

INDEX FOR  
SPECIFICATIONS FOR CONCRETE PAVEMENT

		<u>Page</u>
830.	1	SCOPE..... 3
	1.1	<b>Pre-Construction Meeting ..... 3</b>
830.	2	MATERIALS ..... 3
	2.1	Sampling and Testing ..... 3
	2.2	Supply ..... 3
	2.3	Cement..... 4
	2.4	Fly Ash ..... 4
	2.5	Water..... 4
	2.6	Admixtures ..... 4
	2.7	Aggregates ..... 5
	2.8	Steel ..... 5
	2.9	Grouting Capsules ..... 5
	2.10	Dowel Bar Bond Breaker..... 5
	2.11	Dowel Bar Assemblies ..... 5
830.	3	MIX DESIGN ..... 6
	3.1	Mix Proportions ..... 6
	3.2	Aggregates Samples..... 6
	3.3	Mix Design Changes ..... 7
830.	4	EQUIPMENT ..... 7
	4.1	Inspection of Plant & Equipment..... 7
	4.2	Slip Form Paver ..... 7
	4.3	Automatic Fine Trimming Machine ..... 7
	4.4	Proportioning Plant..... 7
	4.5	Mixers and Agitators ..... 8
	4.6	Side Forms..... 8
	4.7	Screed ..... 8
	4.8	Straightedge..... 8
	4.9	Brooms..... 9
	4.10	Spraying Device ..... 9
	4.11	Portable Vibrator ..... 9
	4.12	Asphalt Kettle ..... 9
	4.13	Additional Equipment ..... 9
830.	5	CONSTRUCTION METHODS ..... 9
	5.1	Base ..... 9
	5.2	Setting Side Forms..... 9
	5.3	Placing Steel ..... 10
	5.4	Batching Concrete..... 11
	5.5	Mixing and Delivering Concrete ..... 11
	5.6	Placing Concrete..... 12
	5.7	Finishing Concrete ..... 13
	5.8	Joints ..... 14
	5.9	Curing..... 14
	5.10	Removing Forms..... 14
	5.11	Sealing Joints ..... 14
	5.12	Weather Limitations ..... 15

5.13 Grouting Steel ..... 15

830. 7 ACCEPTANCE TESTING AND PAY ADJUSTMENTS ..... 15

    7.1 Concrete Strength ..... 15

    7.2 Surface Smoothness..... 16

**7.2.1 Riding Bonus for Concrete Pavement ..... 17**

    7.3 Cracked Concrete ..... 17

    7.4 Pavement Width..... 17

830. 9 METHOD OF MEASUREMENT ..... 17

830. 11 BASIS OF PAYMENT ..... 17

SPECIFICATIONS FOR CONCRETE PAVEMENT

## 830. 1 SCOPE

These specifications govern all operations necessary for and pertaining to the construction of an air-entrained Portland Cement Concrete Pavement.

**1.1 Pre-Construction Meeting**

The Contractor and his Superintendent shall attend a pre-construction meeting with the Regional Construction Engineer and Departmental Staff, to discuss the project. The meeting shall be initiated by the Contractor and held at a mutually agreed upon date before starting his field operations. Topics to be discussed will include the type and quantity of equipment to be used, sequence of work, traffic control, **application of dust suppressants** and other pertinent topics.

**At the pre-construction meeting the Contractor shall provide the location of the concrete mixing plant.**

## 830. 2 MATERIALS

## 2.1 Sampling and Testing

Prior to approval for use, proposed materials will be subject to inspection and/or testing by the Testing Laboratory designated by the Department. When requested, the samples of materials shall be submitted at least 14 days before their intended use.

The Department shall not be charged for the sampling of the materials submitted for testing.

When agitating trucks are used to deliver concrete, the Department will collect samples at the point of delivery.

When non-agitating trucks are used to deliver concrete, the Department will collect samples at the concrete batch plant and at the point of delivery. The Contractor shall provide a method of sampling from trucks at the batch plant that is acceptable to the Engineer.

## 2.2 Supply

The Contractor shall be responsible for the supply, safe storage and handling of the following materials:

1. Concrete Constituent Materials
  - (i) Type GU Normal Portland Cement
  - (ii) Fly Ash
  - (iii) Aggregates
  - (iv) Water
  - (v) Air-entraining Agents
  - (vi) Admixtures
2. Reinforcing Steel (includes dowels, deformed tie bars, dowel assemblies, chairs and other accessories)
3. Joint Sealants

- (i) Hot-poured elastic compounds with backer rods
- 4. Liquid, Membrane-Forming, Curing Compound
- 5. Grouting Capsules
- 6. Bond Breaker Coating for Dowels

The Department maintains an Approved Products List and all materials to be used must be on this list. All materials shall be applied in strict accordance with the manufacturer's recommendations.

### 2.3 Cement

Cement for use in concrete shall meet the requirements of the latest edition of CSA Standard A3000.

### 2.4 Fly Ash

The contractor shall submit the mill certificate including chemical and physical composition and analysis, fly ash source and name of supplier. A new mill certificate shall be provided for each change of source of fly ash or when a new batch of fly ash is delivered. The certificate shall be produced prior to the start of production of concrete and approved by the Engineer.

The mill certificate shall detail the following properties and the fly ash supplied shall meet the following properties:

Property Limits	Specified Limit
Fineness (% retained on 45µm sieve)	Max. 34%
Autoclave Expansion	0.8%
CaO %	8 – 20%
SiO <sub>2</sub> %	Min. 50%
SO <sub>3</sub> %	Max. 3%
Loss on Ignition	Max. 3%
Moisture Content	Max. 3%
Pozzolanic Strength	Min. 75% at 28 days

### 2.5 Water

The water shall be free from injurious amount of oil, acid, organic matter, soluble chlorides, excess alkali, or other deleterious matter. All water for use in concrete shall be from a source which meets the requirements of the latest edition of AASHTO Specification M 157

### 2.6 Admixtures

Air-entraining admixtures shall conform to the requirements of ASTM C260.

Chemical admixtures shall conform to the requirements of ASTM C494 or ASTM C1017.

The Contractor is responsible for selecting the admixtures to be used. The Department will perform a mix design using the selected admixtures. If an acceptable mix design cannot be achieved using the admixtures selected, the Contractor shall select different admixtures.

## 2.7 Aggregates

Aggregates for use in concrete shall meet the "Specifications for Aggregate for Portland Cement Concrete."

## 2.8 Steel

All steel in new concrete pavements shall be 'corrosion resistant steel' and shall meet the requirements of 'corrosion resistant steel' in the Department's Approved Products List.

For concrete rehabilitation projects, refer to the Special Provisions for steel requirements.

## 2.9 Grouting Capsules

The Contractor shall supply and install anchoring grout capsules wherever existing concrete pavement or new concrete pavement must be drilled for the installation of load transfer dowels, deformed dowels, or deformed tie bars. The Contractor shall supply grout anchoring capsules in accordance with the Department's Approved Products List. The grout anchoring capsules shall be installed according to the manufacturer's recommendations.

Tie bar and dowel bar holes shall be blown clean with compressed air before grouting.

Excess grout shall be cleaned from the area surrounding the hole prior to curing.

## 2.10 Dowel Bar Bond Breaker

Smooth load transfer dowels shall be thoroughly coated at the site with a thin uniform coating of an approved bond breaker for the length of the dowel. The bond breaker coating shall be smooth and free of voids. Bond breakers supplied by the Contractor shall be on the Department's Approved Product List.

The Manufacturer of the dowel assemblies shall follow the product information sheet, noting the following:

- Dry film thickness shall be 0.85mm – 1.28mm;
- Prior to application, all surfaces shall be clean, dry, and free of rust, oil, and mill scale;
- The surface temperature of the dowels and the temperature of the Bond Breaker shall be between 10°C – 35°C at the time of application;
- Bond Breaker used for application shall be stored at temperatures between 10°C – 35°C.

The Department will inspect the dowels four (4) weeks prior to being used and if in the opinion of the Engineer the quality of the Bond Breaker is questionable, a "pull out" test AASHTO M253 will be performed and the maximum pull out load shall not exceed 11.2kN. Dowels failing this test shall be replaced or re-coated by the Contractor.

Prior to re-coating, all contaminants must be removed from the dowels and cure time shall be 24 hours. The same Bond Breaker material that was originally used to coat the dowels shall be used to re-coat them. Any dowels that require replacement or recoating shall be done at the Contractor's expense.

## 2.11 Dowel Bar Assemblies

Dowel Bar assemblies shall be supplied in accordance with the Department's Approved Products List and the Drawings.

## 830. 3. MIX DESIGN

## 3.1 Mix Proportions

The use of fly ash in the concrete mix will be permitted. The Contractor will have the option to replace cement up to but not exceeding the following limits, by weight of total cementitious materials, depending on the type of cement used in the concrete. The types of cement shall be in accordance with the following table:

Type of Cement	Maximum Amount of Fly Ash Permitted
GU: General use of Hydraulic Cement	20%
MS or HS: Moderate or High Sulphate-resistant hydraulic cement	20%
HE: High Early strength hydraulic cement	0%
MH or LH: Moderate or Low Heat of hydration cement	0%

The use of Fly ash will not be permitted when ambient temperature during placing is below 0°C or is expected to be below 0°C within 3 days of placement.

Before concrete mixing starts, the proportions of cement, fly ash, water, fine and coarse aggregates and admixtures that are to be used in the concrete, will be determined by the Department. The mix design will be based on the test results of the samples previously tested and approved for concrete. The mix proportions will be based on the concrete meeting the following physical requirements:

Cement Requirements	
Type of Mix	Minimum Cementitious Content
Normal	340kg/m <sup>3</sup>
Cold Weather or Early Strength	355kg/m <sup>3</sup>

Concrete Physical Requirements	
Air Content (at delivery point)	6 – 8%
Slump	± 25mm from design slump
Minimum 28 Day Strength	32MPa
Max. Water / Cement Ratio	0.40

Minimum air behind the paver is 4.5%. The Contractor shall adjust the air content, at delivery, to maintain the minimum air behind the paver at all times.

The Contractor shall select a design slump for each concrete mix used on a project. The Department will provide a mix design to achieve the requested slump.

## 3.2 Aggregate Samples

During aggregate production, the Contractor shall provide sufficient quantities of fine and coarse aggregate samples for concrete mix designs.

### 3.3 Mix Design Changes

Changes to the mix design shall not be made without the Department's approval.

## 830. 4 EQUIPMENT

### 4.1 Inspection of Plant & Equipment

The equipment provided by the Contractor shall be on site and available for inspection, testing and approval, before paving starts.

### 4.2 Slip Form Paver

The equipment shall consist of a slip form paver and any additional equipment that is required to construct a stable and rigid pavement, which meets the specified widths, depths, crown, alignments and grades.

For pavement widths between 5.0m and 8.6m, the slip form paver shall have a minimum manufacturer rating for gross weight of 25 000kg and an engine having a minimum power output of 150kW.

For pavement widths less than 5.0m, the slip form paver shall have a minimum manufacturer rating for gross weight of 15 000kg and an engine having a minimum power output of 100kW.

### 4.3 Automatic Fine Trimming Machine

The machine used for automatic fine trimming of the granular base course shall be capable of trimming the base to the design specifications.

### 4.4 Proportioning Plant

The concrete plant shall proportion the cement and fine and coarse aggregates by mass. The plant shall have separate bins or compartments for the cement, fly ash and for each type and size of aggregate. They shall be designed to prevent intermingling of different materials, contamination, segregation, breakage, and allow free movement of materials to the discharge openings.

Water and liquid admixtures shall be proportioned by volume or mass. If water is to be measured by volume, the device shall be so arranged that variable pressure in the water supply line does not affect the measurements. The device shall be fitted with the necessary valves and connections to divert the water measured for a batch so that the accuracy of measurement can be easily verified.

The dispensing equipment for adding the liquid admixtures shall be automated and shall also have visual, volumetric measuring or read-out units. Pressure systems shall have a safety check valve to prevent admixtures from re-entering the read-out units before the discharge of the admixture to the present batch.

The Contractor shall supply and install filters, dust collectors or other equipment to minimize any loss or damage to the cement.

Weighing devices in the plant shall be tested and their accuracy approved before the construction starts and may be tested with standard weights at any time. Scales shall be designed and maintained to within 0.5% accuracy through the normal operating range for cement, water and aggregates. Minimum increments on the scale or digital readout shall not exceed 2kg for the cement scale and 10kg for the aggregate scale. The weighing beam, dial, or digital readout shall be placed in full view of the operator during the operation of the gate, which

delivers the material to the hopper. Adjustments to the weighing devices shall not be made without the Department's approval.

#### 4.5 Mixers and Agitators

Mixers may be stationary mixers or truck mixers. Agitators may be truck mixers or truck agitators. Each mixer or agitator shall have the manufacturer's rating plate(s) attached to it in a prominent place indicating:

- a) the gross volume of the drum or container;
- b) the rated maximum mixing capacity, measured by volume;
- c) the rated maximum agitating capacity;
- d) the maximum and minimum mixing and agitating speeds for the drum, blades or paddles.

When stationary mixers are used for the complete mixing of concrete, the time of discharge shall be controlled by an acceptable timing device that prevents discharge of the batch until the specified mixing time has elapsed.

Mixers and agitator trucks shall be operated within the limits specified on the equipment manufacturer's rating plates.

To ensure that the mixers and agitators are producing concrete uniform in consistency throughout the batch, "within-batch" uniformity tests may be made on selected batches. Individual samples, at approximately the beginning, the mid-point, and the end of the load, will be obtained and tested for uniformity of the slump.

If the slump of the 3 individual samples varies by more than 30mm, then the mixer or agitator shall not be used until the condition is corrected.

Accumulation of hard concrete or mortar within the mixer will not be permitted.

#### 4.6 Side Forms

The side forms shall be constructed of steel for all concrete pavements. Forms shall be rigid, straight and true with a smooth face and have locked joints. For every 3m form section, a minimum of 3 pins shall be used for securing the forms to the base.

Forms for curves shall be capable of installation to within 12mm of the true curve. If the radius is less than 50m, forms shall be either flexible material or custom-shaped to fit the curve. The forms shall be designed to be securely fastened together in the correct position.

The forms shall be clean and free of hardened concrete.

#### 4.7 Screed

The Contractor shall provide a mechanical screed and a back up manual screed to accommodate a breakdown.

The manual screed will only be permitted to screed concrete already mixed and placed on grade at the time of the mechanical screed's breakdown. Further paving shall stop until the mechanical screed is again operative.

#### 4.8 Straightedge

The Contractor shall provide one metal straightedge, 3m long, with suitable handles. The straightedge shall have at least one machined edge and shall be checked frequently for accuracy.



#### 4.9 Brooms

When required, the Contractor shall provide a mechanical broom. At least 2 hand brooms will be on site to accommodate a breakdown. Each hand broom shall be approximately 600mm wide with at least 3 rows of bassine fibres not more than 112mm long. The brooms shall have handles long enough to permit the brooming of one lane of pavement.

#### 4.10 Spraying Device

The Contractor shall provide a mechanical sprayer for applying the liquid, curing compound to the surface and sides of the pavement. To accommodate a breakdown, the Contractor shall provide portable, pressurized, spray containers capable of completing the application as soon as the finishing is completed.

#### 4.11 Portable Vibrator

The Contractor shall provide a portable vibrator, with its own power unit, to operate at a uniform, minimum 3 600 impulses per minute.

#### 4.12 Asphalt Kettle

The Contractor shall provide thermostatically controlled heating equipment for the joint sealant used. The heating equipment shall meet the requirements specified by the joint sealant manufacturer.

#### 4.13 Additional Equipment

The Contractor shall also provide foot bridges, edgers, small tools and other equipment necessary to complete the work in accordance with these specifications.

### 830. 5 CONSTRUCTION METHODS

#### 5.1 Base

Main-lane pavements shall be the travel and passing lanes, excluding exit legs, acceleration and deceleration lanes, tapers, median crossover, connecting roads **50m** or less in length and pavements to be overlaid with asphalt.

For main-lane pavements, the Contractor shall use an automatic fine trimming machine to bring the base to the design elevations before placing the concrete.

Immediately after fine grading the base, it shall be compacted with at least 2 passes of a compactor. All high areas in the base shall be levelled to the design elevation. Low areas in the base greater than 15mm shall be filled to the design elevation and thoroughly compacted.

When necessary, base shall be dampened with water immediately before placing the concrete. There shall be no pools of water on the base. Concrete shall not be placed on a soft or frozen base.

#### 5.2 Setting Side Forms

Side forms shall be set to exact grade and alignment ahead of placing the concrete. The side forms shall be set on a minimum 450mm wide and a maximum 15mm deep sand or granular base course cushion. The cushion shall be placed on a stable and well-compacted foundation.

Form sections shall be tightly joined by a locked joint, free from play or movement in any direction. They shall be staked with a minimum of 3 steel pins for each 3-metre section. A pin shall be placed at each side of every joint.

Staked forms shall be securely set to withstand deflection from the impact and vibration of the consolidating and finishing equipment. The forms shall not deflect more than 6mm when tested with a load equal to the loads exerted by the consolidating and finishing equipment. Before placing the concrete, the forms shall be cleaned and coated with a form release agent.

### 5.3 Placing Steel

Reinforcing steel shall be straight and free from distortion and shall be positioned as shown on the Drawings. It shall be kept clean and free from rust and from release agents.

Deformed tie-bars shall be supported on metal chairs so it will not be displaced while placing the concrete.

The Contractor shall place deformed tie bars at 500mm on centre along the centreline through all horizontal curves and at other locations as noted in the Drawings. Deformed tie bars at all other applicable locations shall be placed at 750mm on centre.

The tolerance for the alignment of deformed tie bars will be as follows:

- Vertical tolerances shall be  $\pm 6$ mm from the middle of the concrete slab depth.
- Vertical tolerance shall be  $\pm 6$ mm from the concrete surface grade.
- Horizontal tolerance shall be  $\pm 25$ mm from being centered over the joint.
- Horizontal tolerance shall be  $\pm 6$ mm from perpendicular to roadway centerline.

All measurements are to the centre of the deformed tie bar. The horizontal position of deformed tie bars may be adjusted to avoid contact with existing deformed tie bars in the longitudinal joint when panel replacements are being constructed.

Side forms shall be used whenever a sawed full depth vertical face cannot be maintained.

Dowels for plain-dowelled, concrete pavement shall be located at all transverse contraction joints using dowel assemblies as shown on the Drawings. The dowels shall be aligned parallel to the centreline and the slab surface. The dowel assemblies shall be rigidly fabricated and fastened to the base to hold the dowels horizontally and vertically in alignment until the concrete is placed and finished. Cutting dowel assemblies and reinforcing steel to size will not be paid for directly as the work will be considered as an incidental operation to concrete pavement. The cutting of assembly transport ties will not be permitted.

The use of a dowel bar inserter will not be permitted.

The Department will mark the location of the dowel assemblies on the top of the forms or on the grade so the transverse joint can be accurately marked and cut.

Smooth dowel bars shall be uniformly coated with an approved bond breaker. Approved products are listed on the Department's Approved Products List.

Load transfer dowel bars shall be installed mid-depth of the concrete slab, in a plane with the pavement surface and parallel to the centerline of the road. The tolerance for the alignment of dowel bars will be as noted below:

- Vertical tolerances shall be  $\pm 6$ mm, as measured from the ends of the dowel to the surface of the pavement (or to the top of the base layer) less  $\frac{1}{2}$  the design concrete pavement thickness ( $t/2$ );
- Horizontal tolerances shall be  $\pm 6$ mm, as measured from centreline to each end of the dowel;

- Depth tolerance shall be  $\pm 6\text{mm}$ , as measured from the top of the base layer to  $\frac{1}{2}$  the design concrete pavement thickness ( $t/2$ );
- Side shift tolerance shall be  $\pm 50\text{mm}$ , as measured from the transverse and longitudinal joint locations.

All measurements shall be to the centre of the dowel. The Engineer may inspect steel placement using various means of inspection.

If steel placement is found to be out of tolerance, the Contractor shall modify his construction methods, as necessary, to bring steel placement within the alignment tolerances.

#### 5.4 Batching Concrete

The concrete mixes shall be batched in accordance with the mix design.

The weight of aggregates and cement from the proportioning plant shall be within 0.5% of the designated batch weights. The batch weights may be adjusted to allow for moisture variations in the aggregates.

#### 5.5 Mixing and Delivering Concrete

Concrete shall be mixed and transported to the point of delivery by one of the following combinations:

- 1) Mixed completely in a stationary mixer and transported to the point of delivery in a truck mixer operating at agitator speeds.
- 2) Mixed completely in a truck mixer at the batch plant and transported to the point of delivery operating at agitator speeds.
- 3) Mixed completely in a truck mixer at the point of delivery after the addition of mixing water.
- 4) Mixed completely in a stationary mixer and transported to the point of delivery in a dump truck.

When a stationary mixer, charged to its maximum rated capacity, is used for the complete mixing of the concrete, the mixing time for mixers having capacities of  $1\text{m}^3$  or less shall be a minimum of 1 minute. For mixers of larger capacities, this minimum shall be increased by 20 seconds for each additional cubic metre or fraction of it. Mixing time shall be measured from the time all the cement and aggregates are in the drum.

When batching the concrete, some water shall enter the mixer before the cement and aggregate, and all water shall be in the drum by the end of the first one-quarter of the specified mixing time.

The operation of truck mixers shall not exceed the drum's rated maximum mixing capacity and the mixing or agitating speeds designated by the equipment manufacturer. A truck mixer or truck agitator transporting concrete that has been completely mixed in a stationary mixer shall operate within the limits of its capacity and agitating speed.

For determining the number of mixing revolutions required when a truck mixer is used for complete mixing, all materials, including the mixing water, shall be in the mixer drum before starting. Each batch of concrete shall then be mixed at the designated mixing speed. When complete mixing has been obtained, any additional revolutions shall be at the designated agitating speed.

Concrete delivered to the work site using agitating trucks, shall be discharged completely within 90 minutes after the cement was added to the aggregates. This time may be reduced under conditions contributing to quick stiffening of the concrete or when the temperature of the concrete is  $29^\circ\text{C}$  or above.

Concrete delivered to the work site using non-agitating trucks, shall be discharged completely within 30 minutes after the cement was added to the aggregates.

The following requirements shall apply to the use of non-agitating trucks:

- a) Trucks shall meet the requirements of CSA A23.1-09, clause 5.2.4.2.2.
- b) Concrete shall be covered while in transit.
- c) Unless otherwise approved by the Engineer, the Contractor shall use a concrete transfer device. It shall be in good working order and will be subject to approval by the Engineer.
- d) Loads not meeting air, slump, or time requirements will be rejected. The Contractor shall dispose of all rejected material at an environmentally acceptable site.
- e) The Contractor shall be responsible for maintaining a smooth surface on all gravel haul roads used for the delivery of concrete with non-agitating trucks. The gravel surface shall be free of washboard and potholes, and will be subject to the approval of the Engineer.

Each load of concrete delivered to the job site shall have a delivery ticket issued at the batch plant, showing the following minimum information:

- a) Contract Number
- b) Truck number
- c) Date and time loaded or the time of the first mixing of the cement with the aggregates
- d) Volume of the truck load (batch)

The Contractor shall issue the delivery tickets.

When the Special Provisions specify that a dedicated plant be used, then that plant shall not produce concrete for other projects while producing for the Department's project. The dedicated plant and concrete delivery equipment shall ensure a minimum delivery of 60m<sup>3</sup>/hr of concrete to the placing machine.

Concrete shall be used as long as its consistency and workability meet the job requirements. Additional water may be added to the concrete after the initial mixing water has been added, if the measured slump at the start of discharge is less than that specified, and the time between batching and the start of discharge has not exceeded 60 minutes. The addition of water shall not cause the water / cement ratio to be exceeded. The drum shall then be turned at mixing speed to meet the within-batch uniformity stated in Clause 4.5. Water shall not be added to the batch at any later time.

When non-agitating trucks are used, the design slump of the concrete shall not be greater than 30mm.

## 5.6 Placing Concrete

Main-lane pavements, 8.6m or less in width, shall be constructed in one complete pass using a self-propelled slip form paver.

The plastic concrete shall be uniformly discharged, full width in front of the spreader in a manner which prevents segregation of the mixed material.

The slip form paver shall spread, consolidate, screed, and float finish the freshly placed concrete, to provide a dense and homogeneous pavement. Hand finishing shall be kept to a minimum.

The mixing, placing and spreading operations shall be performed in a continuous, uniform, forward movement. Vibrating and tamping shall cease immediately upon the paver's forward movement being stopped.

The slip form paver shall construct the pavement true to the specified grades and alignments.

Paving equipment riding on steel side forms will be permitted to construct non main-lane pavements.

When side forms are used the concrete adjacent to the side forms and fixed structures shall be placed to the required depth and thoroughly consolidated with a portable vibrator. The vibrator shall not contact the base while it is being operated nor shall it be used to move the concrete horizontally.

Equipment paving adjacent to a slab previously placed will be permitted to operate on that slab. Damage to the adjacent existing concrete, caused by the paving equipment, shall be repaired at the Contractor's expense.

Joints in adjacent lanes of pavement shall align with joints in previously placed concrete.

Two-lift construction or other special construction methods will not be permitted without prior written approval. Where approval is given to use two-lift construction, the first lift shall be roughly struck off with a template or screed at the correct elevation to place the reinforcing steel as shown on the drawings. The concrete above the reinforcing steel shall be placed within 15 minutes after the first lift has been placed. Any dust, dirt, or other foreign matter which collects on the first lift shall be removed before the second lift is placed.

A transverse construction joint may be required to close a section when the continual placing of concrete is delayed. The construction joint shall be located between the contraction joints.

#### 5.7 Finishing Concrete

After the concrete has been placed, it shall be struck off by a finishing machine or a slip form paver designed to perform the finishing as one of its operations.

The finishing machine shall be designed and operated to strike off and consolidate the concrete, eliminate ridges and produce an even surface true to the specified grades and alignment. The operation of the machine shall be controlled to keep the coarse aggregate near the finished surface of the pavement. Repeated operation of the machine over any area shall be avoided.

There shall be no noticeable water on the surface before hand finishing.

After finishing, the Contractor shall test the smoothness of the pavement surface with a 3-metre metal straightedge. Noticeable deviations shall be corrected at this time.

As a final finishing operation, the pavement surface shall be textured to a broomed, tined or diamond ground finish in the transverse or longitudinal direction. The type of finish to be constructed will be stated in the Special Provisions of the Contract.

When a broomed surface is specified, it shall be completed before initial set has developed and when the concrete will not be torn or excessively roughened. Brooms shall be clean and free from an accumulation of hardened cement. The stroke of the mechanical broom shall be made, without stopping, for the full width of the concrete, with the adjacent strokes overlapping. Sufficient pressure must be exerted on the broom to produce a uniformly serrated surface. The broom marks shall be approximately 2.5mm deep. Handheld brooms will not be permitted on pavement lanes exceeding 5.0m widths unless a work bridge is provided that spans the full width of the fresh pavement.

When tining is specified, it shall be completed after all finishing operations are completed on concrete pavements and before initial curing and protection of the concrete, the plastic surface of the concrete shall receive an initial and final tining. Initial tining shall be performed with a transverse or longitudinal texturing comb to produce a uniform textured surface. The texturing

comb shall be kept in a clean and damp condition, free from encrusted mortar. Final tining shall be achieved using equipment manufactured to produce transverse grooves  $3\text{mm} \pm 1\text{mm}$  wide on  $16\text{mm} \pm 3\text{mm}$  centers with a groove depth of  $4\text{mm} \pm 1\text{mm}$ . Transverse grooving shall extend to within  $75\text{mm} \pm 15\text{mm}$  of the pavement edge. Grooving for small or irregular areas may be done by hand methods.

When diamond grinding is specified, it shall be performed in accordance with the applicable specifications.

The surface shall be free in all cases from displaced aggregate particles and local projections.

## 5.8 Joints

The location of the transverse and longitudinal joints shall be marked by the Department.

All joints shall be sawn. The Contractor shall have a minimum of 2 concrete saws and sufficient auxiliary equipment on the job to insure that joint sawing is completed within the required time limits.

Transverse and longitudinal joints shall be sawn in conjunction with one another and begin as soon as the concrete surface has hardened sufficiently to resist raveling as the cut is made.

Transverse and longitudinal joints shall be sawn to the width and depth shown on the Drawings.

All the residue within each joint and on the pavement surface shall be removed after the sawing of that joint is completed.

Sawn joints which are ravelled or do not conform to the specified size and shape shall be repaired before the sealant is installed.

Expansion joints may be required adjacent to fixed structures and at other locations directed by the Department. They shall be constructed as shown on the Drawings.

If a fibre joint filler is required, it shall be supported rigidly in place while placing the concrete. Immediately after the finishing of the pavement is completed, the concrete over the filler shall be cleaned out and the edges of the slab on each side of the joint shall be rounded with an edging tool to a radius of 6mm.

All reinforcing steel shall be placed in accordance with the details shown on the Drawings.

## 5.9 Curing

Upon the completion of concrete finishing, all exposed surfaces shall be sprayed with the curing liquid to completely cover the surfaces in accordance with the manufacturer's recommendations. The Contractor shall use a curing compound listed on the Department's Approved Products List (APL). When side forms are used, the pavement's vertical sides shall be sprayed immediately after the forms are removed.

## 5.10 Removing Forms

Forms shall remain in place for a minimum of 12 hours after the concrete has been placed, unless permitted otherwise. Forms shall be removed without damaging the pavement.

## 5.11 Sealing Joints

When the Special Provisions or Drawings require sealed joints, the joints shall be clean and surface-dry at the time of sealing and the ambient temperature must be at least  $4^{\circ}\text{C}$  and rising. Joints shall not be sealed before the concrete has aged a minimum of 7 days. Transverse and longitudinal joints shall be sealed to within 6mm of the surface with a hot-poured, rubberized asphalt joint-sealing compound.

Joints which fail shall be cleaned out and resealed at the Contractor's expense.

#### 5.12 Weather Limitations

During hot weather, the temperature of the mix shall be kept as low as possible and shall not exceed 32°C. Aggregates or water, or both shall be cooled to reduce the concrete's temperature.

Additional measures shall be taken to prevent rapid moisture loss from the concrete surface.

The Contractor shall suspend paving operations if weather conditions increase the risk of cracking, as agreed by the Engineer.

The Contractor shall have a protective cover available at all times to protect the surface from rain before the concrete has sufficiently hardened. Paving shall stop immediately when rain starts and the concrete shall be covered with the protective cover.

Paving will not be allowed when the ambient temperature is below 0°C.

Paving may start when the ambient temperature is between 0°C and 5°C depending on the weather forecast, type of work, and quantity of concrete to be placed.

The Contractor shall provide sufficient insulated tarps or other approved protective coverings to maintain a minimum temperature of 10°C on the concrete surfaces for a minimum of 48 hours after it has been placed. If the air temperature drops below 0°C during this 48-hour period, the pavement shall be covered for a further 5 days.

Sufficient weights shall hold the tarps in place. Additional payment will not be made for any of these protective measures.

When the concrete is protected by insulation no more than 25 linear metres of concrete pavement shall be exposed for saw cutting operations. In no case shall concrete pavement be exposed more than one hour.

#### 5.13 Grouting Steel

The Contractor shall supply and install anchoring grout capsules wherever existing concrete pavement or new concrete pavement must be drilled for the installation of load transfer dowels, deformed dowels, or deformed tie bars. The grout anchoring capsules shall be installed according to the manufacturer's recommendations.

Tie bar and dowel bar holes shall be blown clean with compressed air before grouting.

Excess grout shall be cleaned from the area surrounding the hole prior to curing.

### 830. 7 ACCEPTANCE TESTING AND PAY ADJUSTMENTS

#### 7.1 Concrete Strength

The Department will determine the compressive strength of the concrete produced. The 28 day compressive strength will be determined from concrete cylinder specimens cast and tested by the Department. If the cylinder specimens fail to meet 85% of the minimum compressive strength specified, the department will obtain core specimens from the suspect areas of the concrete and their compressive strengths determined in accordance with the latest edition of CSA Standard A23.1 and A23.2.

If the core results determine that the concrete did not meet the minimum compressive strength requirement, then the areas represented by the cores will not be eligible for full payment.

If the average of the compressive strengths of the cylinders are at least 85% of the specified strength requirement and no single cylinder is less than 75% of the specified strength, the concrete will be deemed to have met the strength requirement. If the compressive strengths of the cylinders are less than 85% of the specified compressive strength, the following will apply:

1. Less than 85% but greater than 80% - Payment for the concrete will be reduced by 25% of the unit price.
2. Less than 80% but greater than 70% - Payment for the concrete will be reduced by 50% of the unit price.
3. Less than 70% - The concrete shall be removed and replaced at the Contractor's expense.

## 7.2 Surface Smoothness

For surface smoothness, the surface profile will be measured by the Department using a profile measuring device capable of simulating a California Profilograph. The readings will be taken in each wheel path of the mainline pavement. The International Roughness Index (IRI) will be determined by using the average wheel path results per 100m section in each driving lane. The Engineer will determine the final ride quality based on the results of the profile data. The occurrence of bridges will not interrupt the continuity determination, but the bridge surface and approach panels will not be included in the ride quality determination. Surface evaluation procedures will be as follows:

- Each lane is divided into 100 meter sections.
- Remaining subsections shorter than 100 meters will be prorated for equivalency in the riding quality.
- Each section shall have a maximum IRI as shown in the Special Provisions. Sections in excess of the maximum IRI shall be corrected by the Contractor.

On pavement sections where corrections have been made, a second profile measurement will be performed to verify that the corrections have produced a maximum IRI value as shown in the Special Provisions. Corrected areas which fail to meet the smoothness requirements will require further correction. No additional payment will be made to the Contractor for any further corrective action required as this will be considered incidental to the bid item for Concrete Texture Planing. Payment of the ride bonus will be based on the final profile measurement.

The procedures for appealing the acceptance test results shall be as follows:

- The Contractor may appeal the acceptance testing for smoothness of any 100-metre section only once.
- This appeal must be made within 2 calendar days of receiving the test results.
- The new test results will be binding on both the Contractor and the Department.
- The Engineer will make every effort to conduct the new test and provide a copy of the test results to the Contractor within 2 calendar days of receiving the Contractor's request for the new test.
- If the Engineer fails to provide the test results within the time provided in this specification, the Contractor shall not be relieved of his obligation to repair any defect.
- If the appeal testing verifies the original test result, subsequent testing will be at the Contractor's expense.
- Pay Adjustments will be in accordance with the schedule outlined in the Special Provisions.



Pay adjustment in lieu of correction for individual bumps or dips per 7.6 metres, will be made according to the following schedule:

Method of Measurement	Bump or Dip Measured in the Vertical Direction		Price Adjustment per Bump or Dip (\$)
	Bump	Dip	
Laser Profiler	> 8 but < 12mm	> 8 but < 12mm	\$600 Deduction or Correct
Laser Profiler	12mm or greater	> 12mm but < 16mm	Correct or Remove and Replace
Concrete Core		16mm or greater variation from design thickness	Remove and Replace

All work involved in the correction or removal and replacement of the concrete shall be done at the Contractor's expense.

### 7.2.1 Riding Bonus for Concrete Pavement

**Riding Bonus for Concrete Pavement shall be paid out of Contingency that is added to the Contract at the time of Award. This figure is only an estimate. The Contractor will be paid for the actual riding bonus achieved.**

### 7.3 Cracked Concrete

Concrete with cracking that extends greater than 1/3 of the slab thickness shall be removed and replaced, or at the Department's option accepted with zero payment. Concrete with cracking that extends less than 1/3 of the slab thickness may be repaired by methods approved by the Engineer. All work to remove and repair cracked concrete will be at the Contractor's expense.

### 7.4 Pavement Width

For the concrete pavement width to be accepted, the average pavement width shall not be more than 15mm less than the design pavement width.

## 830. 9 METHOD OF MEASUREMENT

Concrete pavement will be measured for payment in the field, to the maximum design width, in square metres.

## 830. 11 BASIS OF PAYMENT

The unit price per square metre for "Concrete Pavement" will be payment in full for supplying materials and for constructing a concrete pavement and for performing all work necessary or incidental thereto.