CONSTRUCTION SPECIFICATION FOR NON-PRESTRESSED PRECAST CONCRETE BRIDGE ELEMENTS

TABLE OF CONTENTS

1.0 SCOPE
2.0 REFERENCES
3.0 DEFINITIONS
4.0 DESIGN AND SUBMISSION REQUIREMENTS
5.0 MATERIALS
6.0 EQUIPMENT
7.0 PRODUCTION
8.0 QUALITY ASSURANCE
9.0 MEASUREMENT FOR PAYMENT - Not Used
10.0 BASIS OF PAYMENT

1.0 SCOPE

This specification covers the requirements for non-prestressed precast concrete bridge elements for prefabricated bridge systems. The requirements include certification of production facilities, production, storage, transportation, and installation of the precast elements.

2.0 REFERENCES

This specification refers to the following standards specifications or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 904 Concrete Structures
OPSS 905 Steel Reinforcement for Concrete
OPSS 929 Abrasive Blast Cleaning – Concrete Construction
OPSS 930 Construction Specification for Structure Rehabilitation – Concrete Patches, Refacing and Overlays
OPSS 932 Crack Repair – Concrete
Ontario Provincial Standard Specifications, Materials

OPSS 1002 Aggregates - Concrete
OPSS 1213 Hot Applied Rubberized Asphalt Waterproofing Membrane
OPSS 1350 Concrete - Materials and Production
OPSS 1440 Steel Reinforcement for Concrete

Ontario Ministry of Transportation Publications:

Structural Manual
Specification for Self-Consolidating Concrete in Precast Products

Laboratory Testing Manual:
LS-432 Method of Test for Microscopical Determination of Air Void System Parameters in Hardened Concrete
LS-433 Method of Test for Electrical Indication of Concrete’s Ability to Resist Chloride Ion Penetration

CSA Standards

A23.2-14C Obtaining and Testing Drilled Cores for Compressive Strength Testing*
*A23.1-09/A23.2-09 - Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete
A23.4-09 Precast Concrete Material and Construction
S6-06 Canadian Highway Bridge Design Code
W47.1-09 Certification of Companies for Fusion Welding of Steel Structures
W59-03 (R2008) Welded Steel Construction (Metal Arc Welding)
W186-90 (R2007) Welding of Reinforcing Bars in Reinforced Concrete Construction

ASTM International

A153 - 09 Zinc Coating (Hot-Dip) on Iron and Steel Hardware
B633 - 07 Electrodeposited Coatings of Zinc on Iron and Steel
C171 - 07 Sheet Materials for Curing Concrete
C403 - 08 Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance

American Association of State Highway and Transportation Officials (AASHTO)

M 182 - 05 Standard Specification for Burlap Cloth made from Jute or Kenaf and Cotton Mats

Canadian Precast/Prestressed Concrete Institute (CPCI).

CPCI Precast Concrete Certification Program for Structural, Architectural and Specialty Precast Concrete Products and Systems, Program Requirements.
3.0 DEFINITIONS

For the purpose of this specification, the following definitions apply:

**Bed** means the assembly consisting of platform, forms and end blocks in which the elements are cast.

**Cold Weather** means those conditions when the air temperature is at or below 5 °C. It is also considered to exist when the air temperature is at or is likely to fall below 5 °C within 96 hours after concrete placement. Temperature refers to shade temperature.

**Element Type** means an element defined by function and cross-sectional shape.

**Honeycombing** means a rough and stony concrete surface with voids where the mortar did not fill the spaces between the coarse aggregate particles.

**Lot** consists of all of the same element types, of the same mix design produced over seven consecutive Days.

**Low Permeability Concrete** means concrete typically containing silica fume and having rapid chloride permeability of 1000 coulombs or less when tested according to LS-433.

**Precaster** means the producer of the precast concrete elements.

**Precast Element** means an individual precast section of the prefabricated bridge. For the purposes of this specification, precast elements do not include precast girders but may include precast footings, columns, shafts, abutments, ballast walls, wingwalls, pier caps, and bridge deck elements. “Precast element” is used interchangeably with “element”.

**Regular Permeability Concrete** means concrete typically containing no silica fume and having rapid chloride permeability of 2500 coulombs or less when tested according to LS-433.

**Segregation** means visible separation of the mortar and coarse aggregate particles in the concrete, resulting in concrete that is not uniform in appearance or proportions.

**Steel Reinforcement** means a general term which includes reinforcing steel bars, stainless steel reinforcing bars, splice bars, welded steel wire fabric and prestressing tendons.

4.0 DESIGN AND SUBMISSION REQUIREMENTS

4.01 Design Requirements

4.01.01 General

The design shall be according to CAN/CSA S6 and the Structural Manual where design is required.

4.02 Submission Requirements

4.02.01 Working Drawings

Working Drawings shall include shop drawings and drawings for handling and installation of the elements.
The Contractor shall prepare and submit 3 sets of Working Drawings and all supporting documentation, to the Contract Administrator at least 5 Business Days prior to commencement of fabrication of the elements, for information purposes only. Working Drawings shall be signed and sealed by an Engineer.

The Working Drawings shall include the following information:

a) Element details.
b) Steel reinforcement schedules.
c) Lifting point locations.
d) Details and location of all temporary supports.
e) All other applicable details.

The supporting documents shall include the following information:

a) Handling and installation procedures including calculations and lifting point locations.
b) Details of bracing installed to provide adequate support and stability to the element during construction.

When other authorities are involved in the approval of the design or construction of a highway structure, submissions shall be made at least 5 weeks prior to commencement of work and one additional copy of the submission shall be provided for each authority. The requirements, as stated elsewhere in the Contract Documents of each authority and the Owner shall be satisfied prior to commencement of the Work.

4.02.02 Concrete Mix Design

The Contractor shall submit the concrete mix design to the Contract Administrator according to the Mix Design requirements of OPSS 1350.

When self consolidated concrete (SCC) is proposed to be used by the Contractor, the requirements for submission shall be according to the Specification for Self-Consolidated Concrete in Precast Products available from the Ministry’s Materials Engineering and Research Office.

4.02.02.01 Concrete Plant Certification

The precast concrete plant certificate verifying compliance with the certification requirements specified in the Production Facility subsection shall be submitted to the Contract Administrator with the concrete mix design.

Documentation verifying certification of the concrete production facility by the Ready-Mixed Concrete Association of Ontario shall be submitted when concrete is supplied by an external concrete supplier.

4.02.03 Product Report

A product report shall be submitted to the Contract Administrator for each shipment of elements, prior to shipping the elements.
The report shall contain the following information:

a) List of elements including their ID number and description.
b) Documentation of defects or deficiencies other than those listed in Table 1, and all related repair proposals.

The following documentation shall be made available upon request:

a) The mill certificates for the steel reinforcement used in the elements.
b) Temperature control records including location of thermocouple wires.
c) Copies of all measurements and inspections carried out by the Contractor to verify compliance with this specification, including the concrete cover over steel reinforcement, crack measurement summary, tolerances, and surveys for geometric control.
d) Documentation verifying that all repairable defects have been identified, evaluated and corrected as detailed elsewhere in the specification.

5.0 MATERIALS

5.01 Concrete

Concrete materials and production shall be according to OPSS 1350 with the following exceptions and amendments:

a) Rapid chloride permeability shall meet the requirements found in Table 2 for each specified precast element listed.

* Designer Fill-in - See Notes to Designer

b) The air void system in hardened concrete when tested according to LS-432 shall be:
   i. Air Content: 3.0% minimum
   ii. Spacing Factor: 0.200 mm maximum

c) Aggregates shall be according to OPSS 1002 with the exception that the maximum nominal size of coarse aggregate shall not exceed 19.0 mm.

d) Slag aggregate shall not be used.

e) Superplasticizer may be added to the mix at time of batching for all types of concrete.

f) After the addition of superplasticizer the slump shall not exceed a maximum of 230mm.

g) Self consolidated concrete will be considered subject to the Ministry’s approval. The Contractor’s proposal shall be consistent with the Specification for Self-Consolidating Concrete in Precast Products.
5.02  Concrete Sealers

Concrete sealers shall be from the Owner’s list of acceptable sealers. The list of concrete sealers shall be obtained from the Contract Administrator.

5.03  Elastomeric Coating

Elastomeric coating shall be according to OPSS 1213

5.04  Forms

All forms shall be according to CAN/CSA A23.4. Forms shall be fabricated to meet the dimensional tolerances and finishes required by this specification.

5.05  Hardware

All hardware shall be non-corroding or galvanized according to ASTM A153.

Surfaces of hardware located within 40 mm of the concrete surface shall be chromate coated over an electro-deposited coating of zinc according to ASTM B633.

5.06  Materials for Moist Curing

Burlap cloth and cotton mats for wet curing shall be according to AASHTO M 182. When burlap is used, it shall be Class 4.

5.07  Proprietary Patching Materials

Proprietary patching materials shall be from the Owner’s list of acceptable concrete patching materials. The list of proprietary patching materials shall be obtained from the Contract Administrator.

5.08  Steel Reinforcement

Steel reinforcement shall be according to OPSS 905 and OPSS 1440.

6.0  EQUIPMENT

6.01  Chipping Hammers

Chipping hammers shall have a maximum weight of 9.0 kg and a maximum piston stroke of 102 mm. All hammers shall have the manufacturer’s name and model number engraved on them by the manufacturer. All information must be legible.

6.02  Thermocouples and Dataloggers

Thermocouples and associated instrumentation shall have an accuracy of ± 1.5 °C and shall be capable of recording and displaying the temperature. The instrumentation shall include dataloggers with a minimum recording frequency of 30 minutes or less and shall be capable of storing all data for the temperature monitoring period.
7.0  CONSTRUCTION

7.01  General

The work shall consist of fabrication, curing, storage, transportation and installation of precast elements.

The Contractor shall notify the Contract Administrator in writing at least 5 Business Days prior to commencement of fabrication.

The Contractor shall be responsible for all quality control inspection and testing to ensure that the precast concrete elements are fabricated to meet the requirements of this specification and the Contract Documents.

7.02  Precast Concrete Elements

7.02.01  General

Precast elements of the same type and for a given component shall be fabricated from the same mix design regardless of whether or not they are cast in the same facility.

7.02.02  Element Identification

Each precast element shall be identified with a tamper-resistant, permanently-affixed means of identification which includes a unique identification number, date of casting and location of the production facility.

7.02.03  Dimensional Tolerances

All elements shall meet the dimensional tolerance requirements of CSA 23.4 unless otherwise specified in the Contract Documents. For dimensional tolerances not specified, the maximum allowable dimensional variation shall be 1:800 or ± 5 mm, whichever is greater.

7.02.04  Concrete Cover

All elements shall meet the cover requirements of the Contract Documents.

7.02.05  Surface Tolerance

Formed and unformed surfaces shall be such that, when tested with a 3 m long straight edge placed anywhere in any direction on the surface, there shall be no gap greater than 6 mm between the bottom of the straight edge and the surface of the concrete. When the straight edge is placed across a closure strip the gap between the straight edge and the surface of the concrete shall not be greater than 6 mm.

7.03  Production Facility

The precast elements shall be fabricated in a facility that is certified to the requirements of:

a) Canadian Standards Association (CSA A23.4) under the category Precast Concrete Products-Structural, Non-Prestressed and Prestressed, or

b) Canadian Precast/Prestressed Concrete Institute (CPCI), Group B, Products and Group BA, Bridge Products with Architectural Finishes, Category, B1, or BA1, Precast Concrete Bridge Products
7.04 Welding

Welding of steel hardware including shear studs shall be according to the Contract Documents and CSA W59. Welding shall be performed by a qualified welder working for a company certified by the Canadian Welding Bureau according to CSA W47.1.

Welding of steel reinforcement shall be according to the Contract Documents and to CSA W186. Welding shall be performed by a qualified welder working for a company certified by the Canadian Welding Bureau according to CSA W186.

7.05 Steel Reinforcement

The placement of steel reinforcement shall be according to OPSS 905.

7.06 Placing Concrete

The placing of concrete shall be according to OPSS 904 with the exception that the temperature of the formwork, steel reinforcement or the material on which the concrete is to be placed shall be at a minimum temperature of 5 °C immediately prior to the placing operation.

7.07 Sampling and Testing of Plastic Concrete

7.07.01 Testing

Sampling and testing of slump, air content and temperature of plastic concrete shall be carried out by a person holding either of the following certifications:

a) CCIL Certified Concrete Testing Technician; or

b) ACI Concrete Field Testing Technician – Grade 1

This person shall have a valid, original card issued by the certifying agency in his or her possession at all times.

7.07.02 Frequency

The Contractor shall be responsible for all aspects of sampling and testing of the plastic concrete for slump, air content and temperature according to OPSS 1350 and the results of these tests shall be recorded. The minimum frequency of testing shall be at least once for each load of concrete delivered by a truck mixer, or once for every batch of concrete produced by other mixers, until satisfactory control is established.

Satisfactory control is established when three consecutive tests of concrete are within the specified requirements without adjustments. If any adjustments are required, testing shall continue until three consecutive tests meet the requirements with no field adjustments.

After satisfactory control has been established, testing shall be carried out on every third load delivered by a truck mixer, or at a delivery frequency of 21 m³ of concrete for concrete produced by other mixers.

Satisfactory control shall be re-established each day or when there is a break in production longer than 1 hour.
7.08 Concrete Finishing

Concrete finishing shall be according to OPSS 904 with the exception that the use of a bridge deck finishing machine is not required.

7.09 Curing and Protection

7.09.01 Curing-General

Concrete elements shall be moist cured for 96 hours. Concrete elements containing silica fume shall be moist cured for 7 Days.

During the moist curing period, elements may be exposed to ambient conditions for no more than a cumulative total of 3 hours for the purposes of form removal, filling of bug holes, inspection, and storage.

7.09.02 Moist Curing

Moist curing of exposed surfaces shall commence immediately after concrete placement using one of the following methods:

a) Saturated material for moist curing;

b) Water misting;

c) Steam; or

d) Other means of maintaining 100% relative humidity next to the concrete surface.

Forms shall be removed from bridge deck elements within 24 hours of concrete placement and all surfaces previously covered by forms shall be immediately moist cured as above for the remainder of the 96 hours.

Other formed surfaces shall require no additional curing where the formwork is left in place for the minimum specified curing period. Where the formwork is removed before the curing period is completed, formed surfaces shall be cured with moist curing material for the remainder of the minimum curing period.

Application of heat may be used to accelerate curing, but raising the ambient temperature above 30 °C shall not be allowed until after concrete has reached initial set. The Contractor shall determine the time of initial set of the concrete according to ASTM C403, using the same mix design, placement method, concrete temperature and curing procedures as the elements.

Steam, heat or forced air shall not be directed on the concrete, forms or steel reinforcement. There shall be free circulation of steam, heat and forced air around the top, sides and ends of the elements. The elements shall be heated evenly.

Concrete surfaces shall not be exposed to combustion gases.

7.09.03 Protection Period

After moist curing, elements that will be exposed to air temperatures less than 5 °C shall be protected from moisture loss for a minimum of 3 days, prior to full exposure. The protection period shall be extended beyond 3 days if required to meet the requirements specified in the Control of Temperature subsection.
All elements must be dry before exposing them to air temperature below 0 °C.

### 7.10 Control of Temperature

During production, moist curing, and protection periods, the following temperature requirements shall be met:

- **a)** The concrete temperature shall not exceed 60 °C.

- **b)** The concrete temperature shall not fall below 10 °C before the end of moist curing.

- **c)** The concrete temperature shall not fall below 0 °C before the end of the protection period.

- **d)** The temperature difference between the concrete temperature of the element, and the conditions to which it is to be exposed, shall not exceed 20 °C in any part of the element.

### 7.10.01 Temperature Records

Thermocouples, dataloggers, handhelds units, and associated hardware shall be used to monitor the temperature of the element and the ambient conditions to which the element is exposed.

Recording of the concrete temperatures shall begin at the start of the placing operation and continue until the moist curing and protection period are complete. For each element, the following temperatures shall be recorded at intervals of 30 minutes or less.

A sufficient number of thermocouples and thermocouple wires for each element type shall be installed to ensure compliance with the standard. As a minimum, thermocouples shall be installed to measure:

- **a)** Air temperature that the element is exposed, or will be exposed, to.

- **b)** Concrete temperatures located centrally within the element and the section thickness.

The Contract Administrator shall be provided the necessary access, instrumentation and equipment to verify temperature readings instantaneously. The thermocouples and dataloggers shall be left in place until the end of the curing and protection period.

### 7.11 Access for Concrete Cover Measurement

The Contractor shall clear all debris and obstructions and provide unhindered access to allow the Contract Administrator to carry out the concrete covermeter survey as specified in the Concrete Cover subsection of the Quality Assurance section. The Contractor shall notify the Contract Administrator in writing when the test area is ready for the concrete covermeter survey.

The Contractor shall allow the Contract Administrator a time period of 3 Business Days to complete the survey. This time period shall commence upon receipt of the Contractor's written notification of readiness for the survey. The time period required to complete the concrete survey shall be extended if inclement weather or the ambient air temperatures below 5 °C fall within that time period.

### 7.12 Storage, Transportation, and Installation

Storage, transportation, and installation shall be according to CSA 23.4.
Storage includes, but is not limited to, storage while awaiting delivery, in temporary locations, or at the job site.

The Contractor shall notify the Contract Administrator in writing at least 3 Days prior to delivery of the elements.

Advertising by means of removable signing is permitted on elements only while in transit to the specified site. Any other markings on a surface that would be visible after installation shall not be permitted.

The Contractor shall notify the Contract Administrator in writing of the installation date at least 3 Days prior to the commencement of field installation operations.

Pockets such as those that facilitate cutting of temporary strands for shipping and handling shall be reinstated with a proprietary patching material.

The Contractor shall inspect the elements for defects before installation.

7.13 Certificate of Conformance

For each shipment of elements the Contractor shall issue the following Certificates of Conformance to the Contract Administrator:

a) Certificate of Conformance verifying the elements have been fabricated in general conformance with the signed and sealed documents which include the Contract Documents, supporting documents, and Working Drawings.

b) Certificate of Conformance verifying that storage and transportation were in general conformance with the signed and sealed documents which include the Contract Documents, supporting documents, and Working Drawings.

Within 5 Business Days of installing all the elements within a stage, the Contractor shall submit to the Contract Administrator a Certificate of Conformance verifying the installation of the elements has been carried out in general conformance with the signed and sealed documents which include the Contract Documents, supporting documents, and Working Drawings.

Each certificate shall identify the element or group of elements it addresses.

7.14 Defects and Deficiencies Repairable by Standard Methods

Any individual element having one or more defects and deficiencies identified in Table 1 shall be repaired according to the method specified. Such repairs do not require proposals or prior approval by the Owner. All causes, preventative actions, and correction actions including repairs, methods and materials used shall be documented and submitted to the Contract Administrator.

7.14.01 All Other Defects and Deficiencies

For elements with defects or deficiencies not identified as rejectable or listed in Table 1 the Contractor shall submit a proposal for repair to the Contract Administrator for review. The Contract Administrator shall respond to the Contractor within 5 Business Days of receipt of the complete repair proposal.
The repair proposal, signed and sealed by an Engineer, shall include as a minimum:

a) Description of the element and identification of the defects or deficiencies.

b) Detailed sketches, width, length, depths, location and nature and frequency of any defects.

c) Assessment of any impact of the repaired defect(s) on durability, structural adequacy and integrity of the element or on the structure.

d) A detailed repair plan including materials, method and equipment to be used.

e) Verification that the repair plan complies with the applicable standards for the type of work.

f) All relevant supporting information, including material test results, field measurements and observations, production records, photographs, and structural analysis calculations, used for determining that the performance and function originally expected from the element shall be met.

g) Cause(s) of the defect and corrective action to be taken to prevent recurrence of the defect in future production, delivery or installation.

h) Justification for partial payment.

If the repair proposal is deemed acceptable by the Owner, the element(s) shall be repaired according to the proposal. The Contractor shall not carry out any repairs without the acceptance of the proposal by the Contract Administrator. If the repair proposal is deemed unacceptable by the Owner, the element(s) shall be rejected and shall not be incorporated into the work.

7.15 Sampling for Quality Assurance

7.15.01 Sampling of Reinforcement

The Contractor shall provide samples of steel reinforcement according to OPSS 905 when requested by the Owner. Samples shall be delivered by the Contractor to the Ministry (Head, Concrete Section, Building C, Room 15, 1201 Wilson Avenue, Downsview, Ontario, M3M 1J8).

7.15.02 Sampling of Hardened Concrete

7.15.02.01 General

Precast concrete products shall be sampled on a lot basis for each element type.

The Contractor shall be responsible for removing cores from the precast elements for testing by the Owner.

7.15.02.02 Notification

The Contractor shall be responsible to notify the Contract Administrator within 24 hours of completion of a lot by providing the list of elements and their identification numbers.
7.15.02.03  Coring

One set of cores shall be obtained from each lot for Quality Assurance testing as directed by the Contract Administrator. A set of cores shall consist of six 100 mm x 200 mm cores.

The Contract Administrator shall identify to the Contractor the specific element to be cored. All cores of the same set shall be removed at a location no more than 2 meters from the location of the first core for that set.

For each lot, coring shall be carried out according to CSA A23.2-14C when the concrete is between 4 to 14 days of age, and prior to application of any sealer and/or waterproofing membrane. No core shall be taken within 250 mm of any joint or element edge.

Cores shall not contain steel reinforcement or other embedded material.

7.15.02.04  Identification of Cores

The Contract number, lot number, element identification number and exact location of each individual core shall be marked legibly on the core with durable ink.

7.15.02.05  Transportation of Cores

The Contractor is responsible for transporting all cores in a safe manner to avoid damage to the cores. Each core shall be placed in a plastic bag, sealed to prevent loss of moisture. The cores shall be protected from extremes in temperature from the time they are removed until they are delivered to the Regional Quality Assurance laboratory. The cores shall be delivered to the Regional Quality Assurance laboratory designated by the Contract Administrator with a transmittal form and form PH-CC-433A of the concrete mix design for the element within 24 hours of coring.

7.16   Filling of Core Holes

The Contractor shall fill each core hole immediately after coring with a proprietary patching material from the Owner’s pre-qualified products list or with concrete from the same mix design. The patching material shall be mixed, handled, and cured according to the manufacturer’s instructions. Immediately before filling, the inside surface of each core hole shall be cleaned of the paste left from the coring operation by nylon brushing and all free water shall be removed. The patch shall be finished flush with the surface of the surrounding concrete. All excess material shall be removed from the surface of the concrete.

8.0   QUALITY ASSURANCE

8.01   General

Precast concrete products shall be accepted on a lot basis for each element type.

8.02   Acceptance of Concrete Compressive Strength

Three cores shall be tested to determine the acceptability of compressive strength of the lot. Twenty-eight (28) day concrete compressive strength of a lot shall be considered acceptable when it meets all of the following:

a) The average of three individual compressive strength tests shall be equal to or greater than the specified strength.
b) No individual core test shall be more than 4.0 MPa below the specified strength.

Unacceptable lots shall be removed and replaced at the Contractor’s expense.

Compressive strength shall be determined according to CSA A23.2-14C in a moist condition.

The compressive strength result of the lot shall be the average of one set of three acceptance cores rounded to one decimal place.

The individual test results shall be forwarded to the Contractor as they become available.

8.02.01 Referee Testing, Compressive Strength

The Contractor may invoke referee testing of an individual test result within five business days of receiving the test result.

For referee testing, the Contractor shall obtain a new set of cores. A set of referee cores for compressive strength shall consist of three individual cores taken from the same element from which disputed acceptance samples originated. The new set shall be obtained within 5 business days of invoking referee testing.

The referee laboratory shall be designated by the Owner based on the applicable roster. Referee test results shall be forwarded to the Contractor as they become available.

If the difference between the referee test result and the acceptance test result is less than the confirmation value, then the acceptance test result is confirmed, and the acceptance test result shall be used in the determination of acceptance of the concrete. If the difference between the referee test result and the acceptance test result is greater than the confirmation value, the acceptance test result is not confirmed, and the acceptance test result shall be disregarded and replaced by referee test result in the determination of acceptance of the concrete.

The confirmation value for confirming the acceptance test result shall be the greater of 10% of the specified strength or 10% of the strength of the acceptance cores, expressed to one decimal place.

8.02.02 Referee Testing Cost, Compressive Strength

The cost of referee testing of compressive strength shall be according to OPSS 1350.

8.03 Acceptance of Air Void System in Hardened Concrete

One half of a core shall be tested to determine the acceptability of the lot. The core shall be tested according to LS-432. The other half of the core shall be retained by the Owner for audit purposes.

Individual test results shall be forwarded to the Contractor as they become available.

For a lot to be considered acceptable, the core shall have air content of 3.0% or more and spacing factor of 0.200 mm or less. Acceptable lots shall be subject to full payment.

Lots with a spacing factor between 0.200 mm and 0.250 mm shall be considered unacceptable and shall be repaired as identified in Table 1.
Lots with spacing factor more than 0.250 mm or air content less than 3% shall be rejected and replaced at the Contractor’s expense.

8.03.01 Referee Testing Air Void System in Hardened Concrete

Referee testing of air void system parameters shall be according to OPSS 1350.

8.03.02 Referee Testing Cost of Air Void System in Hardened Concrete

The cost of air void system referee testing shall be according to OPSS 1350.

8.04 Acceptance of Rapid Chloride Permeability

One core per lot shall be tested according to LS-433. Acceptance testing shall be carried out at 28 to 32 Days. Two samples 50 mm long shall be cut from the core representing a lot, and tested to determine the acceptance of the lot. Another core shall be retained for referee testing.

Individual test results shall be forwarded to the Contractor as they become available.

Acceptance of rapid chloride permeability shall be based on the result obtained on the core representing the lot.

Where rapid chloride permeability of 2500 coulombs or less is specified, lots with a rapid chloride permeability result less than or equal to 2500 coulombs shall be considered acceptable. Lots with a rapid chloride permeability result greater than 2500 coulombs and less than or equal to 3500 coulombs shall be considered unacceptable and shall be repaired as identified in Table 1. Lots with rapid chloride permeability results exceeding 3500 coulombs shall be rejected and replaced at the Contractor’s expense.

Where rapid chloride permeability of 1000 coulombs or less is specified, lots with a rapid chloride permeability result less than or equal to 1000 coulombs shall be considered acceptable. Lots containing silica fume with a rapid chloride permeability result greater than 1000 coulombs and less than or equal to 2000 coulombs shall be considered unacceptable and shall be repaired as identified in Table 1. Lots containing silica fume with a rapid chloride permeability results exceeding 2000 coulombs shall be rejected and replaced at the Contractor’s expense.

8.04.01 Referee Testing of Rapid Chloride Permeability

Referee testing of rapid chloride permeability may only be invoked by the Contractor within 5 Business Days of receipt of the acceptance test result.

Referee testing shall be carried out on 2-50 mm samples obtained from the reserved core representing the lot for which referee testing was invoked, and the results shall be averaged to obtain the test result for the lot.

The referee laboratory shall be designated by Owner based on the applicable roster and cores shall be tested according to LS 433 by that laboratory.

Referee test results shall be forwarded to the Contractor as they become available.

When the referee result is greater than the acceptance test result or no more than 200 Coulombs below the acceptance test result, then the acceptance test result is confirmed and shall remain valid. When the referee test result for the lot is more than 200 Coulombs below the acceptance test result, the acceptance test result is
not confirmed, and the referee test result shall replace the acceptance test result in the acceptance requirements of this specification.

8.04.02   Referee Testing Cost of Rapid Chloride Permeability

The cost of referee testing of rapid chloride permeability for all concrete shall be according to OPSS 1350 Acceptance of Rapid Chloride Permeability for Silica Fume Overlays and High Performance Concrete.

8.05   Dimensional Verification

The Contractor Administrator shall carry out measurements on each element to determine compliance with tolerance requirements of CSA A23.4 and the Contract Documents.

8.06   Concrete Cover Measurement

Concrete cover measurements shall be made by the Contractor Administrator on two elements, selected at random from the lot.

The measurements shall be obtained on a one metre grid on all surfaces of the element.

The Contract Administrator shall provide the survey report to the Contractor.

Where the cover does not meet the Contract requirements, the lot shall be rejected and not be incorporated into the work.

8.07   Rejection of Individual Members

An element having any one of the following defects and deficiencies shall be rejected:

a) If concrete temperature exceeds 60 °C at any time during the curing period.

b) If concrete temperature falls below 0°C during the moist curing and protection period.

c) If there is honeycombing, voids, cavities, spalls, delaminations, or cracks, in the concrete that exceed the conditions described in Table 1.

d) If there is a crack that extends through to the opposite face.

e) If cover to steel reinforcement is less than the lower limit of cover by 5mm anywhere on the element.

f) Tolerances exceed the requirements of this specification.

If the element is deemed rejectable, the element shall not be incorporated into the Work.

8.08   Assessment of Repairs

At the discretion of the Owner, where defects or deficiencies have been repaired by either standard methods or by Contractor proposal documentation shall be provided to the Contract Administrator for review and assessment.
The Contract Administrator shall conduct a visual inspection and/or other measures as required, including requesting additional coring, covermeter surveys or any other testing deemed necessary to assess the effectiveness of the repairs.

10.0 BASIS OF PAYMENT

10.01 Precast Concrete Bridge Elements, Fabrication - Item

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

Members stored at the precaster’s premises or at some other location away from the Working Area shall be paid for when the Contractor obtains a lease from the property owner that names the Owner as the tenant. The Owner shall provide the form of lease for this purpose that specifies a payment of $10.00 for the term of the lease. The Contractor shall retain full responsibility for the members.

10.02 Precast Concrete Bridge Elements, Delivery - Item

Precast Concrete Bridge Elements, Installation - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.
<table>
<thead>
<tr>
<th>Repairable Defects and Deficiencies</th>
<th>Condition</th>
<th>Repair Method</th>
</tr>
</thead>
</table>
| Honeycombing, Voids, Cavities, Spalls, and Delaminations | Any area less than an equivalent area of 300 mm x 300 mm with no steel reinforcement exposed. | a) Square all sides of the repair area.  
   b) Sawcut perimeter of removal area to a depth of 10 mm or to the depth of steel reinforcement, whichever is less.  
   c) Remove all loose concrete using a chipping hammer or hand tools.  
   d) Insert corrosion resistant wires and anchors.  
   e) Abrasive blast clean all concrete surfaces to be patched according to OPSS 929.  
   f) Remove all dust and loose material from the prepared surface by using compressed air.  
   g) Moisten area to be repaired.  
   h) Fill repair area with concrete or a proprietary product patching material.  
   i) Cure concrete according to this Special Provision.  
   Cure proprietary patching material according to the manufacturer’s recommendations. |
| Low Cover | Any cover readings outside the minimum tolerance by less than 5 mm. | The entire surface of the element shall be sealed with a two-component sealer. Areas against which concrete is to be placed shall not be sealed. |
| Rapid Chloride Permeability (RCP) | a) RCP value for the lot exceeding 2500 and less than or equal to 3500 Coulombs.  
   b) RCP value for the lot of concrete containing silica fume exceeding 1000 and less than or equal to 2000 Coulombs. | The entire surface of all the elements of the lot shall be sealed with a sealer acceptable to the Owner. Areas against which concrete is to be placed, or waterproofed and paved shall not be sealed. |
| Cracks | > 0.3 mm | a) Repair cracks in the areas where the total linear measurement of crack per m² is < 5m. Repair shall be according to OPSS 932.  
   b) Remove and replace the cracked areas where the total linear measurement of crack per m² is ≥ 5m. Removals and preparation of concrete shall be according to OPSS 930. |
| | ≤ 0.3 mm | Apply sealer acceptable to the ministry to the cracked areas. Where the total linear measurement of crack per m² is ≥5m the entire element shall be sealed. |
| Air Void System | Spacing factor value for the lot exceeding 0.200 mm and less than 0.250 mm. | The entire surface of all the elements of the lot, except areas against which new concrete is to be placed, or waterproofed and paved, shall be sealed with a sealer acceptable to the Owner. |