provide a rough strike off of the concrete. The concrete shall be unloaded into an approved mechanical concrete spreader and deposited uniformly across the subgrade or subbase as close as possible to its final position. The use of a mechanical spreader may be waived provided the concrete hauling equipment is equipped with a discharge system capable of distributing the concrete uniformly without segregation across the width of paving and meets the approval of the Engineer. The spreader shall run on forms when forms are used or on wheels or tracks when slip forming. The mechanical concrete spreader shall be self-propelled and shall be capable of spreading the concrete mix to the desired cross sections. The spreader shall be easily adjustable to spread different elevations of concrete.

Slipform paving equipment shall have the direction of forward motion and grade (vertical elevation) controlled by an electronic sensing device following a taut string line. The slipform paving equipment shall be designed to spread, consolidate, screed, and float finish the freshly placed concrete so that a minimum of hand finishing will be necessary to provide a dense, homogenous pavement.

- 4. Vibrators:** Vibrators, shall be either the surface pan type or the internal type. They may be attached to the spreader, the finishing machine, or mounted on a separate carriage. Vibrators shall be interlocked with the machine's travel mechanism so vibration is stopped when the forward motion stops. Vibrators shall not come in contact with the joints, load transfer devices, reinforcement, subgrade, subbase, or side forms.

The frequency of the surface vibrators shall not be less than 3,500 impulses per minute. The frequency of the internal vibrators shall not be less than 7,000 impulses per minute. When

spud type internal vibrators are used adjacent to forms they shall have a frequency of not less than 3,500 impulses per minute.

Vibrators shall not be operated in excess of this frequency to such a degree that flotation of aggregate particles is caused and is evident or visible either during or after placement or that it causes an accumulation of laitance on the surface of the concrete.

A vibrating reed tachometer, hand type, shall be provided with each paver. The vibrating reed tachometer shall have a range from at least 4,000 to 10,000 VPM.

For a contract which has a minimum of 50,000 sq yd (41,805 sq. m) of pavement that is 12 ft (3.6 m) or more wide, an electronic internal vibrator monitoring device shall be provided. The device shall be capable of displaying the operating frequency of each internal vibrator, and shall be visible to the paving operator. The vibrator monitoring device shall have a range from at least 4,000 to 10,000 VPM.

Vibrators shall not be used to level or spread the concrete, but shall be used only for purposes of consolidation.

5. **Concrete Saw:** Sawing equipment, adequate to complete the sawing to the required dimensions and at the required rate, shall be provided. At least one standby saw in good working order shall be provided.
6. **Forms:** Forms shall have a depth not less than the prescribed edge thickness of the pavement. Built up forms with horizontal joints shall not be used.

When staked in place, forms shall withstand the pressure of the concrete and the impact, vibration and loading of any equipment they are required to support, without significant springing, settlement, or lateral displacement meeting the following requirements:

The top face of any form shall not vary from a true plane by more than 1/8 of an inch in 10 feet (3 mm in three meters), nor shall the contact face of a straight form vary from a true plane by more than 1/4 inch in 10 feet (6 mm in three meters).

Bent, twisted, or broken forms and those with battered top surfaces shall be removed from the work. Repaired forms shall not be used until inspected and approved.

Flexible or curved forms of proper radius shall be used for curves of 100 foot (30 meter) radius or less. Flexible or curved forms shall be of an acceptable design.

7. **Profilograph:** When specified in the Contract, the Contractor shall furnish and operate an approved 25 foot (7.62 meter) California style profilograph. The profilograph shall consist of a 25 foot (7.62 meter) frame supported upon a multiple system of wheels at both ends. The profile shall be recorded from the vertical movement of a wheel, attached to the frame at midpoint, in reference to the mean elevation of the points of contact established by the support wheels. The profilogram (trace) shall be recorded on a scale of 1 inch is equal to 25 feet (10 mm equal to 3m) longitudinally and 1 inch equal to 1 inch (1mm equal to 1mm) vertically.

The Contractor shall supply and use a computerized California type profilograph. The computer shall smooth the profile with a third-order Butterworth filter with a cutoff wavelength of 2.0 feet (600mm). The computer shall generate a profile index using a zero width blanking band. The computer shall also use a 0.3 inch (8mm) bump threshold to identify “must grind” locations.

Prior to use on the project and periodically thereafter, the calibration of the profilograph shall be checked. The vertical and horizontal scales shall be checked. The horizontal scale shall be checked by running the profilograph over a known distance and scaling the results on the profilogram. The cause of incorrect scales shall be determined and corrected prior to using the profilograph.

C. Preparation:

- 1. Stationary Side Form Method:** Forms shall be set to line and grade. The granular surface shall be final graded and dowel assemblies, if required, accurately placed in advance of concrete placement.

The foundation under the forms shall be compacted and true to grade. The form shall be firmly in contact with the granular surface for the entire length of the form. Forms shall be staked into place with not less than three pins for each 10 foot (3 meter) section. A pin shall be placed at each side of every joint.

Form sections shall be tightly locked and free from play or movement. Forms shall be cleaned and oiled prior to placing concrete.

Alignment and grade elevations of the forms shall be checked and corrections shall be made before placing concrete. When forms have been disturbed or the grade has become unstable, the forms shall be reset and rechecked.

After side forms have been set to line and grade and securely fastened, the surface on which the concrete paving is to be placed shall be brought to final grade by a subgrader or subgrade plainer. High areas shall be trimmed to proper elevation. Low areas shall be filled and compacted to a condition similar to that of surrounding grade, or filled with concrete integral with the pavement.

An automatic subgrader operating from a preset grade line may be used prior to setting of the side forms. After grading has been completed by the automatic subgrader, the forms shall be set, the surface checked, and high and low areas corrected.

The finished subgrade surface shall be maintained in a smooth and compacted condition until the pavement is placed.

- 2. Slip Form Method:** The surface on which the concrete is to be placed, shall be brought to final grade by an automatic subgrader operating from a preset grade line.

The finished subgrade surface shall be maintained in a smooth and compacted condition until the pavement is placed.

D. Handling, Measuring, and Batching Materials: The separate aggregate components shall not become intermixed prior to being weighed.

Aggregates shall be transported from stockpiles or other sources to the batching plant in a manner that maintains a uniform grading of the material. The use of track-type dozing equipment will not be permitted in handling coarse aggregates from stockpiles.

Aggregates that have become segregated or mixed with earth or foreign material shall not be used. If the aggregates contain non-uniform moisture, storage or stockpile periods will be required to equalize the moisture content.

The separate aggregate components for each batch may be weighed cumulatively in a single hopper or weighed separately in individual hoppers. Separate scales and hoppers shall be used for weighing cement.

The quantity of cement and fly ash used versus the quantity specified will be checked periodically by running a cutoff. The Contractor shall completely empty the cement silo and necessary conveyances at the direction of the Engineer. Individual cutoffs shall not show an underrun exceeding 1.5 percent, nor shall the final cutoff show an overall underrun exceeding one percent.

E. Mixing Concrete: Concrete shall be mixed at a central stationary plant. Truck mixing will be permitted only when specified.

Mixing and agitating speeds shall be as designated by the manufacturer. Mixers may not be charged in excess of their rated capacity.

Manual operation of the central plant will be permitted only in case of failure of the automatic control. Automatic operation must be restored before work may commence the day following the failure.

A portion of the mixing water shall be charged into the drum in advance of the cement and aggregates. The flow of water shall be uniform and all water shall be in the drum by the end of the first 15 seconds of the mixing period. Concrete mixed less than the specified time shall be disposed of at the Contractor's expense.

When a concrete batch is transported in a truck mixer or agitator and the batch is smaller than 60 percent of the rated capacity of the truck mixer or agitator, the following percentage of additional cementitious material shall be added to the batch:

40% to 60% rated capacity	5%
20% to 39% rated capacity	10%
10% to 19% rated capacity	15%
0% to 9% rated capacity	20%

The above provisions regarding extra cement shall also apply to the mixing of small batches in central plants.

1. **Central Plant Mixing:** Concrete shall be mixed not less than one minute after all materials, excluding water, are in the mixer.
2. **Truck Mixing:** Mixing time for truck mixed concrete shall not be less than 70 nor more than 100 revolutions of the drum or blades at mixing speed, after all ingredients, including water, are in the drum. Additional mixing beyond 100 revolutions shall be done at agitating speed.

The mixing water shall be added at the time of batching. The Engineer may order additional water or cement added to the batch after completion of the original mixing, in which case the batch shall be mixed an additional 30 revolutions at mixing speed. Means to accurately measure the amount of water added shall be provided.

- F. Limitations of Mixing:** Concrete shall be finished before initial set has occurred. Concrete in which initial set has begun shall be wasted. Retempering of concrete will not be allowed. Concrete shall not be mixed, and placed unless natural light is sufficient for finishing operations.

Mixing water shall not be heated above 160° F (71° C). Aggregates shall not be heated above 100° F (38° C) and shall be free of frozen lumps, ice, and snow.

- G. Delivery Requirements:** The rate of delivery of concrete shall be uniform.

When continuously agitated in the hauling unit, concrete shall be discharged within 90 minutes, and discharged and screeded within 105 minutes after the cement has been placed in contact with the aggregates, except when the concrete temperature is 85° F (30° C) or above, the time limitation shall be reduced to discharged within 45 minutes, and discharged and screeded within 60 minutes.

When not continuously agitated in the hauling unit, concrete shall be discharged within 45 minutes, and discharged and screeded within 60 minutes after the cement has been placed in contact with the aggregates, except when the concrete temperature is 80° F (27° C) or above, the time limitation shall be reduced to discharged within 30 minutes, and discharged and screeded within 45 minutes.

The hauling unit shall be thoroughly cleaned and flushed with water as necessary to insure hardened concrete will not accumulate in the concrete hauling compartment. All wash water shall be completely discharged before recharging the hauling unit with fresh concrete.

- H. Placing Concrete:** Placement of concrete on a frozen surface will not be permitted. Forms and steel which will come in contact with the concrete shall be raised to a temperature above freezing prior to placement.

The placement temperature of concrete shall not be less than 50° F (10° C) nor more than 90° F (32° C).

The subgrade surface shall be uniformly moist when the concrete is placed. Moisture shall be applied without forming pools of water.

The concrete shall be deposited on the grade so as to require as little rehandling as possible. Unless hauling equipment is equipped to discharge the concrete without segregation, the concrete shall be unloaded into an approved spreading device and mechanically spread on the grade without segregation of the materials.

Necessary hand spreading shall be done with shovels. Rakes or vibrators shall not be used for spreading concrete. Workmen shall not be allowed in the freshly mixed concrete with boots or shoes coated with foreign substances.

Vehicles tracking earth or foreign substances will not be allowed to drive through or back into fresh mixed concrete. Equipment dropping earth or foreign substances from the unit shall not be allowed over the fresh mixed concrete.

The concrete shall be consolidated against and along the faces of all forms by vibrators. Vibrators shall not come in contact with a joint assembly, the grade, or a side form. The vibrator shall not be operated longer than 10 seconds in any one location.

All concrete material which falls on or is worked into the surface of a completed slab shall be removed immediately.

- I. Protection of Concrete:** The concrete surface temperature shall be maintained above 35° F (2° C) until the concrete has attained a compressive strength of 1,500 psi (10.5 MPa). This protection shall be in addition to one of the curing methods specified in Section 380.3 P. Concrete damaged by cold weather shall be removed and replaced at the expense of the Contractor.

Covering materials such as insulating blankets, burlap mats, or plastic sheeting shall be available for the protection of the pavement surface. The pavement shall not be opened to traffic until meeting the requirements of Section 380.3.T.

When rain appears imminent, paving operations shall stop and the unhardened concrete shall be covered with the protective covering. Pavement not properly protected from weather shall be subject to corrective action as determined by the Engineer.

- J. Test Specimens:** The Contractor shall furnish concrete from the mixture for making test specimens.

- K. Strike-Off of Concrete:** The concrete shall be struck-off, consolidated, and finished, so the surface of the pavement conforms to the cross section and elevation specified. Concrete shoulders shall not be constructed above nor more than 1/8 inch (3 mm) lower than adjacent concrete pavement.

- L. Placement of Reinforcement and Dowel Bar Assemblies:** Reinforcement for continuously reinforced concrete slabs, shall be supported on chairs and the entire slab poured in one operation. The chairs meeting the requirements of Section 480 shall hold the reinforcement in position without displacement, during concrete placement.

The reinforcement shall be free from dried concrete, dirt, oil, paint, grease, mill scale, and rust, which could impair bond with the concrete.

The reinforcement shall be positioned on approved supports in advance of the concrete placement or inserted in the plastic concrete by an approved mechanical device. Tie bars mechanically inserted shall be placed prior to the final strike off of the paver. The Contractor shall verify the placement of tie bars. At a minimum, the tie bar depth, location and spacing shall be verified at the start of paving each day and at a frequency of every 250 feet during normal paving. No hand placement will be allowed.

Dowel bar assemblies shall be installed where specified. Anchor pins for the dowel bar assemblies shall be installed as detailed in the plans. Dowel bar assemblies shall be fabricated in single units for the appropriate lane prior to being placed on the subgrade. Any chair reinforcement that pass through the contraction joint shall be cut after the dowel bar assembly installation, but prior to concrete installation.

The free ends of the epoxy coated dowel bars [minimum of $\frac{1}{2}$ of the dowel length plus two inches (50 mm)] shall be given a thin uniform coating of form oil or multipurpose grease. This coating shall be applied within two hours of being covered by concrete.

In lieu of this manual coating, dowel bar assemblies may be pre-coated by dipping the complete assembly in a bond breaker meeting the requirements of Section 1010. Dowel bar assemblies shall be pre-coated on projects which have quantities of Portland cement concrete pavement of 50,000 square yards (41,805 sq. m) or greater. Pre-coated dowel bar assemblies must be free of foreign materials at the time of placement.

The location of doweled contraction joints shall be carefully marked, to assure accurate placement of the weakened plane of the joint during subsequent operations.

Dowel bars shall be placed parallel to the subgrade and parallel to the centerline of the pavement.

- M. Joints:** Immediately after sawing the joints to their final configuration, the resulting slurry shall be completely removed from the joint and the immediate area by flushing with a jet of water and other tools as necessary. Curing membrane damaged or protective cover removed during the sawing operation shall be repaired or replaced by the Contractor as directed by the Engineer at no cost to the Department.

- 1. Longitudinal Sawed Joints:** Deformed steel tie bars shall be placed perpendicular to the longitudinal joints by approved methods. Tie bars shall not be painted or coated with asphalt or other material, or enclosed in tubes or sleeves.

Longitudinal sawed joints shall be cut to the dimensions specified. Suitable guidelines or devices shall be used to assure cutting the joint to a true line. The sawed joint will not require reapplication of curing compound. The joint shall be sealed as required in Section 380.3 R.

Sawing of the longitudinal joint shall commence as soon as the concrete has hardened sufficiently to permit sawing without raveling, usually four to 24 hours after concrete placement. All joints shall be sawed to the specified depth as shown on the plans before uncontrolled shrinkage cracking occurs.

Repair or correction of uncontrolled cracks shall be as directed by the Engineer and at the expense of the Contractor.

- 2. Longitudinal Construction Joints:** When adjacent lanes of pavement are constructed separately, a keyway shall be formed along the construction joint. The keyway may be omitted at the Contractor's option if the longitudinal joint is tied with deformed steel tie bars. When deformed steel tie bars are required, they may be bent at right angles, with a minimum inside bend radius of 1-7/8" (48 mm), for the first lane constructed and straightened into final position before the concrete of the adjacent lane is placed. Tie bars damaged during the straightening process shall be replaced by drilling and epoxy installation at the Contractor's expense. Tie bars shall conform to Section 380.3 M.1, except that rail steel shall not be used for tie bars that are to be bent and restraightened. The longitudinal construction joint shall be sawed shortly after the end of the curing period and shall be sealed as required in Section 380.3 R.

When adjacent lanes of pavement are constructed separately, epoxy-coated deformed steel tie bars of specified length, size, spacing and material shall be placed across the longitudinal construction joint to tie the lanes together. The epoxy-coated tie bars installed in drilled holes along the vertical edge of the first lane placed, shall be installed with an approved epoxy resin adhesive to provide a minimum pull requirement of 7,750 lbs (35 kN). Holes shall be blown clean and dry prior to placing the adhesive. The installation shall be with methods and tools conforming to the adhesive manufacturer's recommendations.

The drilled holes shall be filled from the back to the front 1/3 to 1/2 full of epoxy or as recommended by the manufacturer, prior to insertion of the steel bar. Care shall be taken to prevent epoxy from running out of the horizontal hole prior to steel bar insertion. Rotate the steel bar during installation to eliminate voids and ensure complete bonding of the bar. Insertion of the bars by the dipping method will not be allowed.

If an epoxy pump is utilized, it shall be capable of metering the components at the manufacturer's designated rate and be equipped with an automatic shut-off. The pump shall shut off when any of the components are not being metered at the designated rate.

The Contractor shall load test five percent of the first 500 tie bars installed. No further installation will be allowed until the initial five percent testing has been completed and approval to continue installation has been given by the Engineer. Testing will be required for 0.5 percent of the bars installed after the initial 500. For each bar that fails to pass the minimum requirements, two more bars selected by the Engineer shall be tested. Each bar that

fails to meet the minimum load requirement shall be reinstalled and retested. The equipment and method used for testing shall meet the requirements of ASTM E 488. All tests shall be performed within 72 hours of installation. The tie bars shall be installed and approved before concrete is placed in the adjacent lane.

- 3. Transverse Contraction Joints:** Transverse contraction joints shall be created by sawing. The initial saw cut shall commence when the concrete has hardened sufficiently to permit sawing without raveling. The widening cut shall not commence until completion of the concrete cure period. Joints shall be sawed before uncontrolled shrinkage cracking takes place. If necessary, the initial sawing operations shall be performed on both day and night, regardless of weather conditions. The initial sawed joint will not require reapplication of curing compound.
- 4. Random Cracks:** The sawing of a joint shall be omitted if a crack occurs within 3 inches (75 mm) of either side of the joint location prior to the time of sawing. Sawing shall be discontinued when a crack develops ahead of the saw. Any procedure which results in premature and uncontrolled cracking shall be revised immediately by adjusting the sequence of cutting the joints or the time interval involved between the placing of the concrete or removal of curing media and the cutting of joints.

Longitudinal random cracks penetrating the full depth of the pavement shall be repaired to the satisfaction of the Engineer. This may involve but not be limited to, cross-stitching, removal and replacement, epoxy injection, or routed and sealed.

Repair or correction of uncontrolled or random cracks shall be as directed by the Engineer and at the expense of the Contractor.

If an uncontrolled crack develops on one side of the contraction joint, more than three inches (75 mm) from the joint and less than six feet (1.8 m) from the same joint, a minimum of six feet (1.8 m) of pavement removal and replacement will be required. Removal and replacement of the pavement shall be done at the Contractor's expense. If cracking occurs on both sides of the joint, more than three inches (75 mm) from the joint, the dowel bar assembly and a minimum of three feet (1 m) of pavement each side of the joint shall be removed and replaced. Removal and replacement of the pavement shall be done at the Contractor's expense.

If an uncontrolled crack develops on one side of the contraction joint in the mid panel area between six feet (1.8 m) from the joint and the midpoint of the panel, the entire panel shall be replaced on that side of the joint within the lane containing the cracking. Removal and replacement of the pavement shall be done at the Contractor's expense.

No section of pavement less than six feet (1.8 m) in length will be allowed to remain in place.

The Department will provide drawings and specification of repair procedures to the Contractor. If extreme conditions exist which make it impractical to prevent erratic cracking by early sawing, the contraction joint groove shall be formed in a manner approved by the Engineer prior to initial set of the concrete.

5. **Transverse Construction Joints:** Transverse construction joints shall be made at the end of each days run and where an interruption is of a duration long enough that the concrete is no longer plastic and cannot be vibrated.

The transverse construction joint shall be located either at the contraction joint location or a minimum of five feet (1.5 meters) from the nearest contraction joint. Supplemental hand vibrators shall be immediately available to provide satisfactory consolidation at joints.

Paving in the area of a transverse construction joint will not be permitted for 12 hours after installation.

N. Final Strike-Off, Consolidation, and Finishing:

1. **Sequence:** The sequence of operations shall be; the strike-off and consolidation, floating and removal of latence, straight edging, and final surface finish.

The addition of water to the surface of the concrete to assist in finishing operations will not be permitted. In isolated areas where extreme conditions exist, the Engineer may determine the addition of water would be beneficial if applied with an approved fog sprayer.

2. **Finishing at Joints:** The concrete adjacent to joints shall be placed without voids or segregation against the joint material, under and around all load transfer devices, joint assembly units, and other features designed to extend into the pavement. Concrete adjacent to joints shall be mechanically vibrated as per Section 380.3 H.
3. **Machine Finishing:** Vibrators meeting the requirements of Section 380.3 B.4 shall be used for full width vibration of concrete paving slabs.

Immediately after placement, the concrete shall be struck off and screeded by an approved finishing machine. The machine shall go over each area of pavement as many times and at the intervals necessary for proper consolidation and to produce a surface of uniform texture.

Excessive finishing over a given area shall be avoided. The tops of the forms shall be kept clean by an effective cleaning device attached to the machine. The travel of the machine on the forms shall be maintained true without lift, wobbling, or other variation affecting the precision finish.

During the first pass of the finishing machine, a ridge of concrete shall be maintained ahead of the front screed for its entire length.

The finishing machine shall be operated with a continuous forward movement. All operations of mixing, delivering, spreading, and vibrating concrete shall be coordinated to provide uniform progress and minimize the stopping and starting of the paver.

Except in an emergency, no tractive force shall be applied to the machine, except that which is controlled from the machine.

- 4. **Hand Finishing:** Hand finishing methods will not be permitted except when narrow widths or irregular areas, that cannot be finished with mechanical equipment, are encountered.

In the event of mechanical equipment breakdown, the concrete already deposited on the grade shall be hand finished and additional concrete placement shall be terminated. Hand finishing shall be done in a manner that produces an acceptable finished surface.

- 5. **Floating:** Long handled floats shall be used to smooth and fill open-textured areas in the pavement. The use of long-handled floats shall be kept to a minimum and shall not be used to float the entire surface of the pavement. Care shall be taken so the crown is not worked out of the pavement during the operation.

Excess water and laitance shall be removed from the surface of the pavement by a straightedge 10 feet (three meters) or more in length. Successive drags shall be lapped 1/2 the length of the straightedge.

- 6. **Final Finish:** Before the concrete has attained its initial set, the surface shall be given a final finish with a carpet drag drawn over the surface in a longitudinal direction. The drag shall be mounted on a bridge and shall be sized so that a strip of the carpet at approximately two feet (600 mm) wide is in contact with the pavement surface while the drag is operated.

The condition of the drag shall be maintained so the resultant surface is of uniform appearance with corrugations approximately 1/16 inch (2 mm) in depth. Drags shall be maintained clean and free of encrusted mortar. Drags that cannot be cleaned shall be discarded and replaced.

The carpet shall meet the following requirements:

Facing Material	- Molded polyethylene pile face
Blade Length	- 7/8", ±1/8" (22 mm, ±3 mm)
Total Fabric Weight	- 70 oz. per square yard min. (2.37 kg per square meter min.)

The backing shall be of a strong, durable material, not subject to rot, which is adequately bonded to the facing.

- a. **Plain Jointed Concrete Pavement:** Immediately following the carpet drag, the surface of the plain jointed concrete pavement shall be given a transverse metal-tine finish with a separate self-propelled mechanical device. The metal-tine finish shall provide a groove width of 1/8" and a groove depth of 3/16 inch (5 mm) ± 1/16 inch (2 mm). The spacing between the individual tines shall meet the following:

Inches (ten foot tining rake)

2-5/16, 2-15/16, 1-1/4, 2-7/16, 2-1/16, 1-1/4, 13/16, 1, 1-5/16, 1-1/8, 2-5/16
 2-1/2, 2-7/8, 2-3/4, 1-1/8, 2-3/4, 2-1/8, 1-15/16, 13/16, 7/8, 2-5/8, 3-1/16
 3-1/16, 7/8, 9/16, 9/16, 1-5/8, 2-3/8, 1, 1-1/4, 1-9/16, 2-15/16, 1-1/8
 1-15/16, 2-3/16, 2, 2-13/16, 1, 2-11/16, 13/16, 1-7/8, 9/16, 2-5/16, 1-7/8

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2-1/2, 1-5/16, 3-3/16, 1-3/8, 15/16, 7/8, 1-5/8, 9/16, 1-3/4, 2-7/8, 3
 1-5/8, 1-5/8, 7/8, 9/16, 5/8, 2-13/16, 1-5/8, 2-7/16, 13/16, 1-1/4, 11/16
 2-3/4, 2-5/16, 1-1/8

Millimeters (3 meter tining rake)

58,	74,	31,	62,	53,	32,	21,	26,	33,	28,	59
64,	73,	70,	29,	70,	54,	49,	20,	22,	67,	78
77,	23,	15,	15,	41,	60,	25,	32,	39,	75,	28
50,	55,	51,	72,	25,	69,	21,	47,	15,	59,	47
64,	34,	55,	35,	24,	22,	42,	14,	45,	73,	76
41,	41,	22,	15,	16,	71,	41,	62,	21,	31,	17
70,	58,	29								

Successive passes of the tining shall not overlap.

Each location, where transverse joint saw cuts are to be made, shall be protected from tining by covering with a metal strip from four inches (100 mm) to six inches (150 mm) or by other methods that produce acceptable results.

Brooming may be used on irregular areas in lieu of the carpet drag and tine finish. The broom shall be drawn transversely across the pavement with adjacent strokes slightly overlapping.

Brooming shall be uniform in appearance and shall produce grooves 1/16 inch (2 mm) deep. Texturing shall be completed while the concrete surface can be broomed without being torn or unduly roughened by the operation.

The finished surface shall be free from rough and porous areas, irregularities, and depressions resulting from improper handling of the broom.

- b.** Continuously Reinforced Concrete Pavement: Immediately following the carpet drag, the surface of the concrete pavement shall be given a longitudinal metal-tine finish with a wire broom or comb attached to a separate self-propelled mechanical device.

The longitudinal tining equipment shall have the ability to be raised and lowered, and shall have vertical and horizontal string line controls to ensure straight grooves that are parallel to the longitudinal joint.

The curing unit shall be separate from the tining unit when longitudinal tining is used unless the tining and curing can be accomplished simultaneously with the same piece of equipment at the specified rate to the satisfaction of the Engineer.

The tine bar shall have a single row of tines and shall provide a groove width of 1/8 inch (3 mm) \pm 1/64 inch (0.4 mm) and a groove depth of 3/16 inch (5 mm) \pm 1/16 inch (2 mm). The spacing between the individual tines shall be uniformly spaced at 3/4 inch (20 mm) intervals.

7. **Edging at Forms and Joints:** After the final finish, and while the concrete is still plastic, the edges of the pavement along each side of the slab, and on each side of transverse joints, shall be worked with an approved tool and rounded to the specified radius. Edging will be permitted along longitudinal construction joints provided the radius does not exceed 1/4 inch (6 mm). A well-defined and continuous radius shall be produced and a smooth, dense mortar finish obtained. The surface of the slab shall not be unduly disturbed by tilting of the tool during use.

Any tool marks appearing on the slab adjacent to the joints shall be eliminated by brooming, belting, or burlap dragging the surface without disturbing the rounding of the corner of the slab. All concrete on top of the joint filler shall be completely removed.

All joints shall be tested with a 10 foot (3 meter) straightedge before the concrete has set and correction made if one side of the joint is higher than the other or if they are higher or lower than the adjacent slabs.

O. Surface Test:

1. **Ten Foot (3 meter) Straightedge:** The pavement surface shall be tested with a 10 foot (3 meter) straightedge. The permissible longitudinal and transverse surface deviation shall be 1/8 inch (3 mm) in 10 feet (3 meters).

The permissible surface deviation for pavement used in rest areas, weigh stations, ramp entrances, shoulders, and other similar areas shall be 1/4 inch (6 mm) in 10 feet (3 meters).

The permissible transverse surface deviation on the outer six inches (150 mm) of the edge of pavement shall be 1/4 inch (6 mm) under a 10 foot (3 meter) straightedge except where the edge will become a longitudinal crown joint. This test should not be performed within 10 feet (3 meters) of a rumble strip.

Areas where the maximum deviation exceeds the permissible deviation by not more than 3/8 inch (10 mm) will be subject to the following at the discretion of the Engineer.

Grind down to an elevation where the area or spot will be within the permissible deviation.

Accept affected area without corrective action with price reduction at a rate noted below.

Areas where maximum deviation exceeds the permissible by more than 3/8 inch (10 mm) will be subject to the following at the discretion of the Engineer.

Grind down to an elevation where the area or spot will be within the permissible deviation.

Accept affected area without corrective action with price reduction at a rate noted below.

Satisfactorily remove and replace deficient area.

Grinding shall be accomplished with specially prepared circular diamond blades mounted on a horizontal shaft. Areas that have been ground shall not be left smooth or polished, but shall have a uniform texture equal in roughness to the surrounding unground concrete.

If the Engineer accepts the deficient area without correction, a price reduction at the following rates will be deducted from the contract.

Ten dollars per square yard (square meter) for those areas where the maximum deviation exceeds the permissible deviation by not more than 1/8 inch (3 mm).

Twenty dollars per square yard (square meter) for those areas where the maximum deviation exceeds the permissible deviation by more than 1/8 inch (3 mm) but not more than 3/8 inch (10 mm).

Thirty dollars per square yard (square meter) for those areas where the maximum deviation exceeds the permissible deviation by more than 3/8 inch (10 mm).

Measurements for determining the limits of deficient areas will be made in the following manner:

The longitudinal pavement surface test shall be completed on each wheel pass on driving lanes and on at least one pass on shoulders, etc. The length of the deviation will be that length out of specification tolerance at the location of the surface test as checked with a 10 foot (3 meter) straightedge and a 1/8 inch (3 mm) shim or 1/4 inch (6 mm) shim, where a 1/4 inch (6 mm) surface tolerance is specified. Where two surface tests vary within a particular site within a driving lane or shoulder, the length used for computation of the area will be the average of the two tests. The width will be the total width of the particular driving lane or shoulder. The depth of the deviation will be the maximum depth of the test(s) at a particular site as checked with 1/8 inch (3 mm), 1/4 inch (6 mm), and 3/8 inch (10 mm) shims.

Where the transverse surface test is out of specification, the maximum length and maximum width at a particular site shall be used in computation of the area.

2. Profilograph: When the profilograph is specified, the following provisions shall apply.

a. Operations: The profilograph shall be operated at a speed no greater than a normal walk. Two passes shall be made in each driving lane, one in each wheel path. The profilogram (trace) shall be marked and labeled at the beginning and end of each trace, equation, and 500 foot (150 m) marker. Each profilogram shall be completely labeled to show the project, stationing, lane, wheel pass, date paved, date tested and the operator's name.

Tests shall be run after each days paving. Tests shall be run the next working day following placement. If less than 1,000 linear feet (300 m) is paved, the days production may be grouped with the subsequent days production. Results shall be furnished to the Engineer within two working days after placement of the pavement and again within two working days after corrections are made.

Curing membrane damaged or protective cover removed during the testing operation shall be repaired or replaced by the Contractor as directed by the Engineer at no cost to the Department.

- b. Evaluation:** The profilogram shall be furnished to the Department and will be evaluated by and become the property of the Department. Evaluation consists of determining the profile index to the nearest 0.05 inch per mile (1 mm/km) by measuring and summing scallops that appear outside a zero width blanking band. The average profile index will be determined from the two wheel paths in each driving lane. Individual bumps will be evaluated using a 0.3 inch (8 mm) bump template. The average of the two profile indexes per lane will be rounded to the nearest 0.1 inch (1 mm).

The Department will spot check or retest areas it desires, with their own profilograph. If a discrepancy between the profilograms exist, the cause of the discrepancy shall be determined and the area re-run when ordered by the Engineer.

- c. Requirements:** The pavement shall conform to the following profile index requirements:
- 1) Pavement on tangent alignment and pavement on horizontal curves having a centerline radius of 1,000 feet (300 m) or more and pavement within the superelevation transitions shall not exceed an average profile index of 35.0 inches per mile (550 mm/km).
 - 2) Pavement on horizontal curves having a centerline radius less than 1,000 feet (300 m) and the superelevation transitions will not be tested with the profilograph. The profile will also terminate 50 feet (15 m) from each bridge approach slab or existing pavement, which is joined by the new pavement. Pavement sections not subject to profilograph testing shall meet the 10 foot (3 m) straight edge test requirements in Section 380.3 O.1.

Grinding shall be accomplished with specially prepared circular diamond blades mounted on a horizontal shaft. Areas that have been ground shall not be left smooth or polished, but shall have a uniform texture equal in roughness to the surrounding unground concrete.

- d.** Pavement, with profile smoothness values from 35.1 to 40.0 inches per mile (550 to 630 mm/km) in any 0.1 mile (100 m) section with bumps in excess of 0.3 inches (8 mm), may be ground and corrected to a profile value of less than 35.0 (550 mm/km) and receive 100.0 percent pay. This will require that the 0.1 mile (100 m) section be reprofiled by the Contractor.
- e.** Pavement, with an average profile index from greater than 40.1 inches per mile (630 mm/km) in any 0.1 mile (100 m) section, shall be subject to one of the following at the Contractor's option.
- 1) Correct by grinding to a value of 35.0 inches per mile (550 mm/km) or less.

- 2) Remove and replace deficient areas.
- f. Individual bumps in excess of 0.3 inches (8 mm) shall be subject to one of the following at the option of the Engineer:
- 1) Correct deficient area by grinding.
 - 2) Bumps less than 1/4 inch in 10 feet (6 mm in 3 m) may be accepted without correction.
 - 3) Remove and replace deficient areas.
- g. Coring for pavement thickness measurement will be performed after all corrective action has been completed by the Contractor.
- h. **Incentive Payment:** Incentive payments will be made based on the chart below:

<u>Profile Index</u> <u>Inches per Mile</u>	<u>Profile Index</u> <u>mm/km</u>	<u>Price Adjustment Percent of</u> <u>Contract Unit Price</u>
10.0 or less	160 or less	104.7
10.1 to 15.0	161 to 235	103.5
15.1 to 20.0	236 to 315	102.4
20.1 to 25.0	316 to 395	101.2
25.1 to 35.0	396 to 550	100.0
35.1 to 40.0	551 to 630	97.7
40.1 and greater	631 and greater	grind*

* Pavement at 40.1 (631 mm) and greater shall be corrected (ground or removed and replaced) to a value of 35.0 (550 mm) or less in any 0.1 mile (100 m) section.

Incentive payments cannot be improved due to grinding regardless of the average profile index.

The adjustments in the unit price will apply to the total area of the 0.1 mile-long section. The area will be computed using the total lane width (12 feet [3.7 m] or less) and the total length of the section (0.1 mile [100 m] or less if it is the segment at the end of the days pavement).

Areas excluded from profilograph testing shall be shoulders, transitions, areas within 50 feet (15 m) of existing pavement and bridges, curb and gutter sections, ramps and sharp curves. These areas will be checked for surface deviations using a 10 foot (3 m) straightedge as per Section 380.3 O.1.

- P. **Curing:** Immediately after the finishing operations have been completed and marring of the concrete will not occur, the entire surface, and exposed edges of the pavement, shall be properly cured. The concrete shall not be left exposed for more than ½ hour between stages of curing or

during the curing period. Curing shall be maintained for at least 72 hours after concrete placement. One of the following curing methods shall be used:

- 1. Cotton or Burlap Mats and White Polyethylene Sheeting:** The surface of the concrete pavement and both pavement edges shall be covered with cotton or burlap mats. The mats shall be thoroughly saturated with water and placed with the wettest side down.

Immediately after placement, the mats shall be covered with white polyethylene sheeting placed in accordance with paragraph three below.

Combination burlap-polyethylene sheeting may be substituted for one layer of burlap and the polyethylene sheeting with the Engineer's approval.

The mats shall be kept moist by periodic applications of water.

- 2. Impervious Membrane Method:** The entire surface of the pavement shall be sprayed uniformly with white pigmented curing compound immediately after the finishing of the surface. If the pavement is cured initially with jute or cotton mats, the impervious membrane shall be applied immediately upon removal of the mats. The curing compound shall not be applied during or immediately after rainfall.

Curing compound shall be applied under pressure by approved self-propelled mechanical sprayers. The curing compound may be applied in one or two applications. If applied in two applications, the second shall be applied within 30 minutes after the first.

The minimum application rate shall be one gallon per 150 square feet (one liter per foursquare meters) for carpet drag or broom finished surfaces and one gallon per 125 square feet (one liter per three square meters) for metal tined finished surfaces.

The sprayer equipment shall be equipped with a tank agitator and shall be fully atomizing. The spray fog shall be protected from the wind by a shield. During application the compound shall be thoroughly mixed and continuously agitated by mechanical means. Hand spraying of odd width or shapes and concrete surfaces exposed by form removal will be permitted.

Curing compound shall not be applied to the inside faces of joints to be sealed, unless the compound is completely removed by subsequent sawing operations. Curing membrane damaged or protective cover removed on the surface of the pavement during the sawing operation shall be repaired or replaced by the Contractor as directed by the Engineer at no cost to the Department.

Should the film become damaged within the curing period, the damaged portions shall be repaired immediately with additional compound.

Upon removal of side forms, the sides of the exposed slab shall be protected immediately with a curing treatment equal to that provided for the surface.

3. White Opaque Polyethylene Sheeting: The top surface and sides of the pavement shall be entirely covered with polyethylene sheeting. The units used shall be lapped at least 18 inches (450 mm). The sheeting shall be placed and weighted down to maintain intimate contact with the surface covered. The sheeting shall be sized so each unit as laid will extend beyond the edges of the slab at least twice the thickness of the pavement. In cold weather the substitution of dark sheeting for white sheeting will be permitted.

Q. Removing Forms: Forms shall not be removed until concrete has set for at least 12 hours, except for auxiliary forms used temporarily in widened areas. Forms shall be removed without damaging the pavement. After the forms have been removed, the exposed sides of the slab shall be cured by one of the methods indicated above.

R. Sealing Joints: Joints shall be sealed with hot-poured elastic joint sealer or low modulus silicone sealant as specified. Joints shall be sealed immediately after completion of the curing period, before the pavement is opened to traffic.

Joint grooves with spalls greater than ½ inch (13 mm) in depth shall be patched with an approved epoxy mortar. All loose concrete shall be removed from the spalled area and the spalled surface shall be thoroughly cleaned. After cleaning, the spalled surface shall be primed and an epoxy mortar of troweling consistency shall be placed in the spalled area and finished as the original pavement surface. The epoxy binder components shall be proportioned and mixed as recommended by the manufacturer. After the epoxy binder is thoroughly mixed, dry silica sand shall be blended into the mixture to give an epoxy mortar of trowelable consistency.

After the epoxy mortar has cured, the forming material shall be carefully removed.

The finished joint shall have vertical faces and the joint width shall be maintained.

Patching of spalls shall be done only when the temperature of the air and pavement are above 50°F (10°C).

Joints to be sealed shall be thoroughly clean and dry. All materials such as old sealant, oil, asphalt, curing compound, paint, rust, and other foreign materials shall be completely removed. Cleaning shall be accomplished by sand blasting and other tools as necessary. Joints to be sealed with silicone sealant shall be sand blasted utilizing a mechanical device that holds the sand blaster at the appropriate angle and distance from the joint to ensure proper cleaning. The device shall have a mechanism attached that will correctly guide the device in the joint.

Just prior to sealing, each joint shall be blown out using a jet of compressed air, at a working pressure of not less than 90 psi (620 kPa), to remove all traces of dust. Air compressors used for cleaning joints shall be equipped with traps capable of removing all free water and oil from the compressed air.

Joint sealer application will not be permitted when the air or pavement temperature near the joint is less than 40°F (5°C) or is 40° F (5°C) and falling.

The sealant shall be applied without spilling on the exposed surface. Sealant on the surface of the concrete pavement shall be removed immediately and the pavement surface cleaned.

Failure of the joint material in either adhesion or cohesion will be cause for rejection. Repair shall be at the expense of the Contractor.

Shoulder joints between Portland cement concrete pavement and asphalt concrete shoulders shall be sealed in accordance with 320.3.I.

1. **Hot-Poured Elastic Joint Sealer:** Hot-poured elastic joint sealer shall be stirred during heating so that localized overheating does not occur. All joints shall be sealed with an approved pressure sealing device, equipped with a nozzle inserted into the joint, so sealing material will be forced from the bottom of the joint to the top.
2. **Silicone Sealant:** Silicone sealant shall be applied with a mechanical device equipped with a nozzle or spout shaped to fit into the joint. The joint sealant shall be applied under pressure from the inside of the joint to remove entrapped air and ensure good joint contact.

Backer rod shall be installed to the proper depth to produce the width and depth of sealant specified.

The sealant surface shall be tooled to produce a slightly concave surface 1/4 inch (6 mm) below the pavement surface. Tooling shall be accomplished before a skin forms on the sealant surface. The use of soap or oil as a tooling aid will not be permitted.

3. **Seasonal Restrictions:** Silicone sealing operations shall be suspended after October 15, unless the Contractor has received written permission from the Region Engineer to continue sealing. After the October 15 seasonal restriction, only the initial cut shall be performed at all joints. Then the following spring the joints shall be widened, backer rod installed, and sealed with silicone according to Section 380.3 R.

All costs related to the seasonal sealing restrictions including additional labor and materials, equipment, traffic control, mobilization, and incidentals shall be at the expense of the Contractor.

- S. **Protection of Pavement:** The Contractor shall protect the pavement and its appurtenances against all traffic. This shall include watchmen to direct traffic and the erection and maintenance of warning signs, lights, pavement bridges, cross-overs, etc. Cross-overs will not be permitted until the concrete is at least 24 hours old.

Any damaged or defective pavement shall be repaired or removed and replaced as directed. When pavement must be removed and replaced, the Engineer will determine the dimensions of the pavement to be removed.

- T. **Application of Live Load:** The pavement shall not be opened to traffic until the concrete has attained a compressive strength of 4,000 psi (28 MPa). The pavement shall be cleaned prior to opening to traffic.

When concrete is placed adjoining a previously constructed pavement, the paving machines, mechanical spreaders, and other heavy equipment shall not be operated on the existing pavement until the existing concrete has attained a compressive strength of 3000 psi (21 Mpa). Hauling units shall not be allowed on the concrete until it has attained a compressive strength of 4000 psi (28 MPa). Working platforms, finishing, tining, curing, and other lightweight equipment may be operated on the edge of the existing concrete 72 hours after the concrete was placed.

When operating on previously constructed lanes, measures shall be taken to protect the previously constructed lane from becoming marred by the equipment.

- U. Tolerance in Pavement Thickness:** The pavement thickness will be determined by average caliper measurement of cores tested in accordance with AASHTO T 148. Cores shall be sampled in accordance with AASHTO T24.

Cores may be taken in areas believed to be deficient in thickness. Pavement deficiencies verified by these core measurements will be considered under the provision of Section 5.3. These core measurements will not be used to determine pavement thickness as set forth in the following:

For the purpose of establishing an adjusted unit price for pavement, units are to be considered separately. The size of units taken from Table 1 are determined as follows. (For concrete shoulders, see paragraph 9 below.)

- 1. Width:** The width of the pavement represented shall be the pavement surface between adjacent longitudinal construction joints; between a longitudinal construction joint and the pavement edge; or between two pavement edges where the entire width is poured in one operation.
- 2. Length:** The length of the unit is that shown in Table 1 corresponding to the width.

TABLE 1

Width of Pavement to be Represented by Cores	Length of Unit	Intervals for Additional Cores
Up to and including 15 ft (5 m)	1,500 ft (450 m)	450 ft (135 m)
over 15 ft thru 30 ft (5 m thru 10 m)	1,000 ft (300 m)	300 ft (90 m)
30 ft thru 42 ft (10 m thru 15 m)	750 ft (225 m)	225 ft (70 m)
over 42 ft (15 m)	500 ft (150 m)	150 ft (45 m)

The remaining fractional unit length in feet (meters) shall be represented by cores in one of the following manners:

- a.** If the fractional part of the unit length is 50% or less of the specified unit length from Table 1, the fractional part shall be added to the previous unit and the intervals for the additional cores should equal approximately 30% of the total length.

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Location of cores will not be a factor in determining average thickness of a unit.

- 8. Payment:** Payment for units will be in accordance with Table 2.

Table 2
Portland Cement Concrete Pavement

Deficiency In Thickness Determined by Cores		Proportional Part of Contract Price
From	Through	Allowed
0.00" (0 mm)	0.20" (5 mm)	100 percent
0.21" (5.1 mm)	0.30" (8 mm)	80 percent
0.31" (8.1 mm)	0.40" (10 mm)	72 percent
0.41" (10.1 mm)	0.50" (13 mm)	68 percent
0.51" (13.1 mm)	0.70" (18 mm)	57 percent
0.71" (18.1 mm)	1.00" (25 mm)	50 percent

- 9. Concrete Shoulders:** The foregoing provisions for tolerance in pavement thickness will apply to Portland cement concrete shoulders with the following exceptions:
- a. Each shoulder shall be cored separately.
 - b. The unit length will be 2,000 feet (600 meters). The last unit on each shoulder will be the appropriate length plus the fractional part of that length in feet (meters) remaining.
 - c. Wherever in the foregoing 0.2 inch (5 mm) is mentioned, substitute 0.3 inch (8 mm).
 - d. When the measurement of the core from a unit is deficient by more than 0.3 inch (8 mm) and not more than one inch (25 mm) from the plan thickness, two additional cores, at intervals not less than 600 feet (200 meters) will be taken and used in the average thickness for that unit.
 - e. Payment for units will be in accordance with Table 3.

Table 3
Portland Cement Concrete Shoulders

Deficiency in Thickness Determined by Cores		Proportional Part of Contract Price
From	Through	Allowed
0.00" (0 mm)	0.30" (8 mm)	100 percent
0.31" (8.1 mm)	0.40" (10 mm)	80 percent

0.41" (10.1 mm)	0.50" (13 mm)	72 percent
0.51" (13.1 mm)	0.60" (15 mm)	68 percent
0.61" (15.1 mm)	0.80" (20 mm)	57 percent
0.81" (20.1 mm)	1.00" (25 mm)	50 percent

380.4 METHOD OF MEASUREMENT

- A. Portland Cement Concrete Pavement, Shoulders, and Pavement -Miscellaneous:** These items will be measured to the nearest 0.1 square yard (0.1 square meter). Pavement which is removed or for which no payment will be made, will not be measured. Area computations will be as set forth in Section 9.1. When an item for Portland cement concrete pavement - miscellaneous is provided in the contract, the areas of concrete pavement to be measured under this item will be described on the plans.
- B. Dowel Bar Assemblies:** Dowel bar assemblies will be measured by the actual number of bars furnished and installed.

380.5 BASIS OF PAYMENT

- A. Portland Cement Concrete Pavement, Shoulders and Pavement -Miscellaneous:** These items will be paid for at the contract unit price per square yard (square meter) or the adjusted unit price as set forth in Section 380.3 U.

Payment will be full compensation for furnishing all materials (including reinforcing steel), labor, equipment, and all incidentals necessary. Payment will also be full compensation for trimming and water used to moisten the subgrade ahead of the paver and curing the concrete.

The amount bid on these items shall be based on the specified amount of cement per cubic yard (cubic meter). If a cement factor is not shown on the plans, the amount bid shall be based on 600 pounds per cubic yard (355 kilograms per cubic meter) for pavement, shoulders and pavement-miscellaneous.

- B. Dowel Bar Assemblies:** Dowel bar assemblies will be paid for at the contract unit price per each dowel bar. Payment will be full compensation for labor, materials, equipment, and all incidentals necessary to furnish and install the assemblies. Payment will be based on plans quantity unless changes are ordered in writing.
- C. Profilograph:** Payment will not be made. The Contractor shall absorb all costs involved in the furnishing, operating and calibration of the profilograph.

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