

## **3.70 Portland Cement Concrete Pavement - End Product Specification**

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## **3.70 PORTLAND CEMENT CONCRETE PAVEMENT - END PRODUCT SPECIFICATION**

### **3.70.1 GENERAL**

#### **3.70.1.1 Description**

Portland Cement Concrete Pavement (PCCP) shall consist of a mixture of Portland Cement, fine aggregate, coarse aggregate, water, admixtures and supplementary cementing materials, where required combined in proportions to meet the Specifications herein. PCCP shall be placed and consolidate on a prepared surface, and fitted with load transfer devices and tie bars, with joint formation and sealing, in conformity to the lines, grades, dimensions, and cross-sections as shown on the Drawings or as directed by the Consultant.

#### **3.70.1.2 Definitions**

For the purposes of this Specification, the following definitions will apply:

##### **3.70.1.2.1 Acceptance Limits**

- (i) Slab Thickness and Compressive Strength - Acceptance Limits for Slab Thickness and Compressive Strength are limiting values of the Lot Mean or individual tests within which the PCCP Lot will be accepted at full, increased, or reduced payment, as determined in Section 3.70.7.
- (ii) Smoothness - Acceptance Limit for Smoothness is the limiting value of the Profile Index within which the PCCP Sublot will be accepted at full, increased or reduced payment, as determined by Section 3.70.7.
- (iii) Early Compressive Strength - Acceptance Limits for determining PCCP adequacy for early opening of the PCCP section to traffic as specified in Section 3.70.5.7.

##### **3.70.1.2.2 Bridge Construction Specification (BCS)**

Bridge Construction Specification (BCS) refers to the most current edition of Alberta Transportation's publication entitled "Specifications for Bridge Construction".

##### **3.70.1.2.3 End Product Specification (EPS)**

A specification whereby the Department does not define the methods of construction. Under EPS, the Department will monitor the Contractor's control of the process that produces the items of construction and will accept or reject the end product according to a specified acceptance plan. The Contractor is entirely responsible for quality control. End product acceptance is the responsibility of the Department and includes a statistically oriented program of acceptance testing.

##### **3.70.1.2.4 Mix Design**

The Mix Design establishes the proportioning of Portland cement, fine aggregate, coarse aggregate, water, admixtures and supplementary cementing materials to be used for production of Portland cement concrete and requires the written approval of the Consultant prior to production of any Portland cement concrete under this Contract.

#### 3.70.1.2.5 Portland Cement Concrete Pavement (PCCP)

Portland Cement Concrete Pavement (PCCP) is a rigid pavement structure with an exposed concrete surface which may include concrete shoulders.

#### 3.70.1.2.6 PCCP Lot

A PCCP Lot is a portion of the Work being considered for acceptance and is defined as follows:

- (i) the greater of 4 000 m<sup>2</sup> or the surface area placed in one day, provided an approved change has not occurred to the mix design. Approved changes to the mix design may require the designation of a new PCCP Lot.
- (ii) One day's production of less than 4 000 m<sup>2</sup> added to the previous or next days day's Lot at the Consultant's option.
- (iii) If the Consultant suspects a portion of a PCCP Lot is substandard, the Consultant may order extra testing to define the area and severity of the deficiency. A new Lot will be designated for this portion if this extra testing indicates the mix is subject to unit price adjustment or rejection.
- (iv) For PCCP placed by hand or placed off the main alignment the Consultant will define the Lot size and limits.

#### 3.70.1.2.7 PCCP Sublot

A PCCP Sublot is portion of a PCCP Lot that is one lane wide and 100 m long on which the calculation for smoothness is based.

#### 3.70.1.2.8 Lot Mean

The Lot Mean is the arithmetic mean of a set of 5 or more test results constituting the samples for the Lot.

#### 3.70.1.2.9 Stratified Random Sample

A Stratified Random Sample is a set of test measurements taken one each from 5 or more separate (stratified) areas or segments within a Lot in an unbiased way in accordance with ATT-56 Part II, Stratified Random Tests for ACP Projects.

#### 3.70.1.2.10 Working Depth Cracks

Working depth cracks are full depth cracks that are subject to horizontal and/or vertical movement.

### 3.70.2 MATERIALS

#### 3.70.2.1 **Aggregates**

The Contractor shall supply Aggregates in accordance with the requirements of Specification 5.5, Supply of Portland Cement Concrete, Specifications 5.2, Supply of Aggregate and Specification 4.5, Hauling.

### 3.70.2.2 **Air-Entraining Admixtures**

The Contractor shall supply and use Air-Entraining admixtures in accordance with the requirements of the latest version of ASTM C260.

### 3.70.2.3 **Burlap**

The Contractor shall supply burlap that conforms to the requirements of the latest version of AASHTO M182 Class 4 and shall be free from substances that are deleterious to concrete.

### 3.70.2.4 **Curing Compound**

The Contractor shall supply curing compound that conforms to the requirements of the latest version of CSA-A23.1 and ASTM C309, except that application of Type I curing compounds will not be permitted. The Contractor shall not add any material to the curing compound as delivered by the manufacturer.

### 3.70.2.5 **Joint Materials**

#### 3.70.2.5.1 Expansion Joint Filler

The Contractor shall supply preformed expansion joint filler in accordance with the following table:

<b>TYPE</b>	<b>DESCRIPTION</b>	<b>PHYSICAL REQUIREMENT</b>
A	Non-Extruding and Resilient Bituminous	ASTM D1751
B	Non-Extruding and Resilient Non-Bituminous	ASTM D1752

#### 3.70.2.5.2 Joint Sealant

##### 3.70.2.5.2.1 Backer Rod

The Contractor shall supply backer rods compatible with the liquid sealant. The backer rods shall be made of polyethylene foam, cross-linked polyethylene foam or polyurethane and shall conform to the requirements of the latest version of ASTM Standard D5249.

##### 3.70.2.5.2.2 Liquid Sealant

The Contractor shall supply liquid sealant that conforms to the requirements of the latest version of ASTM D6690 (Types I and II), ASTM D3406 or ASTM D5893.

##### 3.70.2.5.2.3 Compression Seal

The Contractor shall supply preformed compression seals. Preformed compression seals shall conform to the requirements of the latest version of ASTM D2628.

### 3.70.2.6 **Moisture Vapour Barrier for Curing**

The Contractor shall supply moisture vapour barrier that is white opaque polyethylene film and that conforms to the requirements of the latest version of ASTM C171.

### 3.70.2.7 **Portland Cement**

The Contractor shall supply Portland cement in accordance with the requirements of the latest version of Specification 5.11, "Supply of Portland Cement" and concrete products in accordance with specific requirements in the latest version of CSA-A23.1, "Concrete materials and methods of concrete construction", as further outlined in this specification. The specific test procedures contained in CSA-A23.2, "Methods of test and standard practices for concrete" that are to be used are further outlined in this specification.

### 3.70.2.8 **Supplementary Cementing Materials**

Supplementary cementing materials, including silica fume, fly ash and ground granulated blast furnace slag, shall meet the requirements of the latest version of CSA-A23.5 and CSA-A3000-03. The use of Class 'CH' fly ash will not be permitted.

### 3.70.2.9 **Tie Bars and Dowels**

#### 3.70.2.9.1 Tie Bars

The Contractor shall supply tie bars to the dimensions as indicated on the Drawings. Tie bars shall be 15M, epoxy coated, deformed reinforcing bars that conform to the requirements of the latest version of ASTM A775.

#### 3.70.2.9.2 Dowels

The Contractor shall supply dowels to the dimensions as indicated on the Drawings. Dowel bars shall be plain round bars of grade 300 or better conforming to the requirements of the latest version of CSA-G40.21, and shall be epoxy coated to the requirements of the latest version of ASTM A775. For at least half their length, at either end of the dowels, the dowels shall be coated with oil or a suitable form release agent. Grease will not be permitted for use as a form release agent.

### 3.70.2.10 **Water**

The Contractor shall supply water for mixing and curing in accordance with the requirements of Specification 5.5, Supply of Portland Cement Concrete.

## 3.70.3 PORTLAND CEMENT CONCRETE MIX DESIGN

### 3.70.3.1 **Responsibility for Mix Design**

Preparation and submission of PCCP mix designs for Consultant verification and approval are the responsibility of the Contractor. The sampling and testing of aggregates, and the concrete mix design shall be completed by an independent Category 1 CSA certified concrete testing laboratory which shall have a permit to practice in the Province of Alberta. The testing laboratory shall provide an engineering opinion that concrete aggregate and mix designs are suitable for the intended use and are expected to perform to specified standards.

All costs incurred in mix design formulation are the responsibility of the Contractor. Shipping costs for samples sent to the Consultant for verification and approval are the responsibility of the Contractor.

### 3.70.3.2 Requirements for Mix Design

The mix design shall meet the following requirements:

- (i) The concrete shall have a minimum flexural strength at 28 days as specified in the Special Provisions or as shown on the Drawings.
- (ii) The minimum compressive strength at 28 days shall be the greater of 30 MPa or the compressive strength required to provide the specified minimum flexural strength at 28 days.
- (iii) The nominal maximum size of coarse aggregate shall be 20 mm to 28 mm.
- (iv) Aggregate for concrete shall not be susceptible to D-cracking. Concrete prisms shall be tested in accordance with ASTM C666 Procedure A for 350 cycles. At the end of 350 cycles the maximum allowable expansion shall be 0.035%.
- (v) The concrete mix shall be proportioned to avoid deleterious expansion due to alkali-aggregate reactivity in a service life of 50 years, as shown by laboratory testing conducted in accordance with the latest requirements of CSA-A23.2-27A.
- (vi) The slump of the concrete shall be 40 mm +/- 20 mm if the concrete is slip-formed. The slump of the concrete shall be 80 mm +/- 30 mm if the concrete is fixed-formed with mechanical equipment.
- (vii) The entrained air content of the concrete shall be in accordance with Table 4 of CSA-A23.1 for Air Content Category 1. The air voids system shall be assessed in the hardened concrete in accordance with the latest requirements of ASTM C457 and deemed satisfactory by the Contractors designer for the intended use of the PCCP.
- (viii) The maximum water/cementing materials ratio shall be 0.45.
- (ix) The minimum cementing materials content shall be 335 kg/m<sup>3</sup>. The minimum cement content shall be 300 kg/m<sup>3</sup>.
- (x) Supplementary cementing materials shall be restricted to the following proportions by mass of total cementing materials:
  - (a) silica fume up to 8%
  - (b) ground granulated blast furnace slag or fly ash up to 25%
  - (c) a mixture of silica fume, fly ash and ground granulated blast furnace slag up to 25% except that the individual proportions shall be restricted to the maximum proportions as specified herein.

#### 3.70.3.2.1 Relationship Between 28 Day Compressive and Flexural Strengths

The Contractor shall determine the 28 day compressive strength that provides the specified minimum flexural strength at 28 days, and shall determine the relationship between the 28 day compressive strength and the 28 day flexural strength, in accordance with following formula:

$$f(c) = [S(c) / k]^2 \quad \text{where:} \quad f(c) = 28 \text{ day compressive strength (MPa)}$$
$$S(c) = 28 \text{ day flexural strength (MPa)}$$
$$k = \text{constant, to be established by Contractor}$$

The 28 day compressive strength and the 28 day flexural strength shall be determined in accordance with the requirements of the latest version of CSA-A23.1 and CSA-A23.2. The Contractor shall complete as many tests as necessary (minimum of five) to determine the 'k' value. The Contractor shall have the constant developed by a independent laboratory with CSA



certification operating in the Province of Alberta. The constant shall be determined using test specimens of the proposed mix design.

### 3.70.3.3 Approval of Mix Design

Mix designs shall be subject to the approval of the Consultant. The Contractor shall submit the mix design to the Consultant for verification and approval. The Contractor's submission shall include the following information:

- (i) The flexural strength at 28 days (MPa).
- (ii) The compressive strength at 28 days (MPa).
- (iii) The nominal maximum size of coarse aggregate (mm).
- (iv) The coarse aggregate content.
- (v) The fine aggregate content.
- (vi) The source(s) and location(s) of the coarse and fine aggregates.
- (vii) The gradation of the coarse and fine aggregates to be used in the mix.
- (viii) The expansion following testing for D-cracking (%).
- (ix) The results from the alkali-aggregative reactivity tests.
- (x) The slump of the concrete (mm).
- (xi) The entrained air content of the concrete (% by volume).
- (xii) The water/cementing materials ratio (% by mass).
- (xiii) The cement content ( $\text{kg/m}^3$ ) and cementing materials content ( $\text{kg/m}^3$ ) and individual proportions (% by mass).
- (xiv) The constant, k, relating 28 day compressive and flexural strengths, as specified in Section 3.70.3.2.1, Relationship Between 28 Day Compressive and Flexural Strengths

The Contractor shall submit the mix design for the Consultant's review two weeks before scheduled placing of concrete.

Where required by the Consultant for any change in the nature or sources of the aggregates, or where a new mix design is desired by the Contractor, the Contractor shall provide a separate and complete mix design. This new mix design shall be subject to the same approval process by of the Consultant.

PCCP mix produced prior to the Contractor receiving the Consultant's written approval of the mix design will not be accepted.

The Contractor is responsible for producing mixes which conform with the Specifications.

## 3.70.4 SAMPLING AND TESTING

### 3.70.4.1 General

During the progress of the work, tests will be carried out on materials and workmanship in order to ensure compliance with the requirements of the Specifications.

The Consultant's approval of any materials or mixture shall in no way relieve the Contractor from his obligation to provide materials, mixtures and workmanship in accordance with the Specifications.

Where specified, random sampling procedures shall be followed, and where no specific random sampling procedure is specified the sampling procedure will be as identified by the Consultant in the case of acceptance testing and by the Contractor in the case of quality control testing.

The Contractor shall be responsible for obtaining all quality assurance cores at random locations as determined by the Consultant. Quality assurance cores for determining compressive strength and pavement thickness shall be obtained by the Contractor. The untrimmed cores shall be given to the Consultant for processing and testing.

The Consultant will have access to the Work at all times for taking samples. The Contractor shall provide any assistance necessary for taking samples and shall reinstate pavement layers or other structures to the satisfaction of the Consultant at the positions where samples have been taken. Compensation for providing assistance with sampling and for reinstatement where samples are taken shall be included in the unit price bid for the various items of work tested and no separate payment will be made.

The Contractor shall provide, at his own expense, sampling devices and other facilities which the Consultant may require to safely obtain representative samples of the item being produced.

When required, the Contractor shall provide and prepare, to the satisfaction of the Consultant, a suitable site for the parking of a mobile laboratory trailer. The Contractor shall provide power to the mobile laboratory trailer, at his own expense.

#### **3.70.4.2 Quality Control Testing**

##### **3.70.4.2.1 General**

Quality control testing is the responsibility of the Contractor throughout every stage of the Work. Tests performed by the Consultant will not be considered to be quality control tests. The Contractor shall provide and pay for CSA certified personnel and equipment to perform all quality control sampling and testing necessary to determine and monitor the characteristics of the materials produced and incorporated into the Work, and the final product.

All costs associated with pavement coring for both quality control and quality assurance testing shall be the responsibility of the Contractor.

Test methods and sampling requirements are described in Table 3.70.4.2, Quality Control Testing Requirements. The frequency of tests shall conform to the requirements of the latest version of CSA-A23.1. The Consultant may require an increase in the frequency of any quality control test which has a specified minimum frequency. The Contractor shall pay for any additional tests required by the Consultant.

Results of all quality control tests shall be submitted to the Consultant within 24 hours of their availability.

The Contractor shall bear the cost of all consulting services retained by him.

The Contractor shall be totally responsible for production of aggregates and mixes that meet all the specified requirements.

### 3.70.4.2.2 Quality Control Testing Requirements

Unless otherwise specified, the most recent editions of the following standard test methods shall apply. The Contractor shall conduct the Quality Control Testing in accordance with the following:

**Table 3.70.4.2  
Quality Control Testing Requirements**

<b>Test</b>	<b>Standard</b>	<b>Minimum Frequency</b>
Sampling Plastic Concrete	CSA-A23.2-1C	As required.
Sampling - QA cores	CSA-A23.2-14C	As outlined in Section 3.70.4.3
Compressive Strength	CSA-A23.2-3C & 9C	Not specified
Compressive Strength for Early Opening to Traffic	CSA-A23.2-3C & 9C	As outlined in Section 3.70.5.7
Compressive Strength for Full and Partial Depth Repairs	CSA-A23.2-3C & 9C	As outlined in 3.70.5.8 & 3.70.5.9
Density, Yield and Cementing Material Factor	CSA-A23.2-6C	Not specified, other than that required for Uniformity of Mixed Concrete.
Slump	CSA-A23.2-5C	Note 1
Air Content	CSA-A23.2-4C	Note 1
Uniformity of Mixed Concrete	CSA-A23.1-04	As outlined in 3.70.4.2.2.2
Pavement Smoothness	ATT-59	Not specified
Flexural Strength @ 28 days	CSA-A23.2-3C & 2-8C	Not specified

Note 1: On a daily basis, air content and slump shall be checked at the discharged point on each load until satisfactory control is established, then the frequency may be reduced to a random test for each 100 m<sup>3</sup>. Satisfactory control will be considered to be established when tests on five consecutive truck loads are all within the specified requirements outlined in Section 3.70.3.

#### 3.70.4.2.2.1 Failure to meet Slump and/or Air Requirements

In the event that actual slump and/or air content are outside the specified tolerance as determined by the Contractor's or the Consultant's testing, the Contractor will be required to immediately submit adjustments to the mix design or operations to correct the deficient condition, provided the adjustments made prevent future occurrences and are to the satisfaction of the Consultant.

Material placed that does not meet air content criteria will not be accepted unless testing conducted by the Contractor on core samples indicates that the air content and air-void system parameters of the suspect material is considered satisfactory in accordance with the latest version of CSA-A23.1 clauses 4.3.3.2 and 4.3.3.3. Sampling and testing costs associated with verifying the suitability of suspect concrete will be the responsibility of the Contractor.

#### 3.70.4.2.2.2 Uniformity of Mixed Concrete

Testing for equipment or construction process suitability shall be completed by the Contractor, in

the presence of the Consultant, on the first day of PCCP placement at a mutually agreed upon time.

The determination of within-batch uniformity shall be based upon a comparison of test results for three samples taken in accordance with CSA-A23.2-1C except that the three samples may be taken from the mixer or a load as delivered to the job-site. The three samples shall be tested for density, air content and slump. The concrete will be judged to be uniform or non-uniform based upon the range in the three samples for each test procedure, compared to the criteria listed in Table 3.70.4.2.2.2 as follows:

- (a) Where the range, within each test procedure, is equal to or less than the acceptance limit, the concrete shall be considered uniform.
- (b) Where the range within any single test procedure is greater than the rejection limit, the concrete shall be considered non-uniform.
- (c) Where the range of any single test procedure falls between the acceptance and rejection limits, additional samples shall be taken on the next consecutive batch or load delivered by that unit and tested. If the range within any single test procedure is greater than the acceptance limit, the concrete shall be considered non-uniform.

**Table 3.70.4.2.2.2 Determination of Within-Batch Uniformity**

Test Procedure for Determining Uniformity	Range Between Highest and Lowest Values of Three Test Samples	
	Acceptance	Rejection
Density of Concrete (kg/m <sup>3</sup> )	30	50
Air Content, (%)	0.8	1
Slump (mm)	30	50

If the concrete has been considered non-uniform, the equipment and/or construction process shall be rejected. The equipment shall not be used until it passes a retest, nor shall it be submitted for retesting unless the condition presumed to have caused the lack of uniformity has been corrected.

The Consultant may order the testing for uniformity of mixed concrete to be repeated at any time there is a change in mix design, equipment or construction process.

### 3.70.4.3 Acceptance Sampling and Testing

#### 3.70.4.3.1 General

Within this Specification, certain requirements, limits and tolerances are specified regarding the quality of materials and workmanship to be supplied. Compliance with these requirements where so specified, will be determined by statistical testing as described in this Specification.

Acceptance testing is the responsibility of the Consultant.

Initial acceptance testing will be performed free of cost to the Contractor. The Contractor shall be responsible for the cost of all quality assurance testing performed on material that is used to replace material that has been previously rejected.

The Contractor shall be responsible for the cost of all quality assurance retesting performed following attempts to improve smoothness or to remove bumps and dips.

After all quality control tests for the PCCP Lot are reported to the Consultant, the Consultant will provide the Contractor with a copy of the results of acceptance tests within 24 hours of their availability.

If the Consultant determines that certain test results are faulty due to testing equipment malfunction, improper testing procedures or calculations, he will replace the faulty tests with new tests.

If the testing equipment malfunction, improper testing procedure or calculations were on the part of the Consultant, the Contractor shall be reimbursed \$100 per location for obtaining the replacement cores.

### 3.70.4.3.2 Acceptance Sampling and Testing Procedures

#### 3.70.4.3.2.1 Coring for Compressive Strength and Thickness

Cores are to be obtained by the Contractor, in the presence of the Consultant, between 24 and 27 days inclusive after placement of the Lot. The cores will be 100 mm in diameter and will be drilled through the complete depth of PCCP perpendicular to the surface of the slab.

The minimum number of cores to be taken per Lot shall be as outlined in Table 3.70.4.3.2.1, Minimum Number of Cores for Acceptance Testing.

**Table 3.70.4.3.2.1 Minimum Number of Cores for Acceptance Testing**

Size of Lot (m <sup>2</sup> )	Minimum Number of Cores
4,000 or less	5
4,001 to 5,000	6
5,000 to 6,000	7
6,001 to 7,000	8
greater than 7,000	9

For concrete placed by hand or off the main alignment the minimum number of cores shall be either five, or one core per 300 m<sup>2</sup>, whichever is greater.

The locations of the cores will be selected by the Consultant using random selection criteria. No cores will be taken within 250 mm of edge of slab or 300 mm from a joint. Caution shall be exercised when coring at longitudinal and transverse joints in order to avoid coring through tie bars, dowel bars and dowel basket assemblies.

The cores will be stored at room temperature and moisture conditioned for 40 to 48 hours prior to testing as per CSA-A23.2-14C. Testing for compressive strength will be in accordance with CSA-A23.2-14C and will be completed when the concrete is at least 28 days old. Thickness will be determined in accordance with ASTM C174. The compressive strength and thickness so determined will be the basis for payment to the Contractor in accordance with Sections 3.70.6 and 3.70.7.

#### 3.70.4.3.2.2 Filling of Core Holes

The Contractor shall fill each core hole immediately after coring with an approved non-shrink grout. The patch shall be finished flush with the surface of the PCCP slab.

Immediately before filling, the surfaces of each hole shall be thoroughly cleaned of the paste to ensure a proper bond between the existing concrete and the grout. After filling each hole, all excess material shall be removed from the surface of the PCCP slab.

#### 3.70.4.3.2.3 Pavement Sampling for Smoothness

The surface of the PCCP Sublots will be profiled in accordance with ATT-59 using a California Cox Model Profilograph. Other makes of Profilograph machines may be used if they have been individually approved by the Department. Profiles will be made approximately at the traffic wheel paths.

Smoothness testing will also be undertaken on all passing, climbing, deceleration, and acceleration lanes including future lanes that are greater than 100 m in length, and on all interchange ramps. Tapers will not be subject to smoothness testing.

Smoothness testing will extend completely across all transverse joints between the existing pavement and PCCP placed under this Contract. Penalty assessments and acceptance/rejection criteria will apply to all such bumps and dips identified. P<sub>RI</sub> assessment for smoothness will be determined starting at the location where all wheels of the Profilograph are on PCCP placed under this contract.

Weather permitting, acceptance testing for smoothness will normally be completed within two weeks following the completion of all paving work subject to smoothness testing. All smoothness acceptance criteria will apply regardless of the year that the pavement is placed and the year that it is tested. Requests by the Contractor to have portions of the work tested prior to the completion of all paving will be considered subject to the availability of the Consultant's Profilograph testing crew and seasonal weather conditions. In such cases the Contractor will be invoiced by the Department at a rate of \$750 to cover the extra mobilization and travel costs associated with each occurrence.

#### 3.70.4.4 Retesting Following Attempts to Improve Smoothness

When the test results on a PCCP Sublot indicate a penalty or rejection because of smoothness, the Contractor, at his option, may make one attempt to improve the smoothness on the Sublot by additional work in which case the following shall apply:

- (i) the Contractor shall notify the Consultant in writing that he shall make one attempt to improve smoothness.
- (ii) The Contractor shall notify the Consultant, in writing, when the additional work has been completed.

The Contractor shall not undertake any method of repair that is detrimental to the quality of the pavement.

#### 3.70.4.5 **Appeal of Core Compressive Strength and Thickness Results**

The Contractor may appeal the results of acceptance testing of Core Compressive Strength and Thickness for any rejected or penalized PCCP Lot only once. Appeals will only be considered if cause can be shown. The appeal shall be for all tests within the PCCP Lot, and there will be no appeal allowed for single tests within a PCCP Lot.

The following procedures will apply for an appeal:

- (i) The Contractor shall serve notice of appeal to the Consultant, in writing, within 24 hours of receipt of the test results.
- (ii) The Consultant will arrange and pay for an independent testing laboratory with CSA certification operating in the Province of Alberta, to perform the appeal testing. The personnel employed or testing laboratory retained by the Contractor for quality control testing on the project will not be used for appeal testing.
- (iii) The Contractor will obtain the core samples at new random locations as determined by the Consultant and provide the untrimmed samples to the Consultant. The number and location of the new tests for each segment shall be in accordance with Section 3.70.4.3.2.
- (iv) The single high and single low test results from the old PCCP Lot will be rejected and the remaining test results will be added to the results of the new tests. A new PCCP Lot Mean for the test results will be determined and used for acceptance and unit price adjustment using Table 3.70 A.

The new values, thus determined, will be binding on the Contractor and the Department.

#### 3.70.4.6 **Appeal of Smoothness Results**

The Contractor may appeal acceptance test results of smoothness of any rejected or penalized PCCP Sublot once. The appeal shall be in writing and submitted within 24 hours of receipt of the test results.

Any attempt to improve smoothness on the appealed PCCP Sublot after the Consultant has tested the PCCP Sublot for acceptance shall void the appeal and the original test results will apply.

The appeal testing will be performed by the Consultant and the new results will be binding on the Contractor and the Department.

#### 3.70.4.7 **Payment of Appeal Testing Costs for Core Compressive Strength, Thickness and Smoothness**

If the new results show that a negative unit price adjustment no longer applies, then sampling and testing costs for the appeal procedures for that Lot will be the responsibility of the Department. Furthermore, in such cases, the Contractor shall be reimbursed sampling costs at the rate of \$100 per location.

If the new results verify that any unit price reduction or rejection remains valid for that Lot, then the Contractor will be invoiced by the Department for the testing costs for the appeal procedures, at the following rates:

Core Compressive Strength: \$500 per test

Thickness: \$100 per test

Profilograph: \$100.00 per hour (travel time, testing time and stand-by time)

### 3.70.5 CONSTRUCTION

#### 3.70.5.1 **Equipment**

##### 3.70.5.1.1 General

Equipment shall be designed and operated to produce an end product complying with the requirements of this Specification.

##### 3.70.5.1.2 Automatic Dowel Bar Inserter

Where an automatic dowel bar inserter is used it shall be capable of placing dowel bars as specified. The dowel bars shall be inserted mid-depth of the slab, centred on the transverse joint locations and spaced as shown on the Drawings. The equipment shall be capable of consolidating the concrete around the dowel bars.

##### 3.70.5.1.3 Consolidating

Concrete shall be consolidated by means of surface vibrators, internal vibrators, or a combination of both that provides full depth consolidation without segregation.

##### 3.70.5.1.4 Diamond Grinder

Where a diamond grinder is used to improve smoothness, it shall be power driven, self-propelled equipment specifically designed to grind and texture concrete pavement. It shall be equipped with a grinding head with at least fifty diamond blades per 300 mm of shaft. The grinding head shall be at least 0.9 m wide. The grinder shall be equipped with the capability to adjust the depth, slope and cross-slope to ensure that concrete is removed to the desired dimensions and uniformly feathered and textured across the width and length of the required area. The equipment shall also include a slurry pick-up system.

##### 3.70.5.1.5 Forms

The Contractor shall supply all formwork in accordance with BCS, Section 4, Cast-In-Place Concrete.

##### 3.70.5.1.6 Joint Sealant

The Contractor shall supply all equipment necessary to install the joint sealant in accordance with the manufacturer's recommendations.

##### 3.70.5.1.7 Production and Delivery of Portland Cement Concrete

The Contractor shall produce and deliver Portland cement concrete in accordance with the requirements of Section 5 Production and Delivery of the latest version of CSA-A23.1, unless otherwise approved by the Consultant. The Contractor shall provide the Consultant with a



certificate of calibration that certifies that the batching plant has been calibrated to produce a uniform batch in accordance with the Mix Design.

### 3.70.5.2 Preparation of Existing Surface

The Contractor shall maintain the finished granular base course in a smooth and compacted condition until the concrete is placed. An asphaltic prime coat shall not be applied to the granular base course surface unless approved by the Department in writing.

The granular base course shall be wetted down thoroughly, immediately ahead of the concrete placing operation. The wetting down operation shall be carried out without leaving standing water.

Concrete shall not be placed on a frozen surface.

The initial saw cut, for longitudinal and transverse contraction joints, shall be sawn within eighteen hours of paving operations.

### 3.70.5.3 Concreting

#### 3.70.5.3.1 General

Concrete shall be placed at its permanent location in such a manner so as to avoid segregation of the materials. The Contractor shall repair any segregated concrete in accordance with Section 3.70.5.8 or 3.70.5.9. Any excess concrete beyond the PCCP edge shall be removed immediately.

Transverse joint dowel baskets shall be placed a minimum of 100 m in advance of the paving operations.

When an interruption in placing concrete of more than forty-five minutes occurs, a transverse construction joint shall be formed, in accordance with 3.70.5.5.6. Concrete shall not be placed against any material that is at a temperature above 35°C or below 5°C.

Concrete shall not be placed when the ambient air temperature is below 5°C or above 32°C, unless adequate measures are taken to protect the concrete as outlined further in this Specification.

#### 3.70.5.3.2 Consolidating

Concrete shall be thoroughly consolidated against and along the face of all forms and into the face of previously placed concrete.

For fixed-form placement, hand-held vibrators shall be used to supplement consolidation adjacent and along the full length of the form. They shall also be inserted at regularly spaced intervals along both sides of dowel assemblies. Vibrators shall be operated in accordance with the manufactures recommendations and shall not be operated longer than fifteen seconds in any one location.

For slip-form pavers the concrete shall be consolidated by vibrators of sufficient number, spacing and frequency to provide uniform consolidation to the entire PCCP width and depth. The vibrators shall not operate while the paver is stopped.

The vibrators shall not come in contact with the subgrade, subbase, forms, tie bars or dowel assemblies.

#### 3.70.5.3.3 Finishing

No water or other chemical agents shall be applied to the surface or the sides of the concrete for finishing purposes.

For PCCP where fixed forms are being used or where concrete is being placed against an existing pavement and before surface texturing, the edge of the PCCP shall be finished with an edging tool having a radius of not more than 6 mm. The finished PCCP edge shall be left smooth, true to line and grade.

#### 3.70.5.3.4 Texturing of Surface

After all finishing operations are completed on the PCCP and before initial curing and protection of the concrete, the plastic surface of the concrete shall receive an initial and final texturing. Initial texturing shall be performed with a longitudinal burlap drag to produce a uniform textured surface. Burlap shall be kept in a clean and damp condition, free from encrusted mortar. Final texturing shall be achieved using equipment manufactured to produce longitudinal grooves  $3 \text{ mm} \pm 1 \text{ mm}$  wide spaced at 19 mm with a groove depth of  $4 \text{ mm} \pm 1 \text{ mm}$ .

Grooving shall extend to within  $75 \text{ mm} \pm 15 \text{ mm}$  of the PCCP edge. Grooving for small or irregular areas may be done by hand methods.

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

#### 3.70.5.3.5 Surface Tolerance

The surface of the concrete is to be such that when tested with a 3 m long straightedge placed perpendicular to centerline, including the edge of PCCP, except across the crown or drainage gutters, there shall not be a gap greater than 3 mm between the bottom of the straightedge and the surface of the PCCP.

Diamond grinding may be required to ensure the concrete surface meets these requirements.

Areas of PCCP repaired by diamond grinding will not be excluded from sampling for the determination of core compressive strength or thickness.

#### 3.70.5.4 **Curing**

The Contractor shall apply one coat of an approved curing compound after the texturizing operation without damaging the PCCP surface. A second application of the approved curing compound shall be applied within thirty to sixty minutes after application of the first coat. Both applications shall be such that the membrane formed is of uniform thickness and colour and free of breaks and pinholes. The surface shall be maintained in this condition for a minimum of seven days.

As soon as the forms are removed, the sides of the exposed concrete faces shall be sprayed with the white pigmented curing compound at the rate of application not less than the rate specified by the manufacturer of the compound. Curing compound shall not be applied to joint faces receiving sealant or to concrete surfaces to which concrete or mortar is to be bonded.

### 3.70.5.5 Joints

#### 3.70.5.5.1 General

Joints shall be of the type and at the location shown on the Drawings. The Contractor will be responsible for the layout, placement and construction of all joints.

The Contractor shall schedule the initial saw cut for the longitudinal and transverse contraction joints, such that uncontrolled cracking is prevented. Saw cutting operations shall not result in raveling, spalling or other damage to the concrete. Following the initial saw cut, the Contractor shall saw cut the PCCP to create a reservoir to receive sealant. The Contractor shall saw cut the PCCP to the dimensions shown on the Drawings.

Dowel bars at the transverse contraction joints shall be placed using dowel baskets or an automatic dowel bar inserter.

#### 3.70.5.5.2 Dowel Bars at Transverse Joints

At all expansion and contraction joints, dowel bars shall be installed in accordance with the details on the Drawings. The location of dowel bars shall be marked to permit precise joint forming or cutting operations directly over the centre of the dowel bars.

Dowel baskets used in the placement of dowel bars shall be as shown on the Drawings and suitably affixed to the granular base course such that misalignment is prevented.

When an automatic dowel bar inserter is used, the Contractor shall be required to remove a two metre by full-paver-width area of hardened PCCP at the dowel bar location, as determined by the Consultant, that was placed during the first day of paving. The area that is removed will be inspected by the Consultant to ensure that the placement and alignment of the dowel bars meets the requirements of this Specification. If the dowel bars were not placed and aligned as specified, additional areas shall be removed by the Contractor at locations chosen by the Consultant, until such time that the Consultant is satisfied that the Contractor's operations conform to the Specification. The area that has been removed shall be replaced in accordance with Section 3.70.5.8.

#### 3.70.5.5.3 Tie Bars

At longitudinal joints, epoxy coated tie bars shall be installed where specified and as detailed on the Drawings. Tie bars shall be inserted so that voids are not created around the bar. Tie bars shall not be placed within 400 mm of a transverse joint.

#### 3.70.5.5.4 Position and Alignment Tolerances

##### 3.70.5.5.4.1 Dowel Bars

The dowel bars shall be placed within a tolerance of  $\pm 6$  mm in the vertical and horizontal planes of the PCCP.

##### 3.70.5.5.4.2 Joints

All joints shall be sawn within a tolerance of  $\pm 15$  mm from the position and alignment of the centre

of the dowel bars.

#### 3.70.5.5.5 Handling and Storing Tie Bars and Dowel Bars

The Contractor shall handle and store tie bars and dowel bars in accordance with the requirements for reinforcing steel BCS, Section 5, Reinforcing Steel.

#### 3.70.5.5.6 Transverse Construction Joints

Transverse construction joints shall be made at the end of each day's run or when interruptions occur in the concreting operation. Transverse construction joints shall be formed at a contraction or expansion joint, except in cases of plant breakdown or adverse weather conditions. In these situations, a construction joint may be formed in the mid slab area subject to the provision that the portion of the slab placed, and the portion of the slab to be placed, is not less than two metres long. Construction joints in adjacent lanes shall align with the joints in the previously placed lane.

#### 3.70.5.6 **Joint Sealing**

##### 3.70.5.6.1 General

The Contractor shall saw cut the PCCP in accordance with Section 3.70.5.5.1. Immediately after the sawing operation, reservoirs shall be flushed with water in one direction to remove the slurry. Immediately prior to sealing operations, all joint faces shall be abrasive blast cleaned and then blown clean and dried using an oil free hot compressed air lance. Care shall be taken to prevent excessive drying and damage to the edges of the concrete.

##### 3.70.5.6.2 Sealant Installation

Transverse joints and cracks shall be filled prior to longitudinal joints. Grinding and milling operations shall be completed prior to sealant placement. Sealant shall be installed in accordance with the manufacturer's recommendations.

##### 3.70.5.6.2.1 Liquid Sealant

###### 3.70.5.6.2.1.1 Backer Rods

Backer rods shall have a minimum diameter of 25% greater than the reservoir width. The Contractor shall install backer rods immediately after cleaning and before sealant installation. Backer rods shall be inserted uniformly to the required depth to achieve the required shape factor. The backer rod shall not be punctured or stretched during installation.

###### 3.70.5.6.2.1.2 Liquid Sealant Installation

The sealant shall be placed following the installation of the backer rod by a manual pouring cone, or hose and wand fitted with proper size tip from a low pressure pump connected to the heating kettle. The tip of the cone or wand shall be placed to the top of the backer rod to ensure uniform application.

The reservoir shall be filled with sealant so that upon cooling, the sealant shall be 3 mm to 6 mm recessed below the adjacent PCCP surface. If after the initial placement, the material subsides below the required recess depths, additional sealant shall be placed.

Sealant damaged by construction traffic or the Contractor's operations shall be replaced by the Contractor at the Contractor's expense.

Any spilled material or excess material in the joints or cracks shall be removed immediately and the PCCP surface cleaned.

#### 3.70.5.6.2.2 Compression Seal Installation

After final cleaning of the reservoir, the lubricant adhesive shall be applied to the seal and the seal shall be installed in accordance with the manufacturers' specifications. During installation, twisting, nicking or other damage to the seal shall be avoided. The Contractor shall replace any seal that is damaged during installation. Sealant damaged by construction traffic or the Contractor's operations shall be replaced by the Contractor at the Contractor's expense.

### 3.70.5.7 Miscellaneous Protection

#### 3.70.5.7.1 Rain

Concrete shall not be placed in the rain. The Contractor shall take all necessary precautions to protect plastic concrete from rain. Any damage to the PCCP caused by rain shall be repaired or PCCP replaced at the Contractor's expense.

#### 3.70.5.7.2 Traffic

Traffic, other than foot traffic, rubber-tired saw cutting equipment, and rubber-tired side wheels of form mounted placing and finishing equipment necessary to construct adjacent lanes, shall not be permitted on the concrete until it has attained 20 MPa compressive strength.

Samples required for early strength determination shall be taken and tested by the Contractor. A minimum of one set of two cylinders per 500 m length of paving shall be required for early opening determination. Samples shall remain on site until time of testing.

For concrete incorporated in Full Depth Repairs of PCCP and Partial Depth Repairs of PCCP, the Contractor shall take a minimum of one set of cylinders from the last load of concrete placed in the PCCP section to be opened to traffic. The test cylinders shall be field cured adjacent to the repair area. The Contractor shall test the samples. Early opening to traffic shall be in accordance with this Specification.

The PCCP shall be protected from damage to the surface at all times when steel-tracked equipment is used.

#### 3.70.5.7.3 Cold Weather

Prior to the placement of any PCCP the Contractor shall submit a detailed curing and protection plan for cold weather conditions. Cold weather conditions shall apply to any placement done between October 1 and April 1, or at any time that the air temperature is forecast to be below 5°C within 72 hours of PCCP placement. No concrete shall be placed under cold weather conditions until the curing and protection plan is reviewed and approved by the Consultant.

As a minimum the curing and protection plan shall contain the following elements:

- (i) The Contractor shall monitor and ensure that the minimum in-place temperature of the PCCP is 15°C for the first three days of curing, and at 10°C for the subsequent four days.
- (ii) All PCCP surface and edge material shall be covered with insulated blankets.

The plan shall describe any further methods to be used by the Contractor to ensure that the minimum concrete temperatures are met.

All costs associated with work completed under cold weather conditions are considered incidental and no additional payment will be provided.

#### 3.70.5.7.3.1 Insulation Removal for Saw Cutting

When the PCCP requires protection by insulation, no more than 25 lineal metres of PCCP shall be exposed for saw cutting operations at any one time. In no case shall any PCCP be exposed for more than one hour during saw cutting.

### 3.70.5.8 Full Depth Repair of PCCP

#### 3.70.5.8.1 General

Where the Contractor is required to carry out full depth repairs of PCCP, the following clauses will apply in addition to the requirements of this Specification:

#### 3.70.5.8.2 Construction

##### 3.70.5.8.2.1 Concrete Removal

The outer limits of the concrete removal shall be saw cut full depth. The concrete removal method shall ensure that the concrete to be removed is not broken in place and that the adjoining concrete and underlying subbase remains undisturbed. Where the existing subbase is disturbed, the loosened material shall be removed, the surface compacted and replaced with an additional depth of concrete at the Contractor's expense. The Contractor shall dispose of the concrete as approved by the Consultant.

##### 3.70.5.8.2.2 Joints

###### 3.70.5.8.2.2.1 Dowel Bar and Tie Bar Placement

Gang drills shall be used to drill holes in the existing concrete for insertion of the dowel bars or tie bars. Drill holes shall be thoroughly cleaned.

The Contractor shall secure one half of the dowel bar into the existing concrete with an approved epoxy resin. The epoxy resin shall be injected into the back of the cleaned drill hole and the dowel bar, with grout retention disks attached, shall be inserted to ensure the bars are completely enveloped with epoxy resin. The other half of the dowel bar shall be coated with oil or a suitable form release agent. Grease will not be permitted for use as a form release agent.

The Contractor shall secure the tie bars into the existing concrete with an approved epoxy resin. The epoxy resin shall be injected into the back of the cleaned drill hole and the tie bars, with grout retention disks attached, shall be inserted to ensure the bars are completely enveloped with epoxy

resin.

#### 3.70.5.8.2.2.2 Dowel Bars and Transverse Joints

Where reinforcement is present, dowels may be adjusted 25 mm horizontally, and raised or lowered 10 mm, to avoid drilling the reinforcement.

#### 3.70.5.8.2.2.3 Transverse Joints - Contraction

Transverse contraction joints shall be cut or formed to match existing joints or working cracks and skewed if required. Dowels or load transfer devices shall be installed at mid depth of the PCCP slab, in a plane with the PCCP surface and parallel to the centreline of the road.

#### 3.70.5.8.2.3 Concreting

##### 3.70.5.8.2.3.1 Placing Concrete

Before placing concrete, it shall be demonstrated that the equipment to be used provides for proper adjustment of screeds, floats, propulsion and control equipment.

##### 3.70.5.8.2.3.2 Texturing of the Surface

Texturing of the surface shall be in accordance with this Specification except that manual devices may be used to provide the required tined texture.

Texturing is not required when the concrete surface is to be diamond ground as specified elsewhere in the Contract.

##### 3.70.5.8.2.3.3 Surface Tolerance

The surface of the concrete repair shall join flush with the existing PCCP.

#### 3.70.5.8.2.4 Curing, Joint Sealing and Removal of Forms

Curing, joint sealing and removal of forms for full depth repair of PCCP shall be in accordance with this Specification.

#### 3.70.5.8.2.5 Miscellaneous Protection

The Contractor shall provide Miscellaneous Protection for full depth repair of PCCP in accordance with Section 3.70.5.7.

#### 3.70.5.8.2.6 Sampling and Testing - Slump, Air Content and Compressive Strength

Sampling and testing for full depth repair of PCCP shall be in accordance with this Specification except that the compressive strength requirement shall be based on testing of standard cylinders with a frequency of one set of three cylinders for each fifteen cubic metre unit of concrete but not less than one set of cylinders per day.

#### 3.70.5.8.2.7 Removal of Unacceptable Concrete

Concrete found to be unacceptable shall be removed and replaced with new material at the Contractor's expense.

#### 3.70.5.8.2.8 Criteria for Determining Unacceptable Concrete

If the tests on cylinders do not show a 28 day compressive strength of the greater of 30 MPa or the compressive strength established in 3.70.3, the area represented by the cylinders shall be removed and replaced at the Contractor's expense.

### 3.70.5.9 Partial Depth Repairs in PCCP

#### 3.70.5.9.1 General

Where the Contractor is required to carry out partial depth repairs of PCCP, the following clauses will apply in addition to the requirements of this Specification

#### 3.70.5.9.2 Construction

##### 3.70.5.9.2.1 General

The Consultant shall clearly delineate the limits of the repair area. The perimeter of the PCCP repair area shall be saw cut vertically to a depth of 50 mm. The concrete within the saw cut area shall be removed to a minimum depth of 50 mm and a maximum depth of one-third of the thickness of the existing concrete slab using equipment that prevents the fracture of the underlying sound concrete.

The area shall be abrasive blast cleaned in accordance with this Specification. Immediately prior to filling the repair area with concrete, the surface area of the repair shall be uniformly coated with cement paste. The cement paste shall consist of normal Portland cement in accordance with Specification 5.5, Supply of Portland Cement Concrete, and sufficient water to produce a paste that can be applied with a brush. Cement paste not used within thirty minutes shall be discarded. The repair area shall then be filled with concrete, finished flush with the adjacent surface and cured in accordance with this Specification.

##### 3.70.5.9.2.2 Joints and Working Cracks

Where the partial depth repair area includes an existing PCCP joint or working crack, a joint shall be formed in the repair area to match the existing PCCP joint or working crack. The joint shall be formed by placing a compressible joint material along the cut line in such a manner that prevents the plastic concrete from infiltrating the existing joint or crack. The width of compressible material shall match the existing joint or working crack. Prior to placement of compressible material, joints or working cracks shall be blown clean with compressed air.

##### 3.70.5.9.2.3 Miscellaneous Protection

The Contractor shall provide Miscellaneous Protection for partial depth repairs in PCCP in accordance with Section 3.70.5.7, except that the requirement of two samples per PCCP Lot does not apply.



#### 3.70.5.9.2.4 Sampling and Testing - Slump, Air Content and Compressive Strength

Sampling and testing for partial depth repair of PCCP shall be in accordance with this Specification except that the compressive strength requirement shall be based on testing of standard cylinders with a frequency of one set of three cylinders for each fifteen cubic metre unit of concrete but not less than one set of cylinders per day.

#### 3.70.5.9.2.5 Removal of Unacceptable Concrete

Concrete found to be unacceptable shall be removed and replaced with new material at the Contractor's expense.

#### 3.70.5.9.2.6 Criteria for Determining Unacceptable Concrete

If the tests on cylinders do not show a 28 day compressive strength of the greater of 30 MPa or the compressive strength established in 3.70.3, the area represented by the cylinders shall be removed and replaced at the Contractor's expense.

### 3.70.6 END PRODUCT ACCEPTANCE OR REJECTION

#### 3.70.6.1 **General**

The Contractor shall provide an end product conforming in quality and accuracy of detail to the dimensional and tolerance requirements of the Specifications and Drawings. Where no tolerances are specified, the standard of workmanship shall be in accordance with normally accepted good practice.

#### 3.70.6.2 **End Product Acceptance At Full or Adjusted Payment**

Acceptance of any Lot at full or increased payment will occur if it contains no obvious defects and if:

- (i) for 28 day compressive strength full payment will be made if the Lot Mean compressive strength is greater than or equal to the greater of 30 MPa, or the compressive strength established in 3.70.3.
- (ii) for thickness, full payment will occur if the Lot Mean for thickness falls between -2 mm and +2 mm of the specified thickness and increased payment will be made if the Lot Mean for thickness in the Lot is 3 mm or greater.
- (iii) for smoothness, full payment will occur if the Profile Index (PrI) of all Sublots in the PCCP Lot does not exceed 10 mm and increased payment will occur for any of the above lift applications if the Profile Index of all Sublots in the PCCP Lot is 0.
- (iv) individual bumps and dips do not exceed 8 mm.

Acceptance at Reduced Payment of any Lot will occur if it contains no obvious defects and if:

- (i) the test results are such that the Lot or Sublot meets with the requirements for acceptance at a reduced payment.

- (ii) the Lot or Sublot is approved in respect of all other requirements.
- (iii) the Contractor has not notified the Consultant in writing that he will exercise his option to repair or remove and replace the Work at his own cost with work meeting the requirements for acceptance at full or increased payment.
- (iv) individual bumps and dips measuring 12 mm or greater have been repaired.
- (v) individual bumps and dips exceeding 8 mm and less than 12 mm which have been designated by the Consultant as unacceptable, have been repaired.

Both bonus and penalty adjustments may be made for any Lot in accordance with Section 3.70.7, Measurement and Payment.

### 3.70.6.3 End Product Rejection

If the Lot Mean for compressive strength or thickness are outside the applicable acceptance limits, then the Lot is rejected automatically, regardless of the values of the other control characteristics.

If the Prl of any PCCP Sublot is equal to or greater than 24 mm / 0.1 km, the Sublot is rejected.

The finished surface of the PCCP shall have a uniform texture and be free of visible signs of poor workmanship. Any obvious defects as determined by the Consultant such as, but not limited to the following, will be cause for automatic rejection of PCCP regardless of the values of any other control characteristic.

- (i) individual bumps and dips 12 mm or greater. The Consultant may reject PCCP with individual bumps and dips exceeding 8 mm and less than 12 mm.
- (ii) segregated and or spalled areas.
- (iii) improper joints.
- (iv) footprints and other marks.
- (v) cracking
- (vi) sampling locations not properly reinstated.
- (vii) improperly constructed patches or repairs.
- (viii) individual core(s) with a thickness deficiency exceeding 25 mm.
- (ix) any concrete damaged due to freezing or rain.

When PCCP is rejected by reason of obvious defects, the minimum area of rejection will be one panel size or as determined by the Consultant.

When PCCP is rejected for an individual core with a thickness deficiency exceeding 25 mm the Contractor shall undertake exploratory coring, in the presence of the Consultant, to determine the limits of the thickness deficiency. The exploratory cores will be at the same offset as the deficient core and shall be taken at 10 m intervals on each side of the station of the deficiency core. The limits of thickness deficiency shall occur at the first station, on each side of the original reject core, where the thickness of the exploratory core is not deficient by more than 20 mm. The limits for repair shall further extend to the next transverse joint.

Rejected work shall be promptly repaired or removed and replaced in accordance with Section 3.70.5.8 or Section 3.70.5.9. The Consultant shall test the new PCCP Lot in accordance with the requirements of Section 3.70.4.3 with modifications as outlined in Section 3.70.8 and 3.70.5.9. The

Contractor shall be responsible for all costs.

No payment will be made for work in any PCCP Lot or PCCP Sublot which has been rejected, until the defects have been remedied.

#### 3.70.6.3.2 Repairs in PCCP

All obvious defects, including cracking, shall be repaired using a full depth repair in accordance with Section 3.70.5.8.

For instances where the cracking is greater than 50 mm but no more than one-third the depth of the PCCP slab, or the obvious defects are confined to the pavement surface, a partial depth repair may be used in accordance with Section 3.70.5.9 with the approval of the Consultant.

Alternative repair methods for obvious defects of minor severity or frequency may be used with the approval of the Consultant.

### 3.70.7 MEASUREMENT AND PAYMENT

The unit prices for the following items of work shall be full compensation for all labour, material, tools, equipment and incidentals necessary to complete the work in accordance with these Specifications.

#### 3.70.7.1 **Portland Cement Concrete Pavement - EPS**

Accepted PCCP will be measured in square metres and will be paid at the unit price bid per square metre for "Portland Cement Concrete Pavement - EPS" subject to the unit price adjustments hereinafter specified. This payment will be full compensation for supplying and installing load transfer devices and tie bars; for supplying and placing the Portland cement concrete; all quality control testing and coring for quality assurance samples; all materials and expenses for form work, curing, texturing and protection; and all materials and expenses related to the forming and sealing of joints; and all expenses related to cold and hot weather concreting.

##### 3.70.7.1.1 Payment for Acceptable Work

The following end product properties of "Portland Cement Concrete Pavement - EPS" will be measured for acceptance in accordance with Section 3.70.4.3.

- (i) 28-Day Core Compressive Strength
- (ii) Thickness
- (iii) Smoothness

##### 3.70.7.1.2 Unit Price Adjustment for 28 Day Core Compressive Strength

The unit price adjustment for 28 day core compressive strength will be the applicable amount shown in Table 3.70 A for the Lot Mean 28 day core compressive strength. Any unit price adjustment so determined will decrease the payment owing for Portland Cement Concrete Pavement - EPS.

Contrary to Section 4.4.6.7 Compressive strength requirements of the latest version of CSA-A23.1-04, no adjustment to the compressive strength criteria will be provided for either cylinder formed

or cored pavement samples.

#### 3.70.7.1.3 Unit Price Adjustment for Thickness

Where the cores in each PCCP Lot are located in sections of PCCP of unequal thickness, the specified thickness and the Lot Mean thickness, for the purpose of determining the applicable unit price adjustment will be based on the following equations:

specified thickness =  $(x_1 + x_2 + x_3 + \dots) / (\text{number of cores})$

where x is the specified thicknesses at the corresponding location in the Lot

Lot Mean thickness =  $(y_1 + y_2 + y_3 + \dots) / (\text{number of cores})$

where y is the measured thicknesses at the locations in the Lot corresponding to x respectively.

The specified thickness and Lot Mean thickness as calculated above will be recorded to the nearest whole millimetre. Coring for thickness will not be undertaken on the inside shoulder on transitions between normal crown and super elevation as determined by the Consultant.

The unit price adjustment for thickness will be the applicable amount shown in Table 3.70 B for the Lot Mean thickness. Any unit price adjustment so determined will increase or decrease the payment owing for Portland Cement Concrete Pavement - EPS.

#### 3.70.7.1.4 Unit Price Adjustment for Smoothness

The unit price adjustment for Smoothness will be the applicable amount shown in Table 3.70 C for the P<sub>rl</sub> of that PCCP Sublot. Any unit price adjustment so determined will be added to or deducted from the payment made for Portland Cement Concrete Pavement - EPS.

Every PCCP Sublot that is outside the acceptance limit for Smoothness will be rejected and payment will not be made for the quantity of PCCP in these PCCP Sublots until they have been made acceptable. Payment for the remainder of the PCCP Lot will be made in accordance with the above, using the applicable unit price adjustment for 28 day core compressive strength and thickness as determined for the PCCP Lot, to which will be added, or from which will be subtracted, any adjustment for Smoothness.

#### 3.70.7.1.5 Payment for Work That Had Been Rejected, But Was Made Acceptable

When defects have been remedied in PCCP Lots or PCCP Sublots that had been rejected, payment for the original quantity of material in those PCCP Lots or PCCP Sublots will be made subject to unit price adjustments determined as follows:

- (i) The unit price adjustment for core compressive strength and thickness will be based upon testing of the replacement material. Where replacement material does not cover the entire PCCP Lot or PCCP Sublot, prior tests to the uncovered area will be averaged with new tests on the corrective work.
- (ii) Unit price adjustments will be made for smoothness as follows:

Unit price adjustments for P<sub>rl</sub> will be determined from Section 3.70.7.1.4 and will be based upon Profilograph tests following the Contractor's corrective efforts for any bumps and dips. Core compressive strength and thickness test results from the PCCP Lot or PCCP Sublot in which the smoothness was initially deficient will be used to determine the new unit price adjustment.

Unit price adjustments for bumps and dips will be - \$300 for each individual bump or dip over 8 mm and will be based upon initial Profilograph testing conducted by the Consultant. Repairs carried out by the Contractor will not affect the unit price adjustment for bumps and dips.

The unit price adjustment determined through retesting of the corrective work will be applied to that quantity of material in the PCCP Lot or PCCP Sublot which was originally rejected, to determine payment.

No payment will be made for additional coring and testing to determine the limits of slab removal. No payment will be made for any material used to replace or repair rejected work and all corrective work shall be performed entirely at the Contractor's expense.

The Department will pay for re-coring and testing of strength and thickness only when the retests result in an increase in payment.

**Table 3.70 A  
Unit Price Adjustment for 28 Day Core Compressive Strength**

Lot Mean			Unit Price Adjustment (\$ / m <sup>2</sup> )
(MPa)		(MPa)	
$m \leq$	f(c)		0
$m - 1 \leq$	f(c)	$< m$	-0.7
$m - 2 \leq$	f(c)	$< m - 1$	-1.5
$m - 3 \leq$	f(c)	$< m - 2$	-2.3
$m - 4 \leq$	f(c)	$< m - 3$	-3.2
$m - 5 \leq$	f(c)	$< m - 4$	-4.4
$m - 6 \leq$	f(c)	$< m - 5$	-6.1
$m - 7 \leq$	f(c)	$< m - 6$	-8.4
	f(c)	$< m - 7$	REJECT

where f(c) = 28 day core compressive strength. Actual age of the samples is targeted to be, but may exceed, 28 days.

m = the greater of 30 MPa, or the compressive strength established in 3.70.3.

**Table 3.70 B  
Unit Price Adjustment for Core Thickness**

Lot Mean			Unit Price Adjustment (\$ / m <sup>2</sup> )
(mm)		(mm)	
	d	$> t + 7$	1

Lot Mean			Unit Price Adjustment (\$ / m <sup>2</sup> )
(mm)		(mm)	
t + 6 =	d	= t + 5	0.75
t + 4 =	d	= t + 3	0.5
t + 2 =	d	= t - 2	0
t - 4 =	d	= t - 3	-2
t - 6 =	d	= t - 5	-3
t - 8 =	d	= t - 7	-4
t - 10 =	d	= t - 9	-5
t - 12 =	d	= t - 11	-6
t - 14 =	d	= t - 13	-7
t - 16 =	d	= t - 15	-8
t - 18 =	d	= t - 17	-9
t - 20 =	d	= t - 19	-10
	d	> t - 20	REJECT

where t = specified thickness (mm)

d = Lot Mean thickness (mm)

**Table 3.70 C**  
**Lump Sum Sublot Adjustment for PCCP Smoothness**

PRI for Tangents and Curves	Adjustment for Smoothness (\$ per PCCP Sublot Lump Sum)
0	-30
>0 and 10 or less	0
11	-40
12	-70
13	-100
14	-130
15	-170
16	200
17	230
18	-260
19	290
20	-320

<b>Prl for Tangents and Curves</b>	<b>Adjustment for Smoothness (\$ per PCCP Sublot Lump Sum)</b>
21	-350
22	-380
23	-410
24	REJECT