

STANDARD SPECIFICATIONS

**FOR
STATE ROAD
AND BRIDGE
CONSTRUCTION**

METRIC VERSION



**Kansas Department
of
Transportation**

Edition



1990

DIVISION 500
RIGID PAVEMENT



SECTION 501
EQUIPMENT

Unless otherwise noted, equipment shall conform to the requirements specified in Division 150.

SECTION 502**PORTLAND CEMENT CONCRETE PAVEMENT****502.01 DESCRIPTION.**

This work shall consist of constructing a concrete pavement with or without reinforcement as specified, constructed on a prepared subgrade or base course in accordance with these specifications, Plans or as established by the Engineer.

BID ITEMS

Concrete Pavement (* Uniform) (AE) (**).

Early Strength Concrete Pavement (* Uniform) (AE) (**).

Concrete Cores.

* Thickness.

** "Plain" denotes concrete pavement without mesh. No entry denotes concrete pavement with mesh.

502.02 MATERIALS.

Materials shall conform to the requirements specified in Division 400 and the Materials Division:

Water	Section 2400
Portland Cement.....	Section 2000
Fine Aggregate	Section 1100
Coarse Aggregate	Section 1100
Combined Aggregate	Section 1100
Reinforcing Steel.....	Section 1600
Fly Ash.....	Section 2000
Silicone Joint Sealant	Section 1500
Expansion Joint Filler Type A	Section 1500
Concrete Curing Materials	Section 1400

502.03 CONSTRUCTION REQUIREMENTS.**(a) Preparation of the Subgrade.**

Both the subgrade and the granular or treated subbase shall be brought to the lines, grades, and typical sections shown on the Plans or designated by the Engineer. All soft and yielding materials and other portions of the subgrade which will not compact readily when rolled or tamped shall be removed, and all loose rock or boulders found in the earth excavation shall be removed or broken off to a depth of not less than 150 millimeters below the surface of the subgrade. All holes or depressions made by the removal of materials as described above shall be filled with approved material, and the entire subgrade brought to line and grade and compacted.

(1) **Compaction.** The entire subgrade, and granular or treated subbase shall be thoroughly compacted. Any portion of the subgrade or granular or treated subbase that is not accessible to a roller shall be compacted with hand tampers. The density requirements for the subgrade shall be as shown on the Plans.

(2) **Protection.** Before placing any surfacing material on any section, the ditches and drains along that section shall be completed to drain the highway effectively. In handling materials, tools, equipment, etc., the Contractor shall protect the subgrade from damage. If ruts are formed, the subgrade shall be reshaped and rerolled. At all times the subgrade surface shall be kept in such condition that it will drain readily. Until the subgrade has been checked and approved, no material shall be deposited thereon.

Storing or stockpiling of materials on the subgrade will not be allowed. The placing of materials or laying of pavement will not be permitted upon a frozen or muddy subgrade.

(3) **Fine Grading for Subgrade or Granular or Treated Subbase.** A subgrade or subbase must be trimmed or fine graded prior to being overlaid with concrete pavement. For slip form paving, unless otherwise authorized by the Engineer, the subgrade or subbase shall be trimmed to grade by the use of an automated, electronically controlled machine. The control of grade and cross slope shall be accomplished by use of sensors actuated by a taut reference line. This line shall be true to line and grade, so as to assure vertical control during the subgrade or subbase trimming and subsequent paving operations. The reference line shall be erected and maintained by the Contractor.

In lieu of the above operation, when side forms have been securely set to grade, the subgrade or subbase shall be brought to the proper cross section. An approved type of subgrade planer that rides on the forms shall be used in shaping the subgrade or subbase to insure that the specified thickness is secured when the pavement is completed. The planer shall have a continuous cutting edge. Scratch planers with spikes or teeth will not be permitted.

The trimming of narrow or irregular areas may be accomplished using other conventional methods.

All high areas in the grade shall be trimmed to the proper elevation. Low areas shall be filled and compacted with suitable subbase material. The Contractor shall maintain the finished grade in a smooth and compacted condition until the concrete pavement is placed. All trimming equipment must

operate far enough in advance of the paving operation that ample opportunity is given to check the grade and make corrections if need be.

(b) Concrete Consistency.

The consistency of the concrete when delivered to the paving train will be as designated by the Engineer. The tolerance permitted from the designated slump shall be plus or minus 20 millimeters. The maximum slump allowable shall be 60 millimeters. When the designated slump is greater than 45 millimeters the plus tolerance will be limited by the maximum slump. When approved by the Engineer, slumps in excess of 60 millimeters may be permitted in areas where hand finishing methods are permitted and used. Additional cement may be required to remain within the water-cement ratio requirements stipulated in Section 402.

(c) Slip Form Paving.

When paving is performed with a slip form paving unit, the equipment shall consist of a concrete spreader or placing machine followed by a separate paving unit. The concrete spreader or placing machine requirement may be waived with the approval of the Engineer only when it is demonstrated that a quality product and riding surface can be attained without the use of an independent spreader. Traffic will not be allowed on the completed subbase without the approval of the Engineer.

No tractive forces shall be applied to the slipform paver except that which is controlled from the machine. The subgrade or surface of the subbase over which the tracks of the paver will travel should be trimmed to grade. The surface shall not be disturbed by other equipment. The paver shall be operated in a continuous operation. Frequent starting and stopping of the paver shall not be allowed. If it is necessary to stop the forward movement of the paver, the vibrator and tamping elements shall be stopped immediately.

The number of paving units and work capacity of machines furnished shall be adequate to perform the work required at a rate equal to that of concrete delivery to the placing units.

Concrete shall not be placed when stormy or inclement weather prevents good workmanship. The subgrade or subbase shall be sprinkled lightly with water so that it will be in a thoroughly moistened condition when the concrete is deposited thereon. Care must be taken to avoid puddling water on the grade, creating a muddy grade.

Once the paving operation has started, the amount of equipment and supply of materials shall be sufficient to insure that placing will be continuous for any given working period. All concrete conveying equipment shall be kept clean.

The concrete shall be deposited on the grade in successive batches in a manner which will require as little rehandling as possible. Concrete shall be placed over and against any joint assemblies in such a manner that the joint assembly is retained in its correct position.

Spreading shall be done by approved mechanical spreaders in a manner that will prevent segregation and separation of the materials.

Necessary hand spreading shall be done with shovels, not rakes. Workmen shall not be allowed to walk in the fresh concrete with boots or shoes coated with earth or foreign substances.

After the concrete is struck off by the spreader there shall be sufficient concrete in place to allow the final shaping by the use of screeds, templates and pan, depending on make, model and type of machines approved for use in the paving train. The paving units shall be adjusted for the required final cross section in such a manner that the need to carry back concrete by hand to fill voids or depressions is minimized. Screeds shall carry a uniform roll of concrete, with each screed or template being so adjusted that the uniform roll of concrete extends the full length of the screed or template and allows just enough concrete to pass under the unit to properly feed the next machine. Screeds or templates should not shove large volumes of concrete. Adjusting a screed or template to maintain a uniform cross section is required.

Should any concrete materials fall on or be worked into the surface of the plastic concrete it shall be removed immediately by approved methods.

Placement of concrete ahead of the initial spreader strikeoff shall not be more than 30 minutes ahead of the final spreader strikeoff. If concrete is placed in one lift, the placement of concrete shall not be more than 30 minutes ahead of the spreader strike off.

Screeds and pans shall be of the adjustable type capable of being adjusted in suitable increments to conform to the transition from plane surface to fully crowned surfaces while the machine is in motion.

All concrete shall be placed while fresh. Any concrete showing improper proportions of materials, including water, shall

not be used in the pavement and any such unsatisfactory concrete shall be removed and disposed of by the Contractor at his expense.

The use of any paving machine in the paving train shall be contingent upon its ability to finish the pavement satisfactorily to the required grade, section, and proper degree of consolidation. The Engineer may at any time require the adjustment, repair or replacement of the machine for mal-performance.

When construction of more than two lanes wide is to be paved by slip form methods, and a cold construction joint is required due to the Contractor's method of operation, the slip form paver will include a device to shape, punch and place a sheet metal open trapezoid as a female key way joint. Bent tie bars or two piece tie bars shall be inserted into the hole provided.

The paver shall be equipped with traveling side forms of sufficient dimensions, shape and strength to support the concrete laterally for sufficient time to produce pavement of the required cross section. Any edge slump of the pavement exclusive of edge rounding, in excess of six millimeters shall be corrected before the concrete has hardened. Excessive edge slumping will be sufficient reason to discontinue paving until machinery is properly adjusted or removed from the project.

A longitudinal finisher designed to eliminate small surface irregularities shall be utilized in the final finishing operation unless otherwise authorized by the Engineer.

Under normal working conditions moisture shall not be applied to the surface of the concrete pavement. The use of additional water on the surface of the fresh concrete to lubricate the float of the longitudinal finisher will be allowed only with the express permission of the Engineer. If unusual weather conditions require the addition of superficial water to the surface of the concrete, it shall be applied only in the form of a fine fog mist.

The surface trueness of the finished pavement shall meet the applicable requirements shown in Section 502.06. When the machine finishing has been completed the surface shall be checked, prior to texturing, with a straightedge not less than three meters in length. The straightedge shall be operated parallel to the pavement centerline starting at the center and progressing outward. Advancement shall be made in successive stages of not more than $\frac{1}{2}$ the length of the straightedge. At the Contractor's option, this requirement may be waived when smoothness is to be determined by the profilograph.

(d) Placing Reinforcement.

Except for irregular areas, pavement reinforcement shall be placed as shown on the Plans. All dowel bars and tie bars required by the Plans shall be held in proper position by sufficient approved metal bar supports or pins. Longitudinal joint tie bars and dowel bars may be installed mechanically by means of equipment and methods approved by the Engineer. The satisfactory placement of the bars shall depend upon the ability of the Contractor's equipment to place the bars in their true position. The Engineer may require, when satisfactory placement is not obtained by mechanical means, that the tie bars and dowel bars be installed ahead of placing the concrete and that they be securely staked and tied if necessary to hold them in their exact position. The use of removable devices, supporting the bars from the forms will not be permitted.

Following the placing of concrete, it shall be struck off to conform to the cross section shown on the Plans and to an elevation such that when the concrete is properly consolidated and finished, the surface of the pavement will be at the elevation shown on the Plans. When reinforced concrete pavement is placed in two layers, the entire width of the bottom layer shall be struck off to such length and depth that the sheet of fabric or bar mat may be laid full length on the concrete in its final position without further manipulation. The reinforcement shall then be placed directly upon the concrete, after which the top layer of concrete shall be placed, struck off and screeded. Any portion of the bottom layer of concrete which has been placed more than 30 minutes without being covered with the top layer shall be removed and replaced with fresh mixed concrete at the Contractor's expense. When reinforced concrete is placed in one layer, the reinforcement may be positioned in advance of the concrete placement or it may be placed in the plastic concrete, after spreading, by mechanical or vibratory means.

Where two layers of wire mesh reinforcement are required, as at bridge approaches, the bottom layer shall be supported in the required position with bar chairs; separators shall be used for the top layer if the strike-off cannot be properly used for the operation. Laps in adjacent sheets or mats of reinforcement shall be as shown on the Plans. Laps parallel to the centerline of the pavement will not be permitted except for unusual widths of pavement lanes or for irregular areas. If the Plans do not show dimensions for laps, the minimum lap either perpendicular or parallel to the centerline of the pavement

shall be 150 millimeters. The adjacent sheets shall be fastened or tied together to hold all parts of the sheets in the same plane. The wire mesh reinforcement shall be placed in the pavement at the elevation as shown on the Plans.

The appearance of a "wire pattern" on the surface of the fresh pavement will be cause to remedy this particular situation and immediately modify placement procedures.

Reinforcing steel shall be free from detrimental amounts of dirt, oil, paint, grease, loose mill scale, and loose or thick rust which could impair bond of the steel with the concrete.

(e) Consolidation and Finishing.

Consolidation of each layer of concrete, when placed in more than one layer or full depth if placed in one lift, shall be attained by the use of approved vibrators or other approved equipment. The concrete shall be sufficiently and uniformly vibrated across the full width and depth of the pavement so that the density of pavement concrete shall be not less than 98 percent of the rodded unit mass. The 98 percent density requirement may be eliminated on such miscellaneous areas as entrance pavement, median pavement, gore areas, etc. Consolidation of these areas shall be attained by the use of approved vibrators.

Vibrators, either of the surface type (pan or screed) or the immersion type (tube or spud) may be attached to the spreader, paver, or the finishing machine, or may be mounted on a separate carriage. The vibrators shall be operated only when the machine to which they are attached is moving forward. In no case shall hand vibrators be operated longer than 15 seconds or less than five seconds in any one location unless approved otherwise by the Engineer. Vibrators shall be placed in and withdrawn vertically from concrete in a slow deliberate manner. Vibrator frequencies shall be checked when the vibrator is under load and shall operate at frequencies as shown below.

**TABLE 1
VIBRATOR ELEMENT FREQUENCIES**

TYPE	FREQUENCY MINIMUM HERTZ
Surface, Pan, or Screed	60
Immersion Tube, Paving Machine Attachment	85
Immersion Spud, Hand Operated	135
Immersion Spud, Gang Mounted	135

Care shall be taken to see that a uniform, continuous roll of concrete over the vibrators ahead of the strike-off is being

maintained. The height of the roll should be approximately the same thickness as the pavement being vibrated.

In order to insure concrete consolidation in the vicinity of joint assemblies, the Engineer may require that these areas be hand vibrated with an immersion spud vibrator.

In the event the specified density is not attained, paving operations shall cease and necessary adjustments be made to produce concrete to conform to the density requirements.

The Engineer shall use an approved nuclear density measuring device to monitor in place density. A moveable bridge shall be furnished and moved to test locations by the Contractor, as required, to allow the inspector to work over the fresh concrete.

On projects or areas within projects where the use of conventional equipment is impractical, other consolidating and finishing equipment, approved by the Engineer may be used in lieu of the equipment designated above.

(f) Fixed Form Paving.

At the option of the Contractor the fixed form paving method may be used.

(1) Forms.

Straight forms shall be of metal having adequate thickness to support the equipment and shall be furnished in sections not less than three meters in length. Forms shall have a depth equal to the prescribed edge thickness of the concrete, without horizontal joint, and a base width at least equal to the depth of the forms. Flexible or curved forms of proper radius shall be used for curves of 50 meters radius or less except, approved straight forms of 1.5 meter lengths may be used for curves of a radius from 20 meters to 50 meters. Flexible or curved forms shall be of a design acceptable to the Engineer. The Engineer may approve the use of wood forms in areas requiring hand finishing. Forms shall be provided with adequate devices for secure setting so that when in place they will withstand, without visible spring or settlement, the impact and vibration of the consolidating and finishing equipment. Flange braces shall extend outward on the base not less than $\frac{2}{3}$ the height of the form. Forms with battered top surface, and bent, twisted or broken forms shall be removed from the work. Repaired forms shall not be used until inspected and approved. Build-up forms shall not be used except where the total area of pavement of any specified thickness on the project is less than 2,000 square meters. The top face of the form shall not vary from a

true plane more than three millimeters in three meters, and the upstanding leg shall not vary more than six millimeters. The forms shall contain provisions for locking the ends of abutting form sections together tightly, and for secure setting.

(2) Base Support.

The foundation under the forms shall be hard and true to grade so that the form, when set, will be firmly in contact for its whole length and at the specified grade.

(3) Form Setting.

Forms shall be set sufficiently in advance of the point where concrete is being placed so that line and elevation can be checked. After the forms have been correctly set, the grade shall be thoroughly tamped, mechanically, at both the inside and outside edges of the base of the forms. Forms shall be staked into place with not less than three pins for each three meter section. A pin shall be placed at each side of every joint. Form sections shall be tightly locked, free from play or movement in any direction. The forms shall not deviate from true line by more than six millimeters at any point. No excessive settlement or springing of forms under the finishing machine will be permitted. Forms shall be cleaned and oiled prior to the placing of concrete.

(4) Grade and alignment.

The alignment and grade elevations of the forms shall be checked and corrections made by the Contractor immediately before placing the concrete. When any form has been disturbed or any grade has become unstable, the form shall be reset and rechecked.

The requirements for placing concrete, reinforcement, consolidation and finishing, and other incidental items concerning concrete paving shall be as outlined and specified for slip form paving.

(5) Removing Forms.

Unless otherwise provided, forms shall not be removed from freshly placed concrete until it has set for at least twelve hours, except auxiliary forms used temporarily in widened areas. Forms shall be removed carefully so as to avoid damage to the pavement. After the forms have been removed, the sides of the slab shall be cured as specified for the surface. Major honeycombed areas will be considered as defective work and shall be removed and replaced. Any area or section so removed shall not be less than two meters in length nor less than the full width of the lane involved. When it is necessary to remove and replace a section of pavement, any remaining portion of the

slab adjacent to the joints that is less than three meters in length, shall also be removed and replaced.

(g) Texturing.

As soon as all excess moisture has disappeared and while the concrete is still plastic enough to make a granular surface possible, a drag shall be used which shall consist of a seamless strip of damp burlap, artificial turf or cotton fabric, which shall produce a uniform surface of gritty texture after dragging it longitudinally along the full width of pavement. Drags shall be maintained clean and free from encrusted mortar. Drags that cannot be cleaned shall be discarded and new drags substituted. Following the dragging operation, unless designated otherwise on the Plans, a final finish or texture shall be made by giving the surface of the plastic pavement a suitable transverse grooving with a mechanical device that is essentially a metal comb. The metal comb shall consist of a single line of tempered spring, rectangular, steel tines, uniformly spaced at 20 millimeter centers and securely mounted in a suitable head. The tines shall be of a size and stiffness to produce grooves of specified dimensions in the plastic concrete. The metal comb shall be attached to an approved mechanical device capable of transversing the entire pavement width in a single pass at a uniform speed. The device shall be an independent, separate unit complete in itself and shall not be attached to equipment performing other functions except that on projects such as small urban projects where it is impractical to use an independent device, the unit may be attached to equipment performing other functions when approved by the Engineer. The device shall be operated so as to produce a relatively uniform pattern of transverse grooves approximately five millimeters in width at 20 millimeter centers and the groove depth should be approximately three millimeters. The operation shall be performed at such time as to minimize displacement of larger aggregate particles and before the surface permanently sets. Small or irregular areas may be grooved by hand methods. On projects of less than 5,000 square meters and when approved by the Engineer, the tining and curing devices may be mounted on the same carriage and continued operations of this type will be on a satisfactory performance basis.

An alternate texturing method to tining that will be acceptable, in lieu of the metal comb, would be a mechanical fluted float that by means of downward pressure put the grooved like configurations in the fresh concrete. The dimensions of the

grooves will be similar to those given for the comb. The desired end result of this fluted float will be a grooved floated surface, smooth textured configuration free of a raveled appearance with all aggregate being firmly seated. Details of such a device shall be submitted to the Engineer, prior to use, for approval.

Prior to texturing, the exposed edge of the pavement shall be finished with an edger to a radius of six millimeters. The interior longitudinal joints on multiple-lane pavement shall be edged to a radius of three millimeters. Any tool marks appearing on the slab adjacent to the joints or edge of slab shall be eliminated. The rounding of the corner of the slab is to be disturbed as little as possible.

(h) Joints.

(1) General.

Joints shall be constructed in accordance with the details shown on the Plans and these Specifications and with the best of workmanship. Failure to construct the joints called for in the best possible manner will be cause for suspension of work until the cause of the defective work is remedied.

If existing pavement of any type is required to abut with the new pavement, and the termination of the removal is not at an existing joint, the new joint shall be made by sawing the existing pavement not less than 50 millimeters deep before removal.

All contraction joints shall be sawed before uncontrolled cracking occurs. When extreme conditions could exist which make it impracticable to prevent erratic cracking by sawing the joints early, methods should be devised at the onset of the project by the Contractor with the cooperation of the Engineer to control this cracking. The principal objective is to create or form a plane of weakness in the fresh concrete no wider than the initial saw cut and to a depth of $D/4 +$ six millimeters. The "wet cut" should be straight and well defined in order that it may be "sawed out" by the saw crew. The "wet cut" would replace the specified initial saw cut. Suggested procedures could be the use of a stiff metal parting strip, with or without handles, that would be gently inserted into the fresh concrete and removed, thereby parting the interlocking coarse aggregate and providing a plane of weakness. Another method would be cutting the fresh concrete with a masons trowel and straight edge from a workers bridge. It is imperative that the wet cut joint and second stage saw cut are the same exact

location. Procedures to control erratic cracking are not limited to only those mentioned here.

Any transverse joint requiring hand finishing and edging shall be edged with a tool having a radius of three millimeters unless otherwise directed by the Engineer. The horizontal surface of the edger should not indent the surface of the pavement.

(2) Pressure Relief Joints.

Pressure relief joints shall be installed in accordance with bridge approach details as shown on the Plans.

(3) Contraction Joints.

Contraction joints shall be of the type and dimensions and at the spacing shown on the Plans.

When the Plans specify that dowels be installed through contraction joints, the subgrade at the contraction joints shall be accurately trimmed to the required cross section and to the proper depth of the pavement.

A string line shall be stretched along the centerline of the joint, or otherwise adequately marked to assure joint assembly alignment.

Each dowel shall be painted and thoroughly coated with hard grease, or an approved lubricant, in accordance with the directions shown on the Plans, to prevent the concrete from bonding to that portion of the dowel. The excessive use of hard grease is prohibited.

The entire joint assembly shall be of the type designated on the Plans and shall be installed in such a position that the centerline of the joint assembly is perpendicular to the centerline of the slab and the dowels lie parallel to the slab surface and parallel to the centerline of the slab. Concrete shall be placed so that it will not displace or disarrange the joint assembly. The location of contraction joints shall be marked in such a manner as to assure the joints are sawed in the proper location.

(4) Longitudinal Joint.

Longitudinal joints shall be constructed in conformance with the details shown on the Plans. The Plan sheets will indicate the type of longitudinal construction joint to be constructed. When sawed joints are specified or used, approved guide lines or devices shall be furnished to insure cutting the longitudinal joint on the true line as shown on the Plans. The sawing of longitudinal joints shall be performed at a time that will preclude erratic or uncontrolled cracking.

(5) Construction Joints.

A butt construction joint shall be made perpendicular to the centerline of the pavement at the close of each day's work and

also when the process of depositing concrete is stopped for a length of time such that the concrete will have taken its initial set. This joint shall be formed by using a clean header having a nominal thickness of 50 millimeters, a depth of not less than the thickness of the pavement and length of not less than the width of the pavement lane unless approved otherwise by the Engineer. The header shall be cut true to the crown of the finished pavement and shall be accurately set and held in place in a plane at right angles to centerline and perpendicular to the surface of the pavement.

The top surface of the header shall be protected with steel. On the face of the header along the center of the header there shall be securely held in place a trapezoidal piece of metal or wood the full length of the header approximately 50 millimeters wide and at least 25 millimeters depth to form a grooved or keyed type joint. This joint shall be tied keyed construction.

In lieu of stopping the paving pour at a fixed header board and at the discretion of the Engineer, the Contractor may elect to "pave by" the joint location and saw the construction joint when the concrete has hardened, drill holes for reinforcing tie bars and epoxy the bars in place. It is necessary to "pave by" the distance required to insure true line and grade at the sawed construction joint location. The cost of additional concrete required, the removal of debris, and other incidental expenses created by this alternative method shall be borne by the Contractor. Any surplus concrete remaining upon the grade shall be removed. Fresh concrete shall be deposited against the previously placed concrete in such manner as to avoid injury to the edge of the concrete and shall be vibrated in such a manner to insure an interlocking joint, and to prevent a honey-combed effect on the face of the joint.

Unless shown otherwise on the Plans no construction joint shall be placed within three meters from an expansion, contraction, or other construction joint.

(6) Special Joints shall be constructed as shown on the Plans or as ordered by the Engineer around drainage, utility and other structures located within the concrete pavement boundaries. Temporary forms used in constructing the joints shall be held securely in place during the concrete placement operation.

(7) Sawing of Joints.

All joints shall be wet sawed and constructed as shown on the Plans. Sawing of joints shall be constructed in two stages as follows:

(7.1) First Stage—The first saw cut shall be a relief cut approximately three millimeters wide and to the full joint depth at the proper location. The relief cut shall be made as soon as the concrete has hardened enough so that no excess raveling or spalling occurs but before any random cracks develop. The sequence of the relief sawing shall be at the Contractor's option provided that all relief sawing is completed before random cracking develops. Suitable guidelines or devices shall be used to insure the joint is cut straight and has the correct geometrics in relation to centerline. See subsection 502.03(h)(1) for alternate method to the first stage sawing. Curing membrane damaged during sawing operation shall be repaired by the Contractor as directed by the Engineer.

(7.2) Second Stage—Widening of the relief joints to full width, shall not be performed until the concrete is at least 48 hours old and shall be delayed longer when the sawing causes raveling of the concrete. If second stage sawing is performed prior to completion of the curing period, the Contractor shall maintain the cure by use of curing tapes, plastic devices, or other materials approved by the Engineer. Membrane curing damaged during the sawing operation shall be repaired by the Contractor as directed by the Engineer.

The joint groove shall be centered over the relief cut and sawed to the specified dimensions shown on the Plans.

Should any spalling of the sawed edges occur which would detrimentally affect the joint seal, it shall be patched with an approved epoxy patching compound and allowed to harden prior to installation of the joint material. Each patch shall be true to the intended neat lines of the finished cut joint.

(7.3) Cleaning Freshly Cut Sawed Joints. Immediately after sawing the joint, the resulting slurry shall be completely removed from the joint and the immediate area by flushing with a jet of water under pressure, and by the use of other tools as necessary.

(8) Cleaning and Filling Joints.

(8.1) Cleaning Joints. Air compressors used for cleaning joints shall be equipped with suitable traps capable of removing all surplus water and oil in the compressed air. This compressed air will be checked daily by the Engineer for contamination. When contaminated air is found to exist, work shall not resume until suitable adjustments are made and the air stream is found to be free of such contaminants.

(8.2) Just prior to sealant being applied, a final cleaning of the joint shall be made by sandblasting the joint, followed by

an air blast to clean incompressibles from the joint. If one sand-blaster nozzle is used, the joint shall be cleaned once in each direction, concentrating on one joint face at a time. If a two nozzle arrangement is used, the nozzles shall be aimed so each nozzle concentrates its blast on one joint face.

(8.3) **Installing Backup Material.** A resilient rod type backup material will be installed in a manner that will produce the shape factor specified and prevent leakage of the sealant below the backup material. If the sealant bonds to the backup material, a bond-breaking tape may be required.

(8.4) **Sealing Joints.** The location, size, configuration and acceptable joint sealant shall be shown on the Plans. Joints shall be sealed prior to opening to traffic. For construction traffic see subsection 502.03(j)(3.1).

(8.5) **Filling the Joint.** A joint shall not be sealed until they are thoroughly clean and dry and the pavement is at least seven days old unless otherwise stipulated in the manufacturers publications and approved by the Engineer. Sealant shall not be applied to wet or damp concrete or installed during inclement weather. The sealer shall be placed in reasonably close conformity with dimensions shown on the Plans. Any unreasonable deviation will be cause for rejection of the joint until satisfactory corrective measures are taken. Joint sealant application will not be permitted when the ambient air temperature is less than 5 °C or as specified in the manufacturer's publications.

(8.6) **Equipment.** The backer rod shall be installed utilizing a device which will place the rod uniformly at the depth shown on the Plans. The joint sealer shall be applied by an approved mechanical device from inside the joint in such a manner which causes it to wet the joint surfaces. The silicone sealant is not self leveling and will not position properly in the joint under its own mass, therefore, the sealant surface shall be tooled using the appropriate tool to produce a slightly concave surface approximately six millimeters below the pavement surface as shown on the plans. Tooling shall be accomplished before a skin forms on the surface. The use of soil or oil as a tooling aid will not be permitted. Any failure of the joint material in either adhesion or cohesion will be cause for rejection, and the joint shall be repaired to the Engineer's satisfaction at the Contractor's expense.

(8.7) **Cleaning Pavement.** After a joint has been sealed, all surplus joint sealer on the pavement or structure surfaces shall be promptly removed.

(8.8) Traffic. Traffic shall not be permitted over sealed joints until the sealer is tack free, or until debris from traffic does not imbed into the sealant.

(8.9) The Contractor shall provide a manufacturer technical representative to be on the project at the beginning of the joint sealing operation in order to have available the technical expertise in proper joint preparation, storing, handling, and application of the sealant. The purpose is to assure strict compliance with manufacturer's recommendations and these Specifications, and he shall instruct both the KDOT inspector and Contractor in the proper procedures. Sufficient time shall be spent with both the Contractor and KDOT inspector to ensure they are familiar with the proper procedure.

(9) Header Boards.

Immediately after the forms are removed, exposed ends of new concrete pavement shall be protected, by use of a wooden header board, from both temporary construction traffic and permanent future traffic. Temporary header boards may be removed when the contractor abuts the joint with a permanent type surfacing. If the joint is not abutted with a permanent type surfacing, the header board shall remain in place until future construction renders it unnecessary.

A header board having dimensions of not less than 75 millimeters (nominal) by 200 millimeters (nominal) shall be bolted securely to the end of the pavement in a manner to protect the edge of the pavement from damage. The header board shall extend the full roadway width, but may be in two sections. At the time of placing the concrete, M12 by 200 millimeter bolts (three for each lane) shall be embedded in the end of the pavement in a manner that will hold the header board securely. The header board shall be shaped to conform to the crown of the pavement and shall be installed flush with the concrete pavement surface. The finishing and installing of the header board shall be considered subsidiary work pertaining to the other items of the Contract and will not be paid for directly.

(i) Hand Finishing.

Unless otherwise specified hand finishing methods should be held to the minimum. Generally, hand methods of placement and finishing will be permitted as follows:

1. For pavement when a breakdown of some portion of the paving train occurs, necessitating the hand finishing of that portion of the concrete already in place.

2. For pavement lanes that may be too narrow or a length too short to accommodate a full paving spread.

3. For all irregular shaped areas.
4. For special approach sections to bridges, widened portions at bridges, intersection, and sections widened beyond traffic lanes.
5. When the dimensions of the work makes the use of a complete power operated paving train impossible or impracticable. Handwork comprised of paving uniform width areas or transition width areas using false forms shall be finished, whenever possible, with a mechanical finishing machine and/or approved vibrating screed.

Approved spud hand vibrators shall be used on any area considered impractical to vibrate with a vibrating screed. Approved metal or wood floats may be used if needed to help close an open or porous surface condition.

The operation of consolidation and screeding or striking off the concrete shall continue until the concrete is uniformly consolidated and the surface is true to line, grade and cross section.

After the concrete has been properly struck off, the surface of the pavement shall be straightedged for trueness and finished. A drag shall be used to remove surface straightedge marks. The drag may be pulled by hand, and the results should be similar to that on the mainline pavement.

Manual methods may be used for texturing hand finished pavement areas. Where applicable the tined texture shall apply. The comb shall have the same physical tine dimensions and spacing as approved for machine mainline paving. The finished textured surface shall be similar to that produced mechanically.

On miscellaneous areas such as entrance pavement, median pavement, gore area, etc., texturing with the metal comb may be eliminated. Final finish may be attained by the use of a drag which shall consist of a seamless strip of damp burlap, cotton fabric or other suitable material capable of producing a uniform surface of gritty texture after dragging it longitudinally along the full width of pavement.

(j) Protection and Curing of Concrete.

The pavement shall be cured by one of the following methods: Burlap, liquid membrane-forming compounds, white polyethylene sheeting, concrete curing blanket or reinforced white polyethylene sheeting. Failure to provide proper curing will be considered as sufficient cause for immediate suspension of the concreting operations.

(1) Burlap, Concrete Curing Blankets, White Polyethylene Sheeting and Reinforced White Polyethylene Sheeting.

Immediately after the pavement has been finished and the concrete has hardened sufficiently to avoid harmful marring of the surface, and yet early enough to prevent undue loss of moisture from the concrete the curing material shall be placed on the pavement. If the pavement becomes dry before the curing material is placed, the concrete shall be moistened with a fine spray of water. Burlap-polyethylene blankets shall be placed with the dampened burlap side down. Burlap shall be damp when placed on the surface and shall be kept damp throughout the entire curing period.

Adjacent units of curing materials shall be lapped approximately 450 millimeters and upon removal of the forms the materials shall be extended so as to completely cover the full depth of the exposed pavement.

The curing material shall be placed and weighted down by continuous windrows of earth, or other approved means, along the sides and edges of the pavement and transversely across the pavement on the laps so as to cause the material to remain in contact with the surface covered throughout the curing period.

Walking on the pavement surface to place the curing material will not be permitted. Walking or operating any equipment on the curing material will not be permitted until the pavement has cured sufficiently to prevent damage to the surface.

The curing material shall be left in place to provide a curing period of at least four days, unless otherwise directed by the Engineer. Any tears or holes appearing in the material during the curing period must be immediately repaired, or replaced by material in good condition.

The material may be reused, provided it is kept serviceable by proper repairs and, if in the judgment of the Engineer, such material will provide water retention during the curing period.

(2) Liquid Membrane-Forming Compounds.

After finishing operations have been completed and immediately after the free water has left the surface, the surface of the slab shall be completely coated and sealed with a uniform layer of white membrane curing compound. The compound shall be applied in one application at a rate of not less than one liter per 3.7 square meters of surface. The curing compound shall be thoroughly mixed at all times during usage.

Thinning the white membrane compound will not be permitted.

If the newly coated film is damaged in any way, the Contractor will be required to apply a new coat of material to the affected areas equal in curing value to that specified for the original coat. The treated surface shall be protected by the Contractor from injury for a period of at least four days. All traffic, either foot or otherwise, will be considered as injurious to the film of the applied compound. A minimum of foot traffic will be permitted on the dried film as necessary to properly carry on the work, including the removal of any high spots, provided any damage to the film is immediately repaired by the application of an additional coat of compound.

Immediately after the forms are removed, (fixed form and slip form) the entire area of the sides of the slab shall be coated with curing compound at the rate specified for the pavement surface regardless of whether or not further concrete placement will be made against the pavement edge. Approved hand-spray equipment will be permitted only for the application for the curing compound on the sides of the slab and for repairing damaged areas and for hand finished areas.

(3) Opening to Traffic.

No motorized traffic shall be allowed on the pavement until all of the following conditions are met:

(3.1) Construction Traffic.

(3.1.1) The four day cure period must be complete.

(3.1.2.) The flexural strength of the pavement shall meet or exceed 26 megapascals. The flexural strength of the pavement shall be determined by testing flexural strength specimens utilizing the third point loading method.

(3.1.3) The Contractor shall provide protection to keep foreign material out of the unsealed joint by an approved method at his expense.

(3.2) All Traffic.

(3.2.1) In addition to (3.1) Construction Traffic. Joints shall be sealed in accordance with subsection 502.03(h)(8.5) before opening to all traffic.

NOTE: The Contractor may, at his expense, increase the cement content from the minimum shown in Section 402 to accelerate the strength gain of the PCCP. In no case will motorized traffic be allowed the use of the pavement until after the four day cure period is complete.

Incidental concrete pavement such as entrance pavement and valley gutter may be opened to traffic after a four day curing period. Where concrete is to be placed adjoining previously constructed lanes, the rubber tired wheels of concrete spread-

ers and finishing machines may be permitted on the pavement after a four day curing period.

(4) Cold Weather Limitation and Curing.

Unless otherwise authorized in writing by the Engineer, concrete placement operations may be started when the ambient air temperature is two °C and rising, and when the surface temperature of the area to be paved is two °C and above. Paving shall be discontinued when the ambient air temperature falls below two °C. Concrete pavement will not be placed when it is raining or snowing; neither will it be placed on wet, muddy or frozen grade.

When the ambient air temperature is expected to drop below two °C anytime during the curing period precautions shall be taken. A sufficient supply of approved moisture barrier material, not to include liquid curing compound, and suitable blanketing material, such as straw, hay, and burlap, shall be close by and available as required to cover the pavement with a moisture barrier material and protect with blanketing material all pavement less than four days old. This cold weather curing and protection will be such that a temperature of at least four °C, as measured along the surface of the concrete, will be maintained for at least four days after placing. Concrete damaged by cold weather, as determined by the Engineer, shall be removed, disposed of, and replaced at the Contractor's expense.

If authorized in writing by the Engineer to place concrete pavement when the ambient air temperature is below two °C, the cold weather specifications as outlined in subsection 402.07 (b) shall govern.

No traffic shall be allowed on this pavement until the opening to traffic requirements of subsection 502.03(j)(3) are met unless otherwise authorized by the Engineer.

(5) Early Strength Concrete Curing. The curing period for early strength concrete pavement shall conform to the requirements specified for concrete pavement. Traffic may use this pavement after the four-day curing period. Joints will be completed in accordance with the manufacturer's recommendations for Early Strength Concrete Pavement.

(k) Tolerance In Pavement Thickness.

The thickness of the pavement will be determined by average caliper measurement of cores.

It is the intent of these specifications that the pavement be constructed to the thickness shown on the plans. Determination of pavement thickness for the purpose of establishing an ad-

justed unit price will be based on cores taken from each unit of the pavement (surface area) except for the following cases; pavement cores will not be taken from any project containing less than 2,000 square meters of pavement, any gore area, any intersection curb return, any entrance, any irregular areas consisting of less than 400 square meters, and any shoulder, median or widening less than 1.5 meters in uniform width, unless coring of these areas is specifically requested by the Engineer. The constructed thickness will be determined, when required, by the average height measurement of the cores representing each pavement unit.

The width of a unit shall be defined as the distance from the pavement edge to the longitudinal joint of the adjacent slab, from one longitudinal joint to the next, or between the pavement edges where there is no longitudinal joint; except that no unit shall be wider than the traffic lane widths nor contains parts of more than one parallel placement. Shoulders, medians and widenings which are placed monolithically and without a longitudinal joint between the adjacent lane are to be considered as part of the traffic line.

For the purpose of this specification a traffic lane shall be defined as a strip of pavement the width of which is intended to accommodate a single vehicle.

Determination of pavement units to be considered separately shall be as specified herein:

For traffic lanes, ramps, shoulders, medians, widenings, acceleration lanes, deceleration lanes, side roads, frontage roads and other continuous strips of pavement with a width of three meters or more; the units shall be defined as 300 meter units and located by starting at the lane end which bears the smaller station number. The last unit in each lane shall be 300 meters plus the fractional part of the remaining 300 meters. One core will be taken at random from each unit. Bridge wearing surfaces and special bridge approach slabs shall not be included in the 300 meter unit.

For all pavement which is less than three meters in width and consisting of at least 420 square meters and for other irregular areas of at least 420 square meters, one core will be taken at random from each unit. Units to be considered separately are defined as 840 square meters of pavement or a fraction thereof.

Where pavement lanes vary in width within a 300 meter unit, the maximum lane width within that unit will be used for determining the appropriate method of sampling.

When the measurement of the first core from any unit is not deficient more than five millimeters from the Plan thickness, full payment will be made. When the measurement of the first core from any unit is deficient more than five millimeters from the Plan thickness, two additional cores within the 300 meter unit will be taken at intervals of not less than 90 meters or two additional cores within the 840 square meter until will be taken at locations such that the pavement will be well represented. The average thickness of the unit will be determined by using the measurements of the three cores taken in that unit. In calculating the average thickness of the pavement, measurements which are in excess of the specified thickness by more than five millimeters will be considered as the specified thickness plus five millimeters and measurements which are less than the specified thickness by more than 25 millimeters will be considered as the specified thickness minus 25 millimeters. If the average thickness of the three cores is not deficient more than five millimeters from Plan thickness, full payment will be made. If the average thickness of the three cores is deficient more than five millimeters from Plan thickness an adjusted unit price as provided in these Specifications will be paid for the unit represented.

When the measurement of any core is deficient by more than 25 millimeters from Plan thickness, exploratory cores will be taken at intervals not less than three meters parallel to the centerline in each direction from the deficient core until in each direction an exploratory core is taken which is not deficient by more than 25 millimeters. Exploratory cores are to be used only to determine the length of pavement in a unit that is to be left in place without pay or removed and replaced as provided in subsection 502.08(b).

502.04 REPAIR OF DEFECTIVE PAVEMENT SLABS.

(a) The following applies to both new reinforced and non-reinforced concrete pavement.

It shall be the responsibility of the Contractor, regardless of reason, to repair or replace any broken panels, and spalls as specified hereinafter at no cost to the Department. The work shall be accomplished prior to completion of joint sealing.

Spalls shall be repaired by making a saw cut at least 25 millimeters outside the spalled area and to a minimum depth of 50 millimeters. In no case will an individual patch of a spall be less than 0.1 square meter with no dimension less than 300

millimeters and the interior angles formed by the intersection of adjacent sides of the patch shall be not less than 60 degrees. When the spalled area abuts a joint, the saw cut shall be made to a depth of 50 millimeters or $\frac{1}{6}$ the slab thickness, whichever is greater. The concrete between the saw cut and the joint or primary crack shall be chipped out to solid concrete. The cavity thus formed shall be thoroughly cleaned of all loose material. A coat of concrete bonding epoxy shall be applied to the dry, cleaned surface of all sides of the cavity, except the joint. The bonding epoxy shall be applied by scrubbing the material into the surface with a stiff-bristle brush. Placement of Portland cement concrete or epoxy-resin concrete or mortar shall immediately follow the application of the bonding epoxy, as directed. If the spalled area to be patched abuts a working joint, an insert or other bond breaking medium shall be used during the repair work to maintain working joints.

The concrete bonding epoxy shall comply with Section 1700.

When necessary, the depth of crack penetration shall be determined by inspection of cores drilled at the Contractor's expense.

Major honeycombed areas found after removal of the forms will be considered as defective work and shall be removed and replaced. Any area or section so removed shall not be less than two meters in length nor less than full width of the lane involved. When it is necessary to remove a section of pavement, any remaining portion of the slab adjacent to the joints that is less than two meters in length shall also be removed and replaced.

(b) The following applies to new non-reinforced PCCP.

The Contractor will be required to remove and replace any pavement panels (contraction joint to contraction joint) containing one or more full depth cracks on new non-reinforced Portland cement concrete pavement with the following exception:

When a transverse random crack terminates in or crosses a transverse contraction joint within one meter of the width and length of the slab, from the corner, repairs shall be made in the following manner: the uncracked portion of the construction joint shall be filled with epoxy resin mortar or grout and the crack shall be routed and sealed.

(c) The following applies to new reinforced PCCP.

(1) When a single full depth transverse crack falls within the middle one third of the panel, no corrective work will be required.

(2) Should a second full depth crack develop within the middle one third of the panel, the panel will be removed to the nearest planned contraction joint to eliminate both cracks and replaced in accordance with (4) below.

(3) If the location of the mid-panel full depth crack is within two meters of the boundaries of the area to be repaired (patch), the area to be repaired shall extend to include the mid-panel crack and replaced in accordance with (4) below.

(4) When any portion of a full depth crack falls outside the middle one third of the panel, the portion of panel between the contraction joint and this crack shall be sawed full depth, removed and replaced. One saw cut will be made parallel to the contraction joint on the mid-panel side of the crack to be removed. Another cut shall be made in the adjacent panel parallel to the contraction joint, clear of the basket assembly, but not less than two meters from the first cut. The basket assembly shall be removed, holes drilled in both sawed faces and bars inserted to make two contraction joints. Bars shall be 31 millimeter smooth dowel epoxy coated bars \times 450 millimeters on 300 millimeter centers. Bar holes shall be approximately 31 millimeters in diameter and filled with epoxy or Portland cement grout. The holes shall be filled from the back of the hole outward to promote expulsion of the air. The free ends of the bars shall be supported in some fashion to assure proper alignment until the epoxy or grout has set enough to hold the bar in proper position. The free ends shall be greased to prevent the concrete from bonding to that portion of the dowel.

(5) If the boundaries of consecutive areas to be repaired (patches) are less than two meters apart, the area between the patches shall also be removed and replaced.

(6) Pavement panels (area between contraction joint and contraction joint) containing multiple cracks through the full depth of the slab separating the panel into four or more parts, shall be entirely removed and replaced at the Contractor's expense in accordance with (3) above.

(7) The existing centerline tie bars in areas to be replaced shall be sawed off flush with the concrete to prevent bonding of fresh to hardened concrete and a bond breaking medium (such as form oil) used on the existing face of the centerline concrete abutting the replaced slab portion.

502.05 PROTECTION OF PAVEMENT AGAINST RAIN.

(a) Prior to beginning a Portland cement concrete pavement project the Contractor shall review with the Engineer his plan

to protect the pavement in the event of rain. This plan will include the type and amount of protective materials as well as the methods proposed to protect the pavement. The plan will be submitted in writing to the Engineer for his approval prior to commencing paving operations.

(b) As a minimum, the Contractor's plan will include protective covering and side forms available at the project site at all times to protect the surface and edges of the newly placed concrete pavement should it rain. Polyethylene, burlap or other covering materials may be used. Side forms may be of wood, or steel and must have a depth not less than the thickness of the pavement. The location of the Contractor's storage site shall be specified in order that a review of the protective materials may be conducted by the Engineer in company with the Contractor's Representative.

When rain appears imminent, all paving operations shall stop and the Contractor shall initiate his Protection Plan. The covering shall extend back to the point where the rain will not indent the surface. Care should be exercised to prevent unnecessary damage to the surface with the covering.

502.06 PAVEMENT TRUENESS.

(a) General.

On pavement surfaces not subject to the profilograph test the surface will be tested using a three meter straightedge at locations selected by the Engineer. The variation of the surface from the testing edge of the straightedge between any two contact points, longitudinal or transverse, with the surface, shall not exceed three millimeters. Irregularities exceeding the specified tolerance shall be corrected by and at the expense of the Contractor with an approved profiling device or by other means as approved by the Engineer. Following correction the areas will be retested to verify compliance with the specified tolerance.

(b) Profilograph Test.

(1) The smoothness of the pavement will be determined by using a profilograph over the surface finish of the mainline pavement, sideroads, auxillary lanes and ramps.

(2) Specifically excluded are:

(2.1) Bridge Decks;

(2.2) Acceleration and deceleration lanes for at-grade intersections;

(2.3) Shoulders;

(2.4) Pavement on horizontal curves with centerline radius of curve less than 300 meters and pavement within the super-elevation transition of such curves.

(c) Equipment.

The profile index will be determined using a California type profilograph or other style of machine that yields compatible results and which is approved by the Bureau of Materials and Research. The equipment shall be furnished and operated by the Contractor as specified in Section 2500.

(d) Surface Test.

The Contractor shall furnish paving equipment and employ methods that produce a riding surface having an average profile index of 160 millimeters per kilometer or less per 0.1 kilometer section, except as provided for in subsequent paragraphs. Initial profiles up to 235 millimeters per kilometer may be accepted with applicable price adjustments.

Pavement profiles will be taken in accordance with Section 2500. Additional profiles may be taken only to define the limits of an out-of-tolerance surface variation.

A profilogram will be made for each continuous placement of 15 meters or more. The profilogram will include the 5 meters at the ends of the section only when the Contractor is responsible for the adjoining surface.

Individual sections shorter than 15 meters shall be inspected by testing with a 3 meter straightedge, a responsibility of the Engineer. The 5 meters at the ends of longer sections will also be inspected in this manner when excluded from the profilogram.

(e) Smoothness Evaluation.

The Contractor shall furnish the profilogram and his evaluation to the Engineer. The testing and evaluation shall be performed by a trained and certified operator, and the evaluation shall be so certified. The testing procedure and evaluation of the trace shall be performed in accordance with Section 2500. Results shall be furnished to the Engineer within two working days after placement of the pavement and again within two days after any corrections are made.

During the initial pavement operations, either when starting up or after a long shut-down period, the pavement surface will be tested with the profilograph as soon as the concrete has cured sufficiently to allow testing. Curing membrane damaged

or protective cover removed during the testing operation shall be repaired or replaced by the Contractor as directed by the Engineer. Initial testing will be used to aid the Contractor and the Engineer in evaluating the pavement methods and equipment. If the initial pavement smoothness, paving methods, and paving equipment are acceptable to the Engineer, the Contractor may proceed with the paving operation.

A daily average profile index will be determined for each day's paving operation. A day's paving operation is defined as a minimum of 0.1 kilometer of full-width pavement placed in a day. If less than 0.1 kilometer is paved, the day's production will be grouped with the next day's production. If the production of the last day of project paving is less than 0.1 kilometer, it will be grouped with the previous day's production. If an average profile index of 190 millimeters per kilometer is exceeded in any one day's paving operation, the paving operation will be suspended and will not be allowed to resume until corrective action is taken by the Contractor. In the event that paving operations are suspended as a result of the average profile index exceeding 190 millimeters per kilometer per 0.1 kilometer section, subsequent paving operations will be tested in accordance with the initial testing procedures.

For determining pavement sections where corrective work or pay adjustments will be necessary, the pavement will be evaluated in 0.1 kilometer sections using the profilogram. Within each 0.1 kilometer section, all areas representing high points having deviations in excess of 10 millimeters in 8 meters or less shall be corrected by the Contractor. Any 0.1 kilometer section, including bumps, having an initial profile index in excess of 235 millimeters per kilometer shall be corrected to reduce the profile index to 160 millimeters per kilometer or less, or replaced at the Contractor's option.

On sections where corrections are made, the pavement will be tested by the Contractor to verify that corrections have produced a profile index of 160 millimeters per kilometer or less.

Corrections shall be made using an approved profiling device or by removing and replacing the pavement. Bush hammers or other impact devices will not be permitted. Where surface corrections are made, the Contractor shall establish a uniform texture but transverse grooving will not be required. Corrective work shall be at the Contractor's expense and shall be completed prior to determining pavement thickness.

The Engineer may subject the surface to monitor for comparison and assurance purposes. The Engineer may test the

entire project length if he determines that the Contractor-certified test results are inaccurate, and the Contractor will be charged for this work at a rate of \$250.00 per kilometer, per profile track, with a minimum charge of \$800.00. Furnishing inaccurate tests may result in decertification.

(f) Pay Adjustments.

When the profile index is 65 millimeter per kilometer or greater per 0.1 kilometer section but does not exceed 160 millimeters per kilometer per 0.1 kilometer section, payment will be made at the Contract unit price for the completed pavement. When the profile index exceeds 161 millimeters per kilometer per 0.1 kilometer section but does not exceed 235 millimeters per kilometer per 0.1 kilometer section the Contractor will be paid the appropriate unit price as shown in Table 2, Schedule for Adjusted Payment. When the profile index is less than or equal to 64 millimeters per 0.1 kilometer section, the Contractor will be entitled to an incentive payment as shown in Table 2, Schedule for Adjusted Payment.

**TABLE 2
SCHEDULE FOR ADJUSTED PAYMENT**

Profile Index Millimeters per kilometer per 0.1 kilometer section	Price Adjustment Percent of Contract unit bid price
48 or less.....	106
49 to 64.....	103
65 to 160.....	100
161 to 180.....	96
181 to 220.....	92
221 to 235.....	90
236 or more.....	88 (Corrective Work required or replace)

Pay adjustments will be based on the initial measured profile index, prior to any corrective work. The adjusted unit price will apply to the total area of the 0.1 kilometer section of the lane width represented by the profilogram. Areas excluded from the profilograph testing as listed in subsection 502.06(b)(2) will not be subject to price adjustments.

If the Contractor elects to do corrective work, rather than to remove and replace sections having an initial profile index in excess of 235 millimeters per kilometer per 0.1 kilometer section, 88 percent of the contract unit price will be the maximum amount of pay the Contractor can receive for those section(s) of pavement.

If the Contractor elects to remove and replace the section(s), the Contractor will be paid the percent of the contract unit price that corresponds to the initial profile index obtained on the pavement section after replacement.

When the Plans dictate that an area(s) of mainline pavement is to be hand finished the area(s) will not be subject to reduced payment; however, it is to be profiled and corrected as necessary to meet these specifications. If the initial profile is 64 millimeters or less per 0.1 kilometer section or less, the incentive will be applied as shown in Table 2.

502.07 METHOD OF MEASUREMENT.

(a) Plan Quantity Measurement.

The quantities of concrete pavement for which payment will be made shall be the quantities shown on the Plans for the main travel lane or lanes and the various paved approaches, exits, interchanges, etc., provided the project is constructed essentially to details shown on the Plans.

When the Plans have been altered or when disagreement exists between the Contractor and Engineer as to the accuracy of Plan quantities in any location or the entire project, either party shall have the right to request and cause the quantities involved to be measured in accordance with the provisions of subsection 502.07(b).

(b) Measured Quantities.

The quantity to be paid for under this item will be the number of square meters of concrete pavement completed and accepted as measured complete in place. The width for measurement will be the width of the pavement shown on the typical cross section of the Plans, additional widening where called for, or as otherwise directed in writing by the Engineer. The length will be measured horizontally along the centerline of each roadway or ramp.

(c) When the grading has previously been completed on another Contract and additional excavation is shown on the Plans or ordered by the Engineer, the volume between the existing roadbed and the bottom of the pavement shall be measured and paid for under the provisions of Section 204.

(d) On projects where the grading and the pavement or base construction is included in the same Contract, the excavation to be measured shall be that required to construct the grading and pavement or base to the final section as shown on the

Plans. No additional measurement will be made for filling above and recutting to the subgrade elevation.

(e) Sawing and Sealing Joints.

This work will not be measured for separate payment. All cost of complying with the requirements specified herein, shall be included in the Contract price for the concrete pavement in which the joints are located.

(f) Concrete Cores.

Concrete cores shall be measured per each.

No measurement will be made for water used in dust control on haul roads, around plant installations, etc. The Contractor shall meet all applicable regulations concerning environmental considerations.

502.08 BASIS OF PAYMENT.

(a) The amount of completed and accepted work, measured as provided above, shall be paid for at the Contract unit price per square meters for "Concrete Pavement", "Early Strength Concrete Pavement" and per each for "Concrete Cores", which price shall be full compensation for furnishing, quarrying, transporting, delivery, and placing all materials incorporated into the project, for all labor, equipment, tools, and incidentals necessary to complete the work.

Concrete Cores shall be paid for at the Contract unit price regardless of any increase or decrease in the quantity as shown in the Contract or on the Plans.

When the average thickness of the pavement determined as hereinafter provided, is deficient by more than 5 millimeters as based on the thickness required by the typical cross sections shown on the Plans or designated in the Contract, an adjusted Contract unit price will be paid as determined in accordance with these Specifications.

(b) Price Adjustments.

Where the average thickness of pavement is deficient in thickness by more than 5 millimeters, but not more than 25 millimeters, payment will be made at an adjusted price as specified in Table 3.

TABLE 3
CONCRETE PAVEMENT DEFICIENCY

Deficiency in thickness as determined by cores, millimeters	Proportioned part of Contract price allowed
0.00 to 5.0.....	100 percent
5.1 to 7.5.....	80 percent
7.6 to 10.0.....	72 percent
10.1 to 13.0.....	68 percent
13.1 to 19.0.....	57 percent
19.1 to 25.0.....	50 percent

When the pavement is more than 25 millimeters deficient in thickness, the Contractor will be required to remove such deficient areas and to replace them with pavement of satisfactory quality and thickness.

When it is necessary to remove and replace a length of pavement and one end of the deficient pavement is less than 3 meters from an expansion, contraction or construction joint the entire pavement up to the joint shall be removed and replaced at the expense of the Contractor. The area shall be removed so that new joints are a minimum of three meters apart. The Contractor shall receive no compensation for materials or labor involved in the removal or replacement of the deficient concrete pavement. With the consent of the Engineer, the Contractor may leave the deficient pavement in place and receive no compensation or payment for such pavement. The area of concrete pavement for which no payment is made shall be identical with the area of pavement which the Contractor would be required to remove and replace as provided above. Deductions for non-pay deficient thickness pavement shall be entered on the final Contractor's Payment Voucher.