Appendix A – Original CPS Documents

1. OPSS.PROV 610 - Nov 2016
    a. SSP 610F01 - Nov 2016
    b. SSP 682F22 - Nov 2016
2. OPSS.PROV 615 - Apr 2017
    a. SSP 615S05 - May 2017
    b. SSP 615S06 - Dec 2018
    c. SSP 682S13 - Feb 2009
    d. SSP 682S30 - May 2019
3. OPSS.PROV 620 - Apr 2017
    a. SSP 106S18 - Apr 2017
4. OPSS.PROV 622 - Apr 2017
    a. SSP 106S19 - Apr 2017
    b. SSP 682F03 - Jun 2020
    c. SSP 682S16 - Jun 2017
5. OPSS.PROV 630 - Nov 2016
    a. SSP 630F02 - Jun 2020
6. OPSS.PROV 706 - Nov 2016
    a. SSP 107S05 - Apr 2017
    b. SSP 706F04 - Aug 2018
7. OPSS.PROV 708 - Nov 2016
    a. SSP 708F01 - Nov 2016
8. OPSS.PROV 723 - Nov 2016
    a. SSP 107S06 - Jan 2025
    b. SSP 723S03 - May 2019
9. OPSS.PROV 903 - Apr 2016
    a. SSP 109F57 - Aug 2021
10. OPSS.PROV 909 - Nov 2016
    a. SSP 109S24 - Jan 2025
11. OPSS.PROV 918 - Apr 2017
    a. SSP 109S27 - Mar 2018
12. OPSS.PROV 928 - Apr 2012
    a. SSP 109S32 - Mar 2018
13. OPSS.PROV 930 - Nov 2014
14. OPSS.PROV 1004 - Nov 2012
    a. SSP 110S16 - May 2023
15. OPSS.PROV 1006 - Apr 2017
    a. SSP 110S05 - Feb 2019
16. OPSS.PROV 1010 - Apr 2013
    a. SSP 110S06 - May 2023

# CONSTRUCTION SPECIFICATION FOR DEEP FOUNDATIONS

## TABLE OF CONTENTS



## 903.01 SCOPE

This specification covers the requirements for the supply and installation of deep foundation units.

### 903.01.01 Specification Significance and Use

This specification is written as a provincial-oriented specification. Provincial-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

**903.01.02 Appendices Significance and Use**

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

**903.02 REFERENCES**

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

This specification refers to the following specifications, standards, or publications:

**Ontario Provincial Standard Specifications, Construction**

| | |
|---|---|
| OPSS 904 | Concrete Structures |
| OPSS 905 | Steel Reinforcement for Concrete |
| OPSS 909 | Prestressed Concrete - Precast members |
| OPSS 911 | Coating Structural Steel Systems |

**Ontario Provincial Standard Specifications, Material**

| | |
|---|---|
| OPSS 1302 | Water |
| OPSS 1350 | Concrete - Materials and Production |
| OPSS 1440 | Steel Reinforcement for Concrete |

**CSA Standards**

| | |
|---|---|
| G40.20-04/G40.21-04 (R2009) | General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel |
| CAN3-056-1962(R2006) | Round Timber Piles |
| O80 Series-08 | Wood Preservation |
| W47.1-03 (R2008) | Certification of Companies for Fusion Welding of Steel |
| W48-06 | Filler Materials and Allied Materials for Shielded Metal Arc Welding |
| W59-03(R2008) | Welded Steel Construction (Metal Arc Welding) |
| W178.1-08 | Certification of Welding Inspection Organizations |
| W178.2-08 | Certification of Welding Inspectors |

**Canadian General Standards Board (CGSB)**

| | |
|---|---|
| 48.9712-2006 | Non-destructive Testing, Qualification and Certification of Personnel |

**ASTM International**

| | |
|---|---|
| A 252-98(2007) | Welded and Seamless Steel Pipe Piles |
| A 328/A 328M-07 | Steel Sheet Piling |
| D 1143/ D 1143M-07 | Standard Test Methods for Deep Foundations Under Static Axial Compressive Load |
| D 3689-07 | Standard Test Methods for Deep Foundations Under Static Axial Tensile Load |
| D 3966-07 | Standard Test Method for Deep Foundations Under Lateral Loads |

**American Petroleum Institute (API)**

| | |
|---|---|
| API 13A | Drilling Fluid Materials, 17th Edition, 10.00.08 |
| RP 13B-1 | Standard Procedure for Field Testing Water Based Drilling Fluids, 4th Edition, |

**Steel Structures Painting Council (SSPC)**

SP10/NACE No.2-Jan. 1, 2001 Near-White Blast Cleaning

**International Organization for Standardization/International Electrotechnical Commission (ISO/IEC)**

17025 General Requirements for the Competence of the Testing and Calibration Laboratories

## 903.03 DEFINITIONS

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

**Anvil** means the component of a diesel hammer that acts as an impact block for the ram

**Bedrock** means a natural solid bed of the hard, stable, cemented part of the earth's crust, igneous, metamorphic, or sedimentary in origin that may or may not be weathered.

**Caisson Pile** means a cast in place deep foundation unit with or without an enclosing liner formed by placing concrete in a bored or excavated hole.

**Cap Block** means a material placed on top of the helmet to cushion the blow of the hammer and to attenuate the peak impact energy without causing excessive loss of the impact energy.

**Casing** means open ended enclosing cylindrical steel tubing or pipe permanently installed in the ground. Casings are structurally required and can be used to stabilize and excavated hole.

**Certificate of Conformance** means a document issued by the Quality Verification Engineer confirming that the specified components of the Work are in general conformance with the requirements of the Contract Documents.

**Deep Foundation Unit** means a structural member, driven or otherwise, installed in the ground to transfer the loads from a structure to soil or rock and derives supporting resistance from the surrounding soil or rock or from the soil or rock strata below its tip or a combination of both.

**Displacement Caisson Pile** means a pile formed in the ground by driving a casing or liner with a concrete plug or an expendable metal plate attached to it and replacing the displaced soil with unreinforced or reinforced concrete.

**Driven Pile** means one of the following pile types: steel H, tube, or sheet piles; wooden pile; or precast reinforced concrete pile that has been installed by means of a pile driver.

**Driving Shoe** means reinforcement attached to the bottom of the pile and designed to protect the pile during driving or to penetrate into a hard stratum.

**Driving to a Set** means driving the pile to the requirement that satisfies pile driving criteria correlated to a required pile resistance.

**Engineer** means a professional engineer licensed by the Professional Engineers Ontario to practice in the Province of Ontario.

**Follower** means a removable extension that transmits the hammer blows to the head of the pile.

**Helmet** means a formed steel cap that fits over the top of a pile head to retain in position a resilient cap block.

**Jetting** means the use of a jet of water at high pressure directed into the ground below the pile tip to assist its penetration

**Liner** means open ended enclosing steel tubing or pipe temporarily installed in the ground to facilitate the construction of caisson piles

**Pile** means a relatively slender structural element that is installed, wholly or partly in the ground by driving, drilling, auguring, jetting, or other means.

**Pile Cap** means a footing or some other structural component used to transfer the load to the piles as well as maintaining them in position.

**Pile Cushion** means a pad of resilient material placed between the helmet and the top of a precast reinforced concrete or wooden pile to minimize damage to the head during driving.

**Pile Group** means the piles supporting a pile cap.

**Pumped Concrete** means a method of transporting concrete through hose or pipe by means of positive and continuous pressure.

**Quality Verification Engineer (QVE)** means an Engineer retained by the Contractor qualified to provide the services specified in the Contract Documents.

**Ram** means the moving or driving part of an air, steam, diesel, or drop pile hammer that delivers an impact blow to an anvil and to the pile.

**Retapping** means verifying that the specified resistance previously attained has been sustained by imparting appropriate hammer energy to the pile and monitoring pile penetration.

**Rock Points** means a specially designed steel tip fitted to piles to enable them to be driven into hard, sound sloped bedrock.

**Sheet Pile** means a pile that is designed to interlock with adjacent piles and form a continuous wall for the purpose of resisting mainly lateral forces and to reduce seepage.

**Slurry** means a drilling fluid, consisting of water mixed with one or more of various solids or polymers, used to maintain the stability of the side walls and bottom of an excavation.

**Tremie** means a hopper with a vertical pipe used for placing concrete under water. The foot of the pipe is

always submerged in concrete except during commencement of concreting and the upper level of the concrete in the pipe is always above water level.

## 903.04 DESIGN AND SUBMISSION REQUIREMENTS

### 903.04.01 Design Requirements

#### 903.04.01.01 Concrete

The Contractor is responsible for providing plastic concrete with suitable characteristics for installation. The concrete shall be flow able, non-segregating concrete that does not exhibit rapid slump loss.

### 903.04.02 Submission Requirements

#### 903.04.02.01 General

All submissions shall bear the seal and signature of an Engineer experienced in the field of deep foundations.

When welded field splices are used, welding procedures according to the Canadian Welding Bureau shall be submitted to the Contract Administrator.

#### 903.04.02.02 Preconstruction Survey

A condition survey of property and structures that may be affected by the work shall be submitted to the Contract Administrator prior to commencing the work. The survey shall include the locations and conditions of adjacent properties; buildings; underground structures; Utility services; and structures, such as walls abutting the site.

#### 903.04.02.03 Materials

##### 903.04.02.03.01 Mill Certificates

One copy of the mill certificates, indicating that the steel meets the requirements for the appropriate standards for H-piles, tube piles, casings, and sheet piles shall be submitted to the Contract Administrator at the time of delivery.

Where mill test certificates originate from a mill outside Canada or the United States of America, the information on the mill certificates shall be verified by testing by a Canadian laboratory. The laboratory shall be certified by an organization accredited by the Standards Council of Canada to comply to comply with the requirements of ISO/IEC 17025 for the specific tests or type of tests required by the material standard specified on the mill test certificate. The mill test certificates shall be stamped with the name of the Canadian testing laboratory and appropriate wording stating that the material conforms to the specified material requirements. The stamp shall include the appropriate material specification number, the date (i.e., yyyy-mm-dd), and the signature of an authorized officer of the Canadian testing laboratory.

##### 903.04.02.03.02 Concrete

A suitable, site-specific concrete mix design that meets the requirements of the hardened concrete shall be submitted to the Contract Administrator 14 Days prior to construction, for information purposes only.

##### 903.04.02.03.03 Slurry

The following shall be submitted to the Contract Administrator 14 Days prior to construction, for information purposes only:

a) The type, source, and physical and chemical properties of the bentonite or polymer.

b) The source of water.

c) Method of mixing slurry.

d) The water solids ratio and the mass and volumes of the constituent parts, including any chemical admixtures or physical treatment employed to produce slurry with the required physical properties.

e) Details of procedure to be used for monitoring the quality of the slurry.

f) A test report showing the properties of the slurry and certifying that the slurry meets the requirements of API RP 13B-1.

g) Method of disposal of the slurry.

**903.04.02.04 Installation**

**903.04.02.04.01 Driven Piles**

The following shall be submitted to the Contract Administrator as least 14 Days prior to construction, for information purposes only:

a) A schedule of work identifying time and sequence of activities.

b) Type of equipment, anvil, helmet, and hammer details, including the hammer energy assumed by the Contractor, stated potential energy (rated energy) of the hammer, operating efficiency, and weight of ram.

c) Working Drawings of precast concrete piles showing the pile dimensions, concrete strength, tendon arrangement, working stresses and arrangement of steel reinforcement, schedules, elongation calculations, method and sequence of casting, complete specifications and details of the prestressing steel, and lift anchors and lifting point locations.

d) The method of maintaining the steel reinforcement cages in position, when steel reinforcement cages are used in tube piles.

e) Procedure for monitoring pile installation.

f) Details of the method of attaching proprietary driving shoes.

g) When load testing is specified in the Contract Documents, details of the full-scale test, including site preparation and the details of the load application, components, equipment, testing apparatus, and method of monitoring.

h) Information pertinent to establishing the resistance of a pile when the wave equation analysis method is used.

**903.04.02.04.02 Caisson Piles**

The following shall be submitted to the Contract Administrator at least 14 Days prior to construction, for information purposes only:

a) A schedule of work identifying time and sequence of activities.

b) Detailed procedures for caisson excavation in overburden and rock.

c) Detailed procedures for casing and liner installation and for the withdrawal of the liner.

d) Detailed procedures for slurry displacement method of excavation, including disposal of slurry upon completion.

e) Detailed procedures for tremie concrete, including the size of tremie delivery pipe.

f) Detailed procedure for placing concrete in the dry.

g) Method of maintaining the steel reinforcement cages in position in the caisson.

h) Details of filling the annular void around a casing.

i) Details of procedure to be used for monitoring installation.

j) When load testing is specified in the Contract Documents, details of the full-scale test, including site preparation, details of the load application, components, equipment, testing apparatus, and method of monitoring.

**903.04.02.04.02.01 Milestone Inspections**

The Quality Verification Engineer shall witness the following interim inspections of the work for caisson piles:

a) Excavation

b) Steel reinforcement installation

c) Placing of concrete

A copy of the written permission to proceed shall be submitted to the Contract Administrator prior to commencement of the next operation.

**903.04.02.04.03 Displacement Caisson Piles**

The following shall be submitted to the Contract Administrator as least 14 Days prior to construction, for information purposes only:

a) A schedule of work identifying time and sequence of activities.

b) Type of equipment, anvil, helmet, and hammer details, including the hammer energy assumed by the Contractor, stated potential energy (rated energy) of the hammer, operating efficiency, maximum stroke or drop, and weight of the ram.

c) Details of procedures used for installation of displacement caisson piles, including detailed procedures for liner installation and withdrawal.

d) Method of maintaining the steel reinforcement cages in position in the pile.

e) Details of procedure to be used for monitoring pile installation.

f) When load testing is specified in the Contract Documents, details of the full-scale test, including site preparation, and the details of the load application, components, equipment, testing apparatus, and method of monitoring.

**903.04.02.04.04 Steel Reinforcement Cages**

Working Drawings showing the fabrication details of the steel reinforcement cages, including the lifting points and lifting lugs, shall be submitted to the Contract Administrator at least 14 days prior to fabrication, for information purposes only.

**903.04.02.05 Qualifications**

Copies of the Canadian Welding Bureau's certification of the Independent Testing Company, the Non-destructive Testing Technician, and the Welding Inspector shall be submitted to the Contract Administrator at least 5 Days prior to the commencement of any non-destructive testing, for information purposes only.

**903.04.02.06 Review of Splice Test Results and Permission to Proceed**

Upon completion of the testing of the splices, the Quality Verification Engineer shall review all test results to verify that all the welds were done according to the welding procedures and Contract Documents and issue the Contractor written permission to proceed with the work.

## 903.05 MATERIALS

**903.05.01 Wooden Piles**

Wooden piles shall be according to CAN3-056 and shall be clean and peeled. Treated piles shall be pressure treated with creosote according to CAN/CSA-080.

Wooden piles shall be provided with collars sufficiently strong to prevent splitting of the head of the wooden pile during driving.

**903.05.02 Steel Piles**

**903.05.02.01 H-Piles**

Steel H-piles shall be according to CAN/CSA G40.20/G40.21, Grade 350 W.

**903.05.02.02 Tube Piles**

Steel tube piles shall be according to ASTM A 252, minimum Grade 2.

**903.05.02.03 Sheet Piles**

Steel sheet piles shall be according to ASTM A 328M.

**903.05.02.04 Straightness Tolerance for Steel Piles, Casings, and Liners**

Steel piles, casings, and liners shall conform to a straightness tolerance of 1.5 mm maximum per metre of length.

Steel sheet piles shall be sufficiently straight to prevent binding in the interlock during driving.

**903.05.03 Driving Shoes and Rock Points**

Rock points and driving shoes shall be as specified in the Contract Documents.

Driving shoes shall transfer the driving stresses to the pile over the full cross-sectional area of the pile.

Where precast concrete piles are driven into dense or hard material, a steel driving shoe cast into the concrete shall be provided.

Where wooden piles are driven into dense material, a steel plate driving shoe shall be provided to prevent damage to the bottom of the pile.

**903.05.04 Casing for Caissons**

Casings shall be according to ASTM A 252, Grade 2. If welded, they shall be welded by the electric arc method according to CSA W59.

The casing wall thickness specified is the minimum that shall be supplied. The wall thickness shall be increased as required to ensure the casing is not damaged during handling and installation.

**903.05.05 Steel Reinforcement**

Steel reinforcement shall be according to OPSS 1440.

**903.05.06 Concrete**

**903.05.06.01 General**

Concrete shall be according to OPSS 1350.

**903.05.06.02 Tube Piles**

Concrete shall have a slump of 150 to 180 mm.

**903.05.06.03 Caisson Piles**

Concrete shall have a slump of 150 to 180 mm. When approved by the Contract Administrator in writing, admixtures may be used. Where the liner is to be withdrawn, sufficient retarder shall be added to prevent arching of concrete during liner withdrawal and to prevent setting of concrete until after the liner is withdrawn.

**903.05.07 Precast Concrete Piles**

The production of precast reinforced concrete piles shall be according to OPSS 904, OPSS 905, and OPSS 909.

Steel reinforcement shall be placed such that direct loading during the ram stroke shall not occur.

Lifting anchors shall be at least 25 mm clear from reinforcement or prestressing steel in the pile.

Concrete in precast reinforced concrete piles shall be according to OPSS 1350 and have a nominal minimum 28-Day compressive strength of 45 MPa.

Concrete for precast reinforced concrete piles shall be cured according to OPSS 904.

Concrete for precast reinforced concrete piles shall be placed in smooth mortar-tight forms that are supported to prevent excessive deformation or settlement during placing or curing.

Unformed surfaces shall be finished smooth.

When removed from the form, the pile shall present true, smooth, even surfaces free from honeycombs and voids. The pile shall be straight so that a line stretched from butt to tip on any face shall not be more than 25 mm from the face of the pile at any point.

Each precast reinforced concrete pile shall have the date of manufacture (i.e., yyyy-mm-dd) inscribed on it.

**903.05.08 Slurry**

**903.05.08.01 Solids**

Bentonite and polymers shall be according to API Spec 13A.

**903.05.08.02 Water**

Water shall be according to OPSS 1302.

**903.05.08.03 Slurry Composition**

The slurry shall consist of a stable colloidal suspension of pulverized solids or polymers thoroughly mixed with water. The density, viscosity, sand content, and pH of the slurry being used during excavation shall be according to API RP 13B-1.

**903.06 EQUIPMENT**

**903.06.01 Hammers**

Hammers shall be capable of installing the piles, casings, and liners to the depth or resistance specified in the Contract Documents, without damage to the portions that are not cut off.

The hammer used to chisel the rock point into the rock shall be capable of delivering a controlled blow in 10% increments ranging in energy from zero to the maximum hammer energy.

For precast reinforced concrete piles, the heaviest hammer practicable shall be employed and the stroke limited so as not to damage the piles. When choosing the size of the hammer, consideration shall be given to whether the pile is to be driven to a resistance or to a given depth.

**903.06.02 Helmets and Striker Plates**

The head of steel piles shall be protected by a striker plate or a helmet. Helmets shall have adequate and suitable cushioning material. Helmets and striker plates shall distribute the blow of the hammer evenly throughout the cross-section of the pile head.

**903.06.03 Leads**

Pile driver leads shall be built to afford freedom of movement for the hammer and shall be held in position at the top and bottom by guys, stiff braces, or other approved means to ensure support of the pile, casing, or liner while it is being driven. Swinging leads shall not be permitted.

Batter piles, casings, or liners shall be driven with leads aligned parallel to the axis of the pile, casing, or liner. The leads shall be equipped with a fixed, rigid, adjustable kicker.

**903.06.04 Followers**

When use of followers are specified in the Contract Documents, followers shall be of type, size, shape, length, and weight as to permit driving the pile, casing, or liner at the location and to the required depth or ultimate resistance specified in the Contract Documents. The follower shall be provided with a socket or hood carefully fitted to the top of the pile, casing, or liner to minimize loss of energy and to prevent damage to the pile, casing, or liner, and shall have sufficient rigidity to prevent "whip" during driving.

When followers are permitted, an identical follower shall be used when the set is being determined.

## 903.07 CONSTRUCTION

### 903.07.01 Transporting, Storing, and Handling Piles, Casings, Liners, and Reinforcing Steel Reinforcement Cages

#### 903.07.01.01 General

Piles, casings, liners, and steel reinforcement shall be transported, stored, and handled in such a manner that damage is prevented and the strength of the components is not affected by deterioration or deformation.

Components shall be lifted and placed using appropriate lifting equipment, temporary bracing, guys, or stiffening devices so that the components are at no time overloaded, unstable, or unsafe.

Material shall be supported to prevent unequal settlement when stacked.

#### 903.07.01.02 Wooden Piles

Canthooks, dogs, pile pulls, or use of other lifting methods that might damage the integrity of the pressure treated surface shall not be used. Cuts or breaks in the surface of treated piling shall be given three brush coats of hot creosote oil. Bolt holes shall be treated with three applications of hot creosote oil applied with a bolt hole treater.

#### 903.07.01.03 Handling Holes in Steel Piles

Unless otherwise approved by the Contract Administrator, holes shall only be made in the portion of the pile to be cut off or in the portion of the pile to be encased in concrete.

When other holes are approved to be cut in a pile they shall be covered by splice plates placed on both sides of the section. The thickness and the mechanical properties of the plate material shall be at least equivalent to the pile material.

#### 903.07.01.04 Precast Reinforced Concrete Piles

Precast concrete piles shall be handled only from the designated lifting points.

When lifting or transporting precast reinforced concrete piles lift anchors, slings, or other approved means shall be used. Care shall be taken when lifting and transporting to avoid any overstressing of the pile or cracking of the concrete.

Precast reinforced concrete piles shall be so handled to avoid breaking or chipping their edges.

Lift anchors shall be removed and the holes filled with a non-shrink grout or epoxy installed according to the manufacturer's recommendations.

#### 903.07.01.05 Caisson Casings and Liners

Casings and liners shall be handled and stored in such a manner to avoid damage or distortion to them. The casings and liners shall be maintained circular within $\pm$ 2% of the casing or liner diameter.

### 903.07.02 Driven Piles

**903.07.02.01 Pile Driving Requirements and Restrictions**

Piles shall not be driven until embankment work or excavation work has been completed to the underside of the footing. When driving of the piles is completed, all material between the piles shall be removed to the correct elevation and any holes or voids created shall be filled to the correct elevation with compacted material approved by the Contract Administrator.

Piles shall be installed at the locations specified in the Contract Documents and to the set or depth specified without being damaged. Damage to the pile, casing, or liner during driving shall be prevented by limiting the drop or energy and number of blows of the hammer. The hammer, helmet, cap block, striker plate, and pile shall be coaxial and shall sit squarely upon each other.

A shorter stroke shall be used and proper precaution shall be taken when there is a danger of damaging or over driving the piles, casing, or liners under conditions such as:

a) In the early stages of driving a long pile where a hard layer near the ground surface has to be penetrated.

b) Where there is very soft material of a considerable depth and a large penetration is achieved at each hammer blow.

c) Where it is anticipated the pile shall meet refusal on rock or other impenetrable soil.

d) When piles are driven onto sloping bedrock.

Damage to adjacent structures, Utilities, and fresh concrete shall be prevented during pile installation. Piles shall not be driven within a radius of 8 m of concrete that has been in place for less than 72 hours. Piles shall not be driven within a radius of 15 m of concrete that has been in place for less than 72 hours without the approval of the Contract Administrator.

The tops of all piles shall be either square to the longitudinal axis of the pile or horizontal as indicated in the Contract Documents.

Piles shall not be forced into their proper position by the use of excessive manipulation. Pile damage due to excessive driving shall be avoided.

**903.07.02.02 Driving Shoes and Rock Points**

Driving shoes and rock points shall be installed in locations specified in the Contract Documents.

Driving shoes shall be welded in accordance with the Contract Documents.

When driving shoes are specified in the Contract Documents, the Titus H bearing pile point or APF Hard Bite, standard model, may be substituted for the driving shoes.

When Oslo points are specified in the Contract Documents, the Titus H bearing pile point or APF, rock injector model, may be substituted for the pile points.

Where proprietary driving shoes are used, they shall be welded or otherwise attached to the driven piles according to the manufacturer's specifications.

**903.07.02.03 Splicing**

**903.07.02.03.01 General**

Any damaged material shall be cut-off prior to splicing.

**903.07.02.03.02 Wooden Piles**

Wooden piles shall not be spliced.

**903.07.02.03.03 H-Piles, Tube Piles, and Sheet Piles**

Welding shall be according to CSA W59 and shall be done by a qualified welder employed by a firm certified according to CSA W47.1, Division 1 or Division 2.1.

Steel H-piles and steel tube piles may be spliced providing the pieces being spliced are not less than 3 m long. Splices in marine structures shall be located below the low water level, unless otherwise encased in concrete.

Sheet piles shall not be spliced without approval by the Contract Administrator.

**903.07.02.03.04 Precast Reinforced Concrete Piles**

Precast reinforced concrete piles shall only be spliced when specified in the Contract Documents and the splices shall only be made with approved mechanical splicing devices.

**903.07.02.04 Concrete in Steel Tube Piles**

Concrete in steel tube piles shall be placed according to OPSS 904.

**903.07.02.05 Cutting Off Piles**

**903.07.02.05.01 General**

Driven piles shall be cut to the elevation as specified in the Contract Documents.

The length of pile supplied shall be sufficient to ensure there is no damaged material below the cut off. Damaged material at the pile head shall be cut off.

Piles shall not be cut off until retapping, redriving, and specified load testing are complete.

**903.07.02.05.02 Wooden Piles**

Where wooden piles are broomed, splintered, or otherwise damaged below the cut-off elevation, the pile shall be considered defective and shall be replaced.

**903.07.02.06 Protective Coating for Steel H and Steel Tube Piles**

Exposed steel H and steel tube piles shall have a coal tar epoxy protective coating applied from an elevation 600 mm below the low water level or finished ground surface up to the top of the exposed steel.

The steel surfaces shall be cleaned according to SSPC-SP10 prior to application of a coal tar epoxy system that shall be according to OPSS 911.

**903.07.02.07 Monitoring Driven Piles**

**903.07.02.07.01 General**

The driving of piles shall be carefully monitored and controlled and pile driving records produced for each pile. The QVE or an individual under the direct supervision of the QVE shall verify the work.

Piles shall not be overdriven. When driving to a specified ultimate resistance, driving to a set or driving to

bedrock, the piles shall be driven to the anticipated tip elevation. The Contract Administrator shall be notified if the piles do not reach set at the anticipated tip elevation, .

In soils where there is a possibility of piles moving upward due to ground heave, elevations of completed pile tops shall be measured at intervals while nearby piles are being installed. The readings shall be recorded and submitted to the Contract Administrator as the work proceeds.

**903.07.02.07.02 Driving to a Specified Elevation**

Piles shall be driven to an elevation specified in the Contract Documents. Driving piles to other elevations shall only be done when approved in writing by the Contract Administrator.

**903.07.02.07.03 Driving to a Specified Ultimate Resistance**

**903.07.02.07.03.01 General**

The Quality Verification Engineer shall establish the reference set used to determine ultimate resistance and measure and record the set for individual pile acceptance.

The set and rebound measurements shall be obtained by the Quality Verification Engineer. The Quality Verification Engineer shall determine the measured ultimate resistance and verify that the design ultimate resistance has been achieved.

**903.07.02.07.03.02 Driving to a Set**

The founding elevation shall be established by driving to a set determined in accordance with the dynamic formula specified in the Contract Documents or by the application of the wave equation analysis procedure that verifies the pile resistance. This set shall be established on the first pile of every ten piles driven in a pile group.

The other piles shall be controlled by the pile penetration rate in blows per millimetre that correlates to the set.

When new conditions, such as change in hammer size, change in pile size, or change in soil material occur, new sets shall be determined.

**903.07.02.07.03.03 Driving to Bedrock**

When driving piles to bedrock, the pile shall be adequately seated on bedrock without damaging the pile.

Where rock points are used, the rock points shall penetrate into the rock. Piles driven using rock points shall be driven to ensure adequate seating on the bedrock without damaging the pile.

Driving of piles on sloping bedrock shall be stopped when initial contact is made with the bedrock. The bedrock elevation shall be recorded. Driving shall then continue, commencing with energy of 10% of the maximum energy of the hammer. The pile shall be driven in sets of 20 blows at this energy until no penetration is observed. Twenty additional blows shall be applied, and, if no penetration is observed, the energy shall be increased by an additional 10% and the above procedure repeated.

Driving shall continue with these stepped increases in energy and with the same series of blows as described above, until the pile has been seated on the bedrock.

If unrealistic excessive penetration per blow is observed, driving shall be stopped and this excessive penetration immediately reported to the Contract Administrator.

The Quality Verification Engineer shall determine when the hammer energy can be increased and when the driving is complete for each pile.

**903.07.02.07.04 Wave Equation Analysis**

When requested by the Contract Administrator, all equipment, material, and personnel shall be supplied to conduct the wave equation analysis procedure. The Quality Verification Engineer shall review the results of the analysis.

**903.07.02.07.05 Hammer Performance**

When requested by the Contract Administrator, the hammer performance using the pile driving analyzer or other approved equivalent shall be verified in the presence of the Contract Administrator. Hammer performance shall be verified to ensure that the actual potential energy (rated energy) is not less than 90% of the stated potential energy. All instrumentation, access, and assistance for the testing and monitoring as directed by the Contract Administrator shall be provided.

**903.07.02.07.06 Retapping Tests on Piles**

In each pile group, 10% of the piles rounded up to the next whole number, but no fewer than two piles, shall be retapped no sooner than 24 hours after installation of the individual pile to confirm that the ultimate axial resistance has been sustained.

Retapping of piles driven to bedrock is not required.

**903.07.02.07.07 Retapping and Redriving Piles**

When the retapping tests indicate that the ultimate axial resistance has not been achieved on any one pile, all piles in the group shall be retapped.

Where the retapping reveals that the ultimate axial resistance of the piles has not been achieved, the piles that have not achieved the ultimate axial resistance shall be redriven to the specified resistance.

Where piles have risen, the piles shall be redriven to the original depth.

**903.07.02.08 Jetting**

Jetting shall be carried out in such a manner that the resistance of the piles already in place and the safety of adjacent structures shall not be impaired. Jetting shall be stopped at least 1 m above the final expected pile-tip elevation and at least 1 m above the tip elevation of any piles previously driven within 2 m of the jet. Where piles are to be end bearing on rock, jetting may be carried to the rock surface.

The driving and jetting of precast reinforced concrete piles shall not be carried out simultaneously.

**903.07.03 Caisson Piles**

**903.07.03.01 General**

Caissons shall be constructed as specified in the Contract Documents.

The final bearing elevation shall be as specified in the Contract Documents or as determined by the Contract Administrator. When permanent casings are not specified, the caisson shall be constructed in a drilled hole with or without the use of a temporary liner or slurry as determined by the Contractor.

**903.07.03.02 Excavation**

**903.07.03.02.01 General**

Sidewall stability shall be maintained throughout the excavation and concrete placement operation. Soil cave-in into the excavation hole shall be prevented.

The bottom of the excavation shall be cleaned before the start of concrete placement.

Excavation methods shall be such that the sides and bottom of the hole are straight and free of loose material that might prevent intimate contact of the concrete with undisturbed soil or bedrock.

Except when founded on sloping rock, the caisson bottom shall be level. On sloping rock, the caisson bottom may be stepped, with each step not greater than ¼ the diameter of the bearing area.

**903.07.03.02.02 Casings**

When an auger is used to excavate for a casing, the diameter of the auger shall be no greater than the outside diameter of the casing.

**903.07.03.02.03 Liners**

The diameter of the excavation for the installation of liners shall not exceed the diameter of the liner by more than 150 mm.

**903.07.03.02.04 Slurry Method**

The level of slurry in the excavation shall be sufficient to prevent the intrusion of water and to maintain a stable wall with no cave-in, sloughing, or basal heave.

Slurry shall be tested as specified in API RP 13B-1All test equipment required for the tests shall be provided. A slurry sampler capable of obtaining samples at any depth within the caisson hole shall be available at all times.

At least 1 set of tests shall be completed every 4 hours during the slurry operation. Samples shall be taken from the mud tank and from within the caisson at a depth within 300 mm of the bottom.

**903.07.03.03 Inspection of the Excavation**

The bottom of excavations shall be visually inspected.

**903.07.03.04 Dewatering**

Where dewatering is required, a dewatering scheme shall be employed in such a manner as to prevent any disturbance to the base founding material. The dewatering shall not create subsidence or cause ground loss that may adversely affect the work or adjacent structures.

**903.07.03.05 Backfilling Liners Left in Place**

The annular space between a liner permanently left in place and shaft excavation shall be filled with concrete or fluid grout.

**903.07.03.06 Steel Reinforcement**

Steel reinforcement steel shall be installed according to OPSS 905. Steel reinforcement cages shall be checked to ensure conformance to the Working Drawings prior to installation and during placement of concrete.

The steel reinforcement cage shall be fabricated in one piece.

Welding of steel reinforcement and use of splices shall not be done unless specified in the Contract Documents.

The steel reinforcement shall not be displaced or distorted during the construction of the caisson.

**903.07.03.07 Concrete**

**903.07.03.07.01 General**

Concrete shall be placed in the caisson according to OPSS 904 and as specified herein. Concrete shall be placed immediately following interim inspection of the caisson hole by the Quality Verification Engineer.

The reinforcement shall not be displaced or distorted during the construction of the caisson.

Arching of concrete during casing withdrawal shall be prevented.

**903.07.03.07.02 Concrete Placed in the Dry**

The concrete may be placed free fall provided the fall is vertically down the centre of the opening and transverse ties, spacers or other objects do not impede the free fall. In the event of interference with the concrete free fall, an elephant trunk or other means shall be used to prevent concrete segregation.

Concrete shall be placed in a continuous operation from the bottom to the top of the caisson or, where columns are cast integral with the caisson, to the elevation of the bottom of the column steel reinforcement cage. The concrete shall be vibrated for the last 1.5 m of the pour.

**903.07.03.07.03 Concrete Placed Under Water or Under Slurry**

Tremie or pumped concrete shall be carried out in one continuous operation. The tremie or pumping operation shall be a continuous flow of concrete that prevents the inflow of water or slurry.

Where tremie concrete is to be placed in a caisson under water, the Contractor shall maintain an adequate head of water within the excavations to prevent the inflow of water through the base or walls of the caisson as the concrete is being placed.

Where tremie is placed under slurry, the caisson shall be filled with concrete entirely by tremie and the method of deposition shall not be changed part way up the caisson.

When concrete placement is not started within 6 hours of acceptance of the excavation, the excavation shall be redrilled, cleaned, and the slurry tested before concrete placement commences.

**903.07.03.07.04 Withdrawal of Liners**

Arching of concrete during withdrawal of the liner shall be prevented.

During withdrawal, the bottom of the liner shall have a minimum embedment into the concrete being placed and a sufficient head of concrete shall be maintained above the bottom of the liner at all times to prevent intrusion of soil and water into the hole.

During withdrawal, upward or downward movement of the steel reinforcement shall be monitored. Upward or downward movement shall be restricted to 150 mm.

A theoretical concrete level shall be calculated based on the quantity of concrete placed and the caisson dimensions, and this theoretical level shall be compared to the actual level of concrete in the caisson to provide a check for possible separation of shaft concrete during liner withdrawal.

**903.07.03.07.05 Founding Elevation**

The final founding elevation shall be as specified in the Contract Documents or an elevation approved in writing by the Contract Administrator. When casings are not specified in the Contract Documents, the caisson shall be constructed in a drilled hole with or without the use of a liner or slurry as determined by the Contractor.

Except when founded on sloping unweathered bedrock, the caisson bottom shall be level. On sloping unweathered bedrock, the caisson bottom may be stepped, with each step not greater than one quarter the diameter of bearing area.

The bearing area of the caisson pile shall be approved by the Quality Verification Engineer prior to placing concrete.

**903.07.04 Displacement Caisson Piles**

Work shall be carried out in accordance with the displacement caisson pile suppliers' installation procedures. A permanent liner shall be used when specified in the Contract Documents.

The sequence of installation shall be such as to prevent damage to any recently completed piles.

The pile shall not be founded above or below the specified pile tip elevation without approval in writing from the Contract Administrator.

The QVE or an individual under the direct supervision of the QVE shall verify the installation of displacement caisson piles.

**903.07.05 Tolerances**

**903.07.05.01 Driven Piles**

a) Cut-off elevation $\pm$ 25 mm.

b) Deviation from vertical not more than 1H:50V, except in the case of a pile cap or footing supporting only a single row of piles the deviation shall not be more than 1H:75V in the direction of the span.

c) The deviation from the specified inclination for battered piles shall not exceed 1H:25V.

d) The centre of the pile at the junction with the pile cap shall be within 150 mm measured horizontally of that specified except in the case of a pile cap or footing supported on a single row of piles the deviation shall not be more than 75 mm measured horizontally in the direction of the span.

**903.07.05.02 Caissons and Displacement Caisson Piles**

a) Cut-off elevation $\pm$ 25 mm.

b) Horizontal location at cut-off not more than 5% of shaft diameter or 75 mm, whichever is less.

c) Vertical alignment not more than 2% of the caisson length from vertical for vertical caissons, or 2% of the caisson length from the specified inclination for battered caissons.

**903.07.06 Load Test**

When a load test is specified in the Contract Documents, the testing shall be according to ASTM D 1143M for piles under vertical static load, ASTM D 3689 for piles under tensile load, and ASTM D 3966 for piles under lateral loads. The Quality Verification Engineer shall witness the pile load test. All records and results of the

pile load test attached with the Certificate of Conformance shall be submitted to the Contract Administrator.

All necessary personnel, equipment, and material to make adjustments during the tests shall be provided and at least one skilled worker shall be present for the complete duration of each test. This worker shall have demonstrated experience in load testing of piles.

The following shall be provided for the duration of all testing:

a) A level dry working area at the test location

b) An adequate enclosure sufficient to provide complete protection from adverse weather conditions

c) All temporary work required to obtain access to the site for the personnel, equipment, and materials.

Upon completion of the tests, the site shall be cleared and restored to the satisfaction of the Contract Administrator. Piles that are not part of the finished work shall be cut off 1.2 m below ground level or 0.6 m below stream bed level. Any resulting void shall be backfilled with suitable fill material.

**903.07.07 Repair of Welds**

Any section of weld that does not meet the requirements of the Contract Documents shall be removed and rewelded.

**903.07.08 Quality Control**

**903.07.08.01 Inspection and Testing of Welds**

**903.07.08.01.01 Qualifications of Companies and Individuals**

An independent testing company with no corporate affiliation with the Contractor shall be employed to carry out the non-destructive testing of welds. The independent testing company shall be certified by the Canadian Welding Bureau to the requirements of CSA W178.1 for bridge structures by radiographic or ultrasonic test methods.

Testing shall be done by a non-destructive testing technician employed by an independent testing company. The non-destructive testing technician shall have documented evidence of training and professional knowledge, skill, and experience in non-destructive testing of structural steel welds and material and have a valid certificate showing qualification to a Level II or III according to CAN/CGSB-48.9712 and the Canadian Welding Bureau for the non-destructive testing specified.

Visual inspections shall be performed by a welding inspector employed by an independent testing company. The welding inspector shall have documented evidence of training, professional knowledge, skill and experience in the visual inspection of structural steel welds and material, and have a valid certificate showing qualification to Level II or III according to CSA W178.2.

**903.07.08.01.02 Visual Inspection of Welds**

A representative sample of not less than 30% of the welds, as determined by the Quality Verification Engineer, shall be visually inspected for conformance to the requirements of CSA W59, the Contract Documents, and the Working Drawings.

**903.07.08.01.03 Non-Destructive Testing of Welds**

Radiographic or ultrasonic testing shall be carried out using procedures according to CSA W59.

Ultrasonic or radiographic testing shall be carried out on the entire length of selected splice welds chosen at

random by the Quality Verification Engineer or the Welding Inspector assigned to carry out visual inspection.

Selection shall be based on the following criteria:

a) For pile groups other than at integral abutments, 10% of the splice welds, rounded to the next highest number, but no fewer than two.

b) For pile groups at integral abutments, 10% of the splice welds, rounded to the next highest number, but no fewer than two of when the welds are below 6 m of the pile cut-off elevation.

c) For pile groups at integral abutments, all splice welds within 6 m of the pile cut-off elevation.

**903.07.08.01.04 Repaired Welds**

All welds that have been repaired shall be visually inspected and shall undergo non-destructive testing.

**903.07.08.02 Non-Destructive Test Reports and Visual Inspection Reports**

Within 7 Days from completion of the inspection and testing, two copies of all inspection and testing reports shall be submitted to the Contract Administrator, for information purposes only.

**903.07.08.03 Certificate of Conformance**

A completed Certificate of Conformance shall be submitted to the Contract Administrator upon completion of the deep foundation work. The Certificate of Conformance shall be sealed and signed by the Quality Verification Engineer and shall state that the deep foundation work has been carried out in general conformance with the Contract Documents and Working Drawings. The Certificate of Conformance shall also certify that the interim milestone inspections have been completed as specified.

When the specified horizontal tolerances are not achieved, the process for “Non-Conforming Work by the Contractor” as specified elsewhere in the Contract Documents shall be followed unless the pile discrepancies are minor and do not require a detailed design evaluation.

For these minor cases, a proposal for an amendment to the Contract Documents stating that the pile discrepancies are minor and do not require detailed design evaluation shall be submitted to the Contract Administrator for acceptance.

The proposal shall be signed by an Engineer and shall be accompanied by a drawing containing the following information:

a) Specified pile locations;

b) Actual pile locations; and

c) Proposed adjustments to the footing and reinforcement.

## 903.09 MEASUREMENT FOR PAYMENT

### 903.09.01 Actual Measurement

**903.09.01.01 H-Piles, Tube Piles, Wooden Piles, and Precast Reinforced Concrete Piles**

Measurement of piles shall be by length in metres of the piling left in place after cut-off.

**903.09.01.02 Sheet Piles**

Measurement of sheet piles shall be by area in square metres based on the driving lines specified and the length of piling left in place after cut-off.

**903.09.01.03 Driving Shoes**

For measurement purposes, a count shall be made of the number of drive shoes used.

**903.09.01.04 Rock Points**

For measurement purposes, a count shall be made of the number of rock points used.

**903.09.01.05 Caissons and Displacement Caisson Piles**

Measurement of caissons and displacement caisson piles shall be by length in metres of the depth along the centreline between the approved bearing surface at the bottom and the specified elevation at the top.

**903.09.01.06 Retapping Piles**

For measurement purposes, a count shall made of the number of piles retapped above and beyond the minimum number described in the Retapping Tests on Piles clause.

Piles retapped as part of the minimum number required for the retapping tests described in the Retapping Tests on Piles clause shall not be measured for payment.

**903.09.02 Plan Quantity Measurement**

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

**903.10 BASIS FOR PAYMENT**

**903.10.01 Supply Equipment for Installing Driven Piles - Item**
**Supply Equipment for Installing Caisson Piles - Item**
**Supply Equipment for Installing Displacement Caisson Piles - Item**

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

For payment purposes, 50% of the work under this item is completed when the satisfactory performance of the equipment has been demonstrated to the Contract Administrator by the installation of 1% of piles. The remaining 50% shall be paid on the satisfactory completion of the installation of piles.

When the hammer performance is requested to be verified, such verification shall be completed at no extra cost to the owner when the energy delivered is less than 90% of the stated potential energy (rated energy) specified in the submission.

When the energy is equal to or greater than 90% of the stated potential energy stated in the required submission, the cost verifying the hammer performance shall be administered as a Change in the Work.

**903.10.02 H-Piles - Item**
**Tube Piles - Item**
**Precast Concrete Piles - Item**
**Wood Piles - Item**
**Displacement Caisson Piles - Item**

**Caisson Piles - Item**
**Driving Shoes - Item**
**Rock Points - Item**
**Sheet Piles - Item**
**Load Test - 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.

Payment for redriving piles shall be at the Contract price for the applicable tender item above.

When the Contractor substitutes driving shoes or Oslo points with Titus H bearing pile points, the cost of such substitutions shall be at no extra cost to the Owner.

**903.10.03 Retapping Piles - 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.

Retapping the minimum specified number of piles for retapping tests shall include all labour, Equipment, and Material to do the work and shall be included in the Contract price for the appropriate pile tender item.

Where additional retapping is required, payment shall be made based on the ratio of the number of piles retapped in a pile group above the minimum requirement, up to the total number of piles in that pile group, times the tender price for retapping all piles for that pile group.

**Appendix 903-A, April 2016**
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

**Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.**

## Designer Action/Considerations

No information provided here.

## Related Ontario Provincial Standard Drawings

No information provided here.

**AMENDMENT TO OPSS 903, APRIL 2016**

Special Provision No. 109F57 August 2021

**903.02 REFERENCES**

Section 903.02 of OPSS 903 is amended by the addition of the following:

**ASTM International**

| | |
|---|---|
| A500 / A500M - 21 | Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes |
| A572 / A572M - 18 | Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel |
| A913 / A913M - 19 | Standard Specification for High-Strength Low-Alloy Steel Shapes of Structural Quality, Produced by Quenching and Self-Tempering Process (QST) |

**903.03 DEFINITIONS**

Section 903.03 of OPSS 903 is amended by the deletion of the definitions for Certificate of Conformance and Quality Verification Engineer.

**903.04 DESIGN AND SUBMISSION REQUIREMENTS**

**903.04.02.04.02.01 Milestone Inspections**

Clause 903.04.02.04.02.01 of OPSS 903 is deleted in its entirety.

**903.04.02.05 Qualifications**

Clause 903.04.02.05 of OPSS 903 is deleted in its entirety.

**903.04.02.06 Review of Splice Test Results and Permission to Proceed**

Clause 903.04.02.06 of OPSS 903 is deleted in its entirety.

**903.05 MATERIALS**

**903.05.02.01 H-Piles**

Clause 903.05.02.01 of OPSS 903 is deleted in its entirety and replaced with the following:

Steel H-Piles shall be of the grade specified in the Contract Documents and shall be according to CSA G40.20/G40.21.

When CSA G40.20/G40.21, Grade 350W has been specified, the following steel grades may be substituted:

a) ASTM A572, Grade 345; or

b) ASTM A913, Grade 345.

When CSA G40.20/G40.21, Grade 450W has been specified, the following steel grades may be substituted:

a) ASTM A572, Grade 450; or

b) ASTM A913, Grade 450.

**903.05.02.02 Tube Piles**

Clause 903.05.02.02 of OPSS 903 is deleted in its entirety and replaced with the following:

Steel tube piles shall be as specified in the Contract Documents. When ASTM A252, Grade 3 has been specified, the following steel grades may be substituted:

a) ASTM A500, Grade C; or

b) CSA G40.20/G40.21, Grade 350W.

**903.07 CONSTRUCTION**

**903.07.02.03.03 H-Piles, Tube Piles, and Sheet Piles**

Clause 903.07.02.03.03 of OPSS 903 is deleted in its entirety and replacing it with the following:

Welding shall be according to CSA W59 and shall be done by a qualified welder employed by a firm certified according to CSA W47.1, Division 1 or Division 2.

Steel H-piles and steel tube piles may be spliced providing the pieces being spliced are not less than 3 m long, except for integral abutments' piles, where the pieces being spliced shall not be less than 7.0 m long. Where piles are located in a waterbody, splices shall be located below the low water level, unless otherwise encased in concrete.

Sheet piles shall not be spliced without approval by the Contract Administrator.

**903.07.02.07.01 General**

Clause 903.07.02.07.01 of OPSS 903 is amended by deleting the first paragraph in its entirety and replacing it with the following:

The driving of piles shall be carefully monitored and controlled. Pile driving records shall be produced for each pile and shall be submitted to the Contract Administrator.

**903.07.02.07.03 Driving to a Specified Ultimate Resistance**

Clause 903.07.02.07.03 of OPSS 903 is deleted in its entirety and replaced with the following:

[* Designer Fill-In, See Notes to Designer]

**903.07.02.07.04 Wave Equation Analysis**

Clause 903.07.02.07.04 of OPSS 903 is deleted in its entirety and replaced with the following:

When requested by the Contract Administrator, all equipment, material, and personnel shall be supplied to conduct the wave equation analysis procedure.

**903.07.03.07 Concrete**

**903.07.03.07.01 General**

Clause 903.07.03.07.01 of OPSS 903 is deleted in its entirety and replaced with the following:

A Request to Proceed shall be submitted to the Contract Administrator before the concrete placement.

The reinforcement shall not be displaced or distorted during the construction of the caisson.

The placement of concrete shall not proceed until the Contract Administrator has inspected the caisson hole and issued a Notice to Proceed.

Concrete shall be placed immediately after the Notice to Proceed has been received and shall be placed in the caisson according to OPSS 904 and as specified herein.

Arching of concrete during casing withdrawal shall be prevented.

**903.07.03.07.05 Founding Elevation**

Clause 903.07.03.07.05 of OPSS 903 is amended by deleting the last paragraph in its entirety and replacing it with the following:

Complete access to inspect the bearing area of the caisson pile prior to the placement of concrete shall be given to the Contract Administrator.

**903.07.04 Displacement Caisson Piles**

Subsection 903.07.04 of OPSS 903 is amended by deleting the fourth paragraph in its entirety and replacing it with the following:

A Request to Proceed shall be submitted to the Contract Administrator before the installation of displacement caisson piles.

The next operation shall not proceed until a Notice to Proceed has been received from the Contract Administrator.

**903.07.06 Load Test**

Subsection 903.07.06 of OPSS 903 is amended by deleting the first paragraph in its entirety and replacing it with the following:

When a load test is specified in the Contract Documents, the testing shall be according to ASTM D1143 for piles under vertical static load, ASTM D3689 for piles under tensile load, and ASTM D3966 for piles under

lateral loads. The Contract Administrator shall witness the pile load test. All records and results of the pile load test shall be submitted to the Contract Administrator.

**903.07.08 Quality Control**

**903.07.08.01.01 Qualifications of Companies and Individuals**

Clause 903.07.08.01.01 of OPSS 903 is deleted in its entirety.

**903.07.08.01.02 Visual Inspection of Welds**

Clause 903.07.08.01.02 of OPSS 903 is deleted in its entirety and replaced with the following:

Complete access to visually inspect the welds shall be given to the Contract Administrator.

All welds shall conform with the requirements of CSA W59 and the Contract Documents. A representative sample of splice welds, not less than 30%, shall be selected by the Contract Administrator for visual inspection. The sample of splice welds shall be taken from different piles.

If the sample of splice welds do not pass the visual inspection and need to be repaired, the visual inspection by the Contract Administrator may be increased up to 100% of the welds.

**903.07.08.01.03 Non-Destructive Testing of Welds**

Clause 903.07.08.01.03 of OPSS 903 is deleted in its entirety and replaced with the following:

The Contract Administrator shall be notified in writing, 48 hours in advance of installing piles, which will require weld splicing. The Contract Administrator shall be immediately notified in writing if there are any schedule changes for each pile requiring weld splicing.

A Request to Proceed shall be submitted to the Contract Administrator after the completion of splice welds for each construction stage of work.

The next operation shall not proceed until a Notice to Proceed has been received from the Contract Administrator.

Radiographic or ultrasonic testing shall be carried out by the Contract Administrator using procedures according to CSA W59.

Ultrasonic or radiographic testing shall be carried out on the entire length of selected splice welds chosen at random by the Contract Administrator.

The welds selected for the random ultrasonic or radiographic testing shall be taken from different piles and shall include 10% of the splice welds, rounded to the next highest number, but no fewer than two.
If any welds do not pass the ultrasonic or radiographic-testing and need to be repaired, these non-destructive testing requirements may be increased up to 100% of the welds.

**903.07.08.01.04 Repaired Welds**

Clause 903.07.08.01.04 of OPSS 903 is deleted in its entirety and replaced with the following:

All welds that have been repaired shall be visually inspected and shall undergo non-destructive testing performed by the Contract Administrator

**903.07.08.02 Non-Destructive Test Reports and Visual Inspection Reports**

Clause 903.07.08.02 of OPSS 903 is deleted in its entirety and replaced with the following:

Results from completed Visual Inspection Reports and Non-Destructive Test Reports will be provided upon request.

**903.07.08.03 Certificate of Conformance**

Clause 903.07.08.03 of OPSS 903 is deleted in its entirety.

**903.10 BASIS FOR PAYMENT**

**903.10.01 Supply Equipment for Installing Driven Piles - Item**
**Supply Equipment for Installing Caisson Piles - Item**
**Supply Equipment for Installing Displacement Caisson Piles - Item**

Subsection 903.10.01 of OPSS 903 is amended by deleting the second paragraph in its entirety and replacing it with the following:

For payment purposes, 50% of the work under this item shall be paid when the satisfactory performance of the equipment has been demonstrated to the Contract Administrator by the installation of 1% of piles.

Another 40% shall be paid by progress payments proportional to the work completed. The remaining 10% shall be paid on the satisfactory completion of the installation of piles.

**903.10.04 Failed Visual Inspection or Non-Destructive Testing of Welds**

Section 903.10 of OPSS 903 is amended by the addition of the following:

Costs associated with any required removals and replacement or repairs of defective welds, following the visual inspection or non-destructive testing, shall be the Contractor's responsibility at no additional cost to the Owner. No additional payment will be made for labour and equipment provided by the Contractor, and the Contractor will pay the Owner $500 for each weld requiring additional re-testing.

NOTES TO DESIGNER:

* Insert the following clauses and fill-in a Dynamic formula or High-Strain Dynamic Testing when a specified ultimate resistance is recommended by the Foundations Engineer.

**903.07.02.07.03.01 General**

Piles are to be driven to a specified ultimate resistance that shall be determined using the [Fill in Dynamic Formula, or High-Strain Dynamic Testing] at end of initial driving. If the specified ultimate resistance is not achieved, retap/restrike shall be conducted after initial driving as specified in the Contract Documents.

A Request to Proceed shall be submitted to the Contract Administrator after the design ultimate resistance is achieved.

The next operation shall not proceed until a Notice to Proceed has been received from the Contract Administrator.

**903.07.02.07.03.02 Driving to a Set**

The founding elevation shall be established by driving to a set determined in accordance with the dynamic formula specified in the Contract Documents or by the application of the wave equation analysis procedure that verifies the pile resistance. This set shall be established on the first pile of every ten piles driven in a pile group.

The other piles shall be controlled by the pile penetration rate in blows per millimetre that correlates to the set.

When new conditions, such as change in hammer size, change in pile size, or change in soil material occur, new sets shall be determined.

**903.07.02.07.03.03 Driving to Bedrock**

When driving piles to bedrock, the pile shall be adequately seated on bedrock without damaging the pile.

Where rock points are used, the rock points shall penetrate into the rock. Piles driven using rock points shall be driven to ensure adequate seating on the bedrock without damaging the pile.

Driving of piles on sloping bedrock shall be stopped when initial contact is made with the bedrock. The bedrock elevation shall be recorded. Driving shall then continue, commencing with energy of 10% of the maximum energy of the hammer. The pile shall be driven in sets of 20 blows at this energy until no penetration is observed. Twenty additional blows shall be applied, and, if no penetration is observed, the energy shall be increased by an additional 10% and the above procedure repeated.

Driving shall continue with these stepped increases in energy and with the same series of blows as described above, until the pile has been seated on the bedrock.

If unrealistic excessive penetration per blow is observed, driving shall be stopped, and this excessive penetration immediately reported to the Contract Administrator.

WARRANT: Always with OPSS 903, Construction Specification for Deep Foundations.

# CONSTRUCTION SPECIFICATION FOR PRESTRESSED CONCRETE - PRECAST GIRDERS

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## 909.01 SCOPE

This specification covers the construction requirements for fabrication, delivery, and installation of precast prestressed concrete girders with steel reinforcement.

### 909.01.01 Specification Significance and Use

This specification is written as a provincial-oriented specification. Provincial-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

### 909.01.02 Appendices Significance and Use

Appendices are not for use in provincial Contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner.

Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their Contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

## 909.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

**Ontario Provincial Standard Specifications, Construction**

OPSS 905 Steel Reinforcement for Concrete
OPSS 910 Stressing Systems for Post Tensioning
OPSS 919 Formwork and Falsework
OPSS 929 Abrasive Blast Cleaning - Concrete Construction

**Ontario Provincial Standard Specifications, Material**

OPSS 1002 Aggregates - Concrete
OPSS 1213 Hot Applied Rubberized Asphalt Waterproofing Membrane
OPSS 1302 Water
OPSS 1350 Concrete - Materials and Production
OPSS 1440 Steel Reinforcement for Concrete

**Ontario Ministry of Transportation Publications**

MTO Laboratory Testing Manual:
LS-407 Method of Test for Compressive Strength of Moulded Cylinders
LS-426 Method of Test for Compressive Strength of High Performance Concrete Cylinders
LS-432 Method of Test for Microscopical Determination of Air Void System Parameters in Hardened Concrete
LS-446 Method of Test for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration – For Precast Girders

Structural Manual

MTO Form:
PH-CC-322 Concrete Construction Report

**CSA Standards**

| | |
|---|---|
| A23.2-3C | Making and Curing Concrete Compression and Flexural Test Specimens * |
| A23.2-1D | Moulds for Forming Concrete Test Cylinders Vertically * |
| A23.2-9C | Compressive Strength of Cylindrical Concrete Specimens* |
| A23.2-14C | Obtaining and Testing Drilled Cores for Compressive Strength Testing* |
| A23.4-09 | Precast Concrete Material and Construction |
| G40.20/G40.21-04 | General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel |
| G189-1966 (R2003) | Sprayed Metal Coatings for Atmospheric Corrosion Protection |
| CAN/CSA S6-14 | 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) |
| W186-03 (R2007) | Welding of Reinforcing Bars in Reinforced Concrete Construction |

* [Part of A23.1-14/A23.2-14 - Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete]

**ASTM International**

| | |
|---|---|
| A 153-09 | Zinc Coating (Hot-Dip) on Iron and Steel Hardware |
| B 633-07 | Electrodeposited Coatings of Zinc on Iron and Steel |
| C 171-07 | Sheet Materials for Curing Concrete |
| C 403-08 | Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance |

**American Association of State and Highway Transportation Officials (AASHTO)**

M182-05 (2009) Burlap Cloth made from Jute or Kenaf and Cotton Mats

## 909.03 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 girders are cast.

**Bughole** means a small regular or irregular cavity resulting from entrapment of air bubbles in the surface of formed concrete during placement and consolidation.

**Cold Joint** means a joint or discontinuity resulting from a delay in placement of sufficient duration to preclude intermingling and bonding of the concrete.

**Cold Weather** means when the air temperature to which the girder is exposed is at or below 5 °C, or when the air temperature to which the girder is exposed is at or is likely to fall below 5 °C within 96 hours after completion of concrete placement. Temperature refers to shade temperature.

**Design Proposal** means a submission of proposed changes, when engineering design is required.

**Laitance** means a layer of weak and nondurable material on the surface of the concrete containing cement and fines from aggregates, brought by bleeding water to the top surface concrete.

**Lot** means all girders produced during a one-week period (seven consecutive days); or, if more than 4 girders are produced in seven consecutive days, a lot means every 4 girders produced consecutively. Girders of the same lot shall be manufactured by the same supplier, made from the same concrete mix design, for the same ministry Contract, and be of the same cross-section and type of precast concrete girder.

**Girder Type** means a girder differentiated by its cross-section shape such as box girder type (solid or voided), I-girder type (such as Nebraska University (NU) and Canadian Precast Prestressed Concrete Institute (CPCI)), or T-girder type.

**Indoor Precast Concrete Plant** means a building, which is a permanent structure, providing protection from sun, wind, and rain and which is temperature controlled, such that the temperature does not fall below 15 °C or exceed 30 °C.

**Post-Tensioning** means a method of prestressing in which tendons are tensioned after the concrete has reached a predetermined strength.

**Pour Line** means a visible delineation between two placements of concrete where the concrete from each placement is well-bonded to the other.

**Precaster** means the party who produces the girders.

**Prestressed Concrete** means reinforced concrete in which internal stresses have been initially introduced so that subsequent stresses resulting from dead load and superimposed loads are counteracted to a desired degree. This may be accomplished by pretensioning or post-tensioning.

**Pretensioning** means a method of prestressing in which strands are tensioned before the concrete is placed.

**Repair Proposal** means a submission when repairs to the girders are required.

**Strand** means a group of wires laid helically over a central core-wire.

**Sweep** means the lateral deviation from straightness of a girder with respect to its design centre line.

**Tendon** means a high strength steel element consisting of one or more wires, strands or bars; used to impart prestress to the concrete.

## 909.04 DESIGN AND SUBMISSION REQUIREMENTS

### 909.04.01 Design Requirements

#### 909.04.01.01 General

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

### 909.04.01.02 Permissible Changes from the Contract Drawings

#### 909.04.01.02.01 General

Changes from the Contract Drawings are permitted and may be implemented by the precaster, without prior approval from the Owner, provided they meet the requirements of this specification.

#### 909.04.01.02.02 Prestressing of Girders

The prestressing strand pattern may be adjusted to suit production requirements provided all changes meet the original design strength without adversely affecting other components of the structure. If the centre of gravity of the strands at the interior hold down closest to mid-span is within ± 10 mm of the original design, then one or more of the following adjustments shall be permitted provided that both the serviceability and ultimate limit states capacities are not adversely affected:

a) Provide additional strands with a lower jacking stress provided the total prestress force is within ± 2% of the original design.

b) Use of imperial strand spacing in lieu of metric, where 25 mm = 1” and 50 mm = 2”.

c) Addition of one hold-down per end is added towards the girder end at the same spacing as the original design.

d) One less hold-down per end when the hold-down closest to mid-span is deleted.

e) Increase or decrease the number of strands in each hold-down group.

f) Increase of vertical strand spacing between hold-down points from 25 mm up to 50 mm.

#### 909.04.01.02.03 Reinforcing of Girders

The stirrup projection may be adjusted from that shown on the original design, based on details such as the predicted camber, provided it meets the deck embedment range indicated elsewhere in the Contract Documents.

Spacing of stirrups around blockouts for diaphragms may be adjusted, provided the minimum spacing requirements of CAN/CSA S6 are satisfied, and up to two stirrups may be added in order to maintain the total reinforcement requirements.

#### 909.04.01.02.04 Other Design Details

Details limited to those below may be adjusted to suit production requirements, provided all changes meet the original design without adversely affecting other components of the structure:

a) Dowel holes and inserts may be adjusted vertically within ± 75 mm from the location shown on the original design to avoid any conflict with strands.

b) Undercut dimensions may be adjusted to accommodate the predicted camber.

c) Additional pockets and hardware for temporary bracing may be added.

d) Additional temporary post-tensioning or pre-tensioning for shipping and handling may be added provided they do not adversely affect the girders at any stage.

The production length of the girder may be adjusted to account for elastic shortening.

### 909.04.01.03 Temporary Bracing

Temporary bracing shall be installed at all substructure locations for I-girders at the time of installation to maintain stability.

Temporary bracing for girders shall be designed according to CAN/CSA S6 using a wind load specific for the location and having a return period of 10 years if the girders are to be permanently connected within the same construction season. If the girders are not to be permanently connected within the same construction season, subject to the Owner's approval, the return period to be used in the design shall be 25 years.

In no case shall temporary bracing be less than the minimum requirements specified in the Contract Documents.

## 909.04.02 Submission Requirements

### 909.04.02.01 Working Drawings

Three sets of fabrication Working Drawings, including supporting documentation, shall be submitted to the Contract Administrator at least 7 Days prior to commencement of fabrication of the girders, for information purposes only. Prior to making a submission, the design Engineer and the design-checking Engineer shall affix their seals and signatures on the Working Drawings verifying that the drawings are consistent with the Contract Documents.

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

The Working Drawings shall include the following information:

a) Girder details.

b) Prestressing reinforcing steel size, grade, location, and jacking force as required by the design.

c) Hold-down locations and forces.

d) Reinforcing steel schedules.

e) Lifting point locations.

f) Details and location of all temporary supports.

g) Strand release sequence.

h) Any changes to the Contract Drawings made according to the Permissible Changes from the Contract Drawings clause.

i) All other applicable details.

The supporting documents shall include the following information:

j) A letter signed and sealed by an Engineer listing all permitted changes made along with supporting calculations. The letter shall state that the changes have not adversely affected the girder capacities.

k) Handling and installation procedures, including calculations and lifting point locations.

l) Details of bracing installed to provide adequate support and stability to the girder during construction.

**909.04.02.02 Concrete Mix Design**

The Contractor shall be responsible for the concrete mix design and shall submit the concrete mix design to the Contract Administrator according to the Mix Design clause of OPSS 1350.

**909.04.02.03 Concrete Plant Certification**

The certificate verifying compliance of the plant with the certification requirements of the Canadian Standards Association (CSA) or CPCI, under the category Group B, Bridges as either subcategory B4 (Prestressed Deflected Strand Bridge Members) or subcategory B3 (Prestressed Straight Strand Bridge Members), as required for the work, shall be submitted to the Contract Administrator with the concrete mix design submission.

Copies of precast plant certification audit reports of CPCI or CSA, or both as applicable, and related documentation shall be submitted to the Owner upon request.

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

**909.04.02.04 Control of Concrete Temperature**

One week prior to the commencement of fabricating the girders, a description of the method for monitoring and effectively controlling the temperature of the concrete shall be submitted to the Contract Administrator, for information purposes only. The description shall include the method of controlling the concrete temperature during the curing and protection period.

**909.04.02.05 Precast Report**

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

a) List of girders in the shipment, including their ID number, lot number, and description.

b) The mill certificates for the strands, along with the elongation calculations based on the actual material properties specified in the mill certificate of the strands used in the work.

c) Record of the jacking force, elongations, and corrections.

d) Temperature records for formwork and steel at the time of concrete placement.

e) Temperature control records, including location of thermocouple wires.

f) Record of inspection of moist curing.

g) Summary of material test results for plastic concrete: air content, slump, and concrete temperature.

h) Summary of material test results for hardened concrete: transfer strength, confirmation of the projected 28-Day compressive strength. If test results are not available at the time of shipping, they may be submitted within 4 Business Days following completion of testing.

i) Summary of all measurements and inspections required by this specification, including the concrete cover, crack measurement summary, tolerances, and surveys for geometric control.

j) Documentation confirming that all repairable defects have been identified, evaluated, and repaired as detailed in the Repair of Defects and Deficiencies Repairable by Standard Methods clause.

k) A letter from the Quality Verification Engineer (QVE), giving the Contractor permission to proceed with the work. The letter shall state that the QVE has conducted an interim inspection and verified that the fabrication of girders and required testing have been carried out in general conformance with the sealed and signed Working Drawings, supporting documents, and Contract Documents.

l) When steam curing is used, test results indicating that time of initial set was determined, unless standard delay periods are used, according to the Steam Curing and Other Application of Heat clause.

**909.04.02.06 Design Proposals**

Five copies of the design proposal shall be submitted to the Contract Administrator for acceptance. The design proposals shall bear the seal and signature of the design Engineer and the design checking Engineer. The Contractor shall not proceed with the proposed changes until the design proposal has been accepted by the Contract Administrator.

The Contract Administrator shall provide a response within 10 Business Days of receiving the proposal.

## 909.05 MATERIALS

**909.05.01 Bearing Plate**

The bearing plate shall be according to CSA G40.20/G40.21, Grade 300W or greater.

Anchor studs shall be a headed type and be according to CSA W59 and shall be welded to the bearing plates prior to galvanizing.

All surfaces shall be hot dipped galvanized according to ASTM A153 or shall be zinc metallized according to CSA G189.

**909.05.02 Burlap**

Burlap shall be according to AASHTO M182, Class 4, and shall be free from substances that are deleterious to concrete. The burlap shall have no tears or holes.

**909.05.03 Concrete**

Concrete materials shall be according to the Materials section of OPSS 1350 with the following additions and amendments:

a) Compressive strength shall be as specified in the Contract Documents.

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) Rapid chloride permeability of concrete containing silica fume at 28 to 32 Days shall be equal to or less than 1,000 coulombs and rapid chloride permeability of all other concrete at 28 Days shall be equal to or less than 2,500 coulombs.

d) Aggregates shall be according to OPSS 1002. The nominal maximum size of coarse aggregate shall be 19.0 mm, except when a smaller nominal size is required in order to meet the requirements of CAN/CSA S6.

e) Slag aggregate shall not be used.

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

When self-consolidating concrete (SCC) is proposed to be used, it shall be subject to Owner approval prior to use. Where accepted for use, SCC shall be according to the Owner's requirements for self-consolidating concrete. A copy of the non-standard Special Provision can be obtained from the Materials Engineering and Research Office, Concrete Section.

**909.05.04 Concrete Sealers**

Concrete sealers shall be from the Owner's list of acceptable sealers.

**909.05.05 Elastomeric Coating**

Elastomeric coating shall be according to OPSS 1213.

**909.05.06 Formwork**

Formwork shall be fabricated steel, except for box girders of non-standard width for which wood forms may be used. All formwork shall be according to OPSS 919 and CAN/CSA A23.4. Forms shall be fabricated to meet the dimensional tolerances and finishes specified in the Contract Documents.

**909.05.07 Hardware**

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

The hold down device may be black steel; however, the surfaces of the hold down device located within 40 mm of the concrete surface shall be chromate coated over an electrodeposited coating of zinc according to ASTM B 633.

**909.05.08 Moisture Vapour Barrier**

The moisture vapour barrier shall be a white opaque polyethylene film according to ASTM C171 and shall not be less than 100 µm thick.

**909.05.09 Post-Tensioning Material**

Post-tensioning material, including grout, shall be according to OPSS 910.

**909.05.10 Proprietary Patching Materials**

Proprietary patching materials shall be from the Owner's List of Concrete Patching Materials. The list of proprietary patching materials shall be obtained from the Contract Administrator.

**909.05.11 Steel Reinforcement**

Steel reinforcement shall be according to OPSS 1440.

**909.05.12 Water**

Water used for curing, fog-misting, and steam curing of concrete, including presoaking of material for moist curing, shall be according to OPSS 1302.

## 909.06 EQUIPMENT

**909.06.01 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.

**909.06.02 Pretensioning and Post-Tensioning**

Pretensioning equipment shall be according to CSA A23.4. Post-tensioning equipment shall be according to OPSS 910.

**909.06.03 Thermocouples and Dataloggers**

Thermocouples and associated instrumentation shall have an accuracy of ± 1.5 °C, shall record temperatures at time intervals not exceeding 15 minutes and shall display the temperature.

## 909.07 CONSTRUCTION

**909.07.01 General**

The Contract Administrator shall be notified in writing at least 7 Days prior to commencement of fabrication.

Each girder shall be identified with a unique number and the date of casting within 24 hours of stripping forms. The information shall be marked on the girders and shall remain exposed and visible throughout the duration of construction. When the information is stencilled, indelible ink or paint shall be used.

**909.07.02 Precast Plant Certification**

Girders shall be fabricated by a plant certified by CSA or by CPCI under the category Group B, Bridges, as either subcategory B4 (Prestressed Deflected Strand Bridge Members) or subcategory B3 (Prestressed Straight Strand Bridge Members), as required for the work.

**909.07.03 Pretensioning**

Strands shall not be tensioned in the deflected position, unless the hold-down device used permits free movement of the strand and the use of the device has been tested by its manufacturer to ensure that the final stress along the full length of the strand is uniform.

**909.07.03.01 Strand Splicing**

Strands shall not be spliced within the concrete girder.

**909.07.04 Welding**

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

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

Welding within 3 m of the prestressing steel is not permitted unless the prestressing steel is fully encased in concrete that has reached the transfer strength specified in the Contract Documents. Welding equipment shall not use any components of the prestressing system or any component in contact with the prestressing system as an electrical ground.

**909.07.05 Steel Reinforcement**

The placement of steel reinforcement shall be according to OPSS 905, with the exception and/or addition of the placing tolerances listed below:

a) Vertical position of prestressing strands: + 5/-10 mm

b) Length of debond on prestressing strands: ± 50 mm

c) Projection of positive moment connection reinforcing steel at girder ends: ± 25 mm

d) Stirrup spacing: ± 15 mm when spacing is 100 mm or less
± 25 mm when spacing is greater than 100 mm
± 30 mm when spacing is 300 mm or greater

Under no circumstances shall reinforcement be inserted into plastic concrete.

**909.07.06 Placing of Sheaths and Anchorages**

When girders are to be post-tensioned, the sheaths and anchorages shall be placed according to OPSS 905 except that the placing tolerances shall be ± 5 mm at splice points and ± 10 mm elsewhere.

**909.07.07 Production of Concrete**

Production of concrete shall be according to the General, Temperature Control, Mixing Time and Mixing Rate, and Delivery sub-sections in OPSS 1350.

When there are multiple batches of concrete in a single ready-mix truck, hopper or other container, discharge times shall be measured from the time of introduction of water to cement for the first batch of concrete in the truck. Discharge of all concrete in the truck shall be completed within 1.5 hours, except when the air temperature exceeds 28 °C and the concrete temperature exceeds 25 °C, the discharge shall be completed within 1 hour.

**909.07.08 Placing of Concrete**

**909.07.08.01 General**

The method of transporting, placing, and consolidating the concrete shall be such as to prevent segregation.

Devices for placing and transporting concrete shall not be supported by the steel reinforcement.

Concrete shall be deposited within 0.5 m of the top of the reinforcement and 2.5 m horizontally of its final position.

Concrete shall be placed at a steady rate, such that a monolithic concrete is obtained without the formation of cold joints or pour lines.

When there is an interruption in placing concrete greater than 20 minutes, the top of the formwork shall be covered with wet burlap to maintain 100% relative humidity above the concrete. The Contract Administrator shall be notified of any interruption resulting in a cold joint. A proposal for remedial action shall be submitted to the Contract Administrator for approval by the Owner.

**909.07.08.02 Concrete Placing Restrictions**

All surfaces against which concrete is to be placed shall be free of standing water. Fresh concrete shall be protected from contact with rain or snow.

All debris shall be removed from the area where concrete is to be placed.

Ice and snow shall be removed from the area where concrete is to be placed. Deicing chemicals shall not be used. Any surface against which concrete is placed, including any existing concrete, steel reinforcement, structural steel, forms, or other surfaces shall be at a minimum temperature of 5 °C immediately prior to commencement of placing concrete.

The average temperature of the formwork, steel reinforcement or any other material against which concrete is to be placed shall not exceed 30.0°C, with no individual temperature exceeding 35.0 °C, and the maximum difference between the highest and lowest temperature measurement shall not exceed 10.0 °C. Average temperature shall be based on the average of a set of 10 temperature measurements, evenly spaced, along the formwork, steel reinforcement or other material against which concrete is to be placed. For formwork, five temperature measurements shall be made on each side of the formwork.

Temperature measurements shall be taken no more than 10 minutes prior to concrete placement, for each girder. Temperature measurements shall be made with a contact thermometer with an accuracy of ± 1 °C. Temperature measurements shall be recorded and included in the precast report.

**909.07.09 Consolidation**

Internal or external vibrators or both shall be used to thoroughly consolidate concrete, within 15 minutes of placing.

Concrete shall be thoroughly consolidated around all steel reinforcement.

Each layer of concrete shall be vibrated. Vibrators shall extend into the previous layer to produce a homogenous mixture at the layer interface and prevent the formation of pour lines or cold joints.

Vibration shall not be used to make the concrete flow or to spread the concrete more than 1.5 m from the point of deposit.

**909.07.10 Concrete Finishing**

The top surface of the girders, against which new concrete is to be placed, shall be intentionally roughened while the concrete is sufficiently plastic so that the depth of the indentations is at least 5 mm and the spacing is not greater than 15 mm.

All concrete surfaces against which new concrete is to be placed shall be clean, sound, and free from any loose particles and laitance.

The following surfaces shall be abrasive blast cleaned according to OPSS 929, prior to shipping the girders:

a) Top portion of girders containing laitance.

b) The portion of the sides and end of the girder against which new concrete is to be placed.

**909.07.11 Control of Temperature**

**909.07.11.01 General**

All necessary actions shall be taken to maintain temperatures within the specified limits. During the moist curing, moisture retention, and protection periods, the following temperature requirements shall be met:

a) The concrete temperature shall not exceed 70.0 °C.

b) The concrete temperature shall not fall below 10.0 °C before the concrete has reached 75% of the specified 28-Day compressive strength.

c) The temperature difference, as measured between thermocouples at the following locations, shall not exceed 20 °C:

   i) Internal concrete temperature and the corresponding surface concrete temperature.
   ii) Internal concrete temperatures at different locations within the girder.

d) The maximum cooling rate of concrete shall not exceed 15.0 °C per hour until the concrete is not more than 20.0 °C above the air temperature. Air temperature is temperature next to the concrete, within the curing enclosure.

**909.07.11.02 Temperature Monitoring and Records**

The concrete and air temperatures during the curing period and, if applicable, cold weather protection period shall be monitored and recorded. Thermocouples and dataloggers shall be used to measure and record temperatures for each girder produced.

Thermocouple wires shall be installed prior to placing concrete according to Table 3. Thermocouples for monitoring air temperature shall measure air temperature adjacent to the girder. Thermocouples used to monitor the surface concrete temperature shall be imbedded in the concrete within 5 mm of the surface. Thermocouples to monitor maximum internal temperature shall be placed at the locations where the concrete is expected to reach the highest temperature, according to Table 3.

Recording of concrete and air temperatures shall begin at the start of placement. The temperatures shall be recorded automatically at time intervals not exceeding 15 minutes until the end of the curing period and, if applicable, the end of the cold weather protection period. The dataloggers shall be left in place until the end of the monitoring period.

The Contract Administrator and any other Owner's representatives shall be provided access to verify temperature readings. If the datalogger does not have a digital display that allows the Contract Administrator to verify temperature, the Contractor shall provide the Contract Administrator with the necessary instruments to allow the Contract Administrator to verify thermocouple function and readings.

The temperature monitoring and recording system shall provide unalterable records of temperature during the recording period. Prior to use on the Contract, the temperature monitoring and recording system shall be confirmed, in writing, to be acceptable to the Owner.

A record of temperatures shall be prepared for each Day during the temperature monitoring period.

The record of temperatures, including a graphical plot of temperature versus time, shall be submitted to the Contract Administrator in the precast report. The format of the temperature plot shall be acceptable to the Owner.

**909.07.12 Curing**

**909.07.12.01 General**

Moist curing shall continue throughout the duration of the moist curing period. The moist curing period shall be 48 hours followed by a 48-hour moisture retention period, except for concrete containing silica fume which shall have a moist curing period of 7 Days.

Moist curing of exposed surfaces shall be applied within 2 to 4 m of concrete placement, except for girders produced in an indoor precast concrete plant and not containing silica fume; for such girders, exposed surfaces may be covered with moisture vapour barrier between concrete placement and concrete finishing, for the shortest practical time period and in no cases exceeding 40 minutes.

For all girders, after formwork is removed, formed surfaces shall be moist cured for the remainder of the 48-hour moist curing period, and no less than 24 hours.

**909.07.12.02 Moist Curing**

Moist curing shall be sufficient to keep all surfaces of the precast girder in a continuously wet condition, with no dry areas, by applying one or a combination of the following methods:

a) Curing with Burlap and Water

b) Curing with Water Mist

c) Steam Curing

d) Immersion

Records of moist curing shall be maintained and submitted according to the Precast Report clause.

Girders whose surfaces have not been kept in a continuously wet condition shall be rejected and replaced; the Contractor may submit a proposal for remediation subject to the approval of the Owner.

**909.07.12.02.01 Curing with Burlap and Water**

Burlap shall be pre-soaked by immersing it in water for a period of at least 24 hours immediately prior to placing. Two layers of burlap shall be applied to the surface of the concrete. Burlap strips shall overlap 150 mm.

The burlap shall be maintained in a continuously wet condition throughout the curing period by means of a soaker hose. The soaker hose shall be turned on as soon as possible, when running water will not cause damage to the concrete surface. The burlap shall be covered with a layer of moisture vapour barrier within 3 hours of placing of the concrete, in a manner that shall prevent deformation of the surface of the concrete.

Air flow in the space between the burlap and the girder shall be prevented.

Water shall not be allowed to drip, flow or puddle on the concrete surface until the concrete has hardened sufficiently to resist damage.

### 909.07.12.02.02 Steam Curing and Other Application of Heat

Application of steam may be used.

The girder shall be heated evenly. Steam, heat or forced air shall not be directed on the concrete, forms or reinforcing steel. There shall be free circulation of steam, heat and forced air around the top, sides, and ends of the girder. Concrete surfaces shall not be exposed to combustion gases during the curing cycle.

There shall be a delay period prior to application of steam or heat above 30 °C, as follows:

a) Delay period of four hours after completion of concrete placement if the mix does not contain a retarder.

b) Delay period of six hours after completion of concrete placement if the mix contains a retarder.

A shorter delay period may be used if it has been demonstrated to the satisfaction of the Owner that initial set occurs earlier. Time of initial set shall be demonstrated by testing according to ASTM C403, using the same mix design, mixing equipment, concrete temperature, and ambient temperature as when producing the girders. Time of initial set testing shall be done in the presence of the Contract Administrator or the Owner's representative. Time of initial set testing shall be done before production. Demonstration of the time of initial set according to ASTM C403 may be required up to two times per year, upon request by the Contract Administrator.

### 909.07.12.03 Moisture Retention

After completion of the moist curing period, girder surfaces shall be completely covered by moisture vapour barrier to protect girders from moisture loss for a period of 48 hours.

Alternatively, moist curing methods may be continued during this period.

### 909.07.13 Cold Weather Protection Period

If cold weather conditions are present at the end of the curing period and moisture retention period, the girders shall be provided with protection from cold weather and moisture loss for an additional 24 hours, prior to exposure to cold weather conditions. Protection shall be extended beyond 24 hours if required to meet the requirements in the Control of Temperature subsection.

### 909.07.14 Exposure

During moist curing, moisture retention and cold weather protection periods, the girder may be exposed for a maximum total period of 1 hour per day for the purposes of formwork removal, release of strands at transfer strength, removal from the bed, filling of bug holes, inspection or relocation within the plant, except for indoor precast concrete plants, where the exposure period shall not exceed 2 hours per day.

During the exposure period:

a) The requirements in the Control of Temperature subsection do not apply.

b) There shall be no more than 3 consecutive thermocouple measurements of surface temperature below 10 °C, and none below 5 °C, when measured at 15 minute intervals at locations according to Table 3.

On the first day only of the moist curing period, the moist curing requirements do not apply during the 1-hour exposure period, or 2-hour exposure period for indoor plants, except for concrete containing silica fume, where continuous moist curing shall be applied throughout the exposure period.

**909.07.15 Transfer of Prestressing Force**

The prestressing force shall not be transferred to the girders until the transfer strength specified in the Contract Documents has been reached. The prestressing force shall be transferred according to the strand release sequence specified on the Working Drawings.

**909.07.16 Treatment at Ends of Girders**

The prestressing strands at ends of girders that are to be encased in concrete shall be cut off 25 mm beyond the ends of the beams. The prestressing strands at the end of girders that are not to be encased in concrete shall be cut back to recess the cable 25 mm from the end of girder. The recess shall be cleaned, filled with a proprietary patching material, and the ends of the girders coated with elastomeric coating.

**909.07.17 Surface Finish**

**909.07.17.01 General**

Concrete surfaces shall not be treated with cement slurry or paste.

Bugholes with a depth less than or equal to 5 mm and a maximum dimension at the surface of 50 mm do not require repair.

Surface defects and deficiencies with dimensions according to Table 2 are repairable by standard methods according to Table 2.

A repair proposal shall be submitted to the Contract Administrator to repair surface defects and deficiencies with dimensions greater than those listed in Table 2.

**909.07.17.02 Exposed Surfaces**

The appearance of the concrete and repairs shall be uniform in colour, pattern, and texture when viewed from a distance of 15 m. Care shall be taken to select material, including proprietary patching materials, to achieve uniformity of colour and appearance.

All projections, such as fins and bulges, and all blemishes, such as stains and rust marks, shall be removed.

**909.07.18 Sampling and Testing of Plastic Concrete**

Sampling and testing of the plastic concrete for slump, air content, and temperature shall be according to OPSS 1350. The results of these tests shall be recorded. The minimum frequency of testing shall be as follows:

a) For concrete supplied by an external concrete supplier and delivered by a ready-mix truck, once for each of the first three trucks, until satisfactory control is established, and then once every third truck.

b) For batches of concrete produced at the precast plant and transported by a ready-mix truck, once for each of the first three trucks, until satisfactory control is established, and then once every third truck

c) For batches of concrete produced at the precast plant, and not delivered by a truck, once for each of the first five batches of concrete, until satisfactory control is established, and then once every fifth batch.

Satisfactory control is established when three or five consecutive tests of concrete, as specified above, are within the specified requirements, without adjustments. If any adjustments are required or conducted, testing shall continue until three or five consecutive tests, as specified above, meet the requirements with no adjustments. Satisfactory control shall be established each Day.

Testing of plastic concrete shall be carried out as close as possible to the location of discharge of concrete into the formwork.

Sampling and testing of slump, air content, and temperature of plastic concrete, and casting of cylinders for determination of compressive strength 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.

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

**909.07.19 Transfer Strength**

Prior to transfer of the prestressing force, it shall be demonstrated that the transfer strength specified in the Contract Documents has been achieved. The Contractor, when requested by the Owner, shall participate in standard cylinder correlation strength testing programs conducted by the Owner.

**909.07.20 Concrete Cover Measurement**

The Contractor shall carry out, at the precaster's facility, a cover meter survey on all girders until satisfactory control is established. For each type, design and size of girder, satisfactory control shall be established when three consecutive girders of the same design are within the specified tolerances. After satisfactory control has been established, testing shall be carried out on every fifth girder. If testing indicates that cover measurements for a girder do not meet the tolerances specified in Table 1, testing shall resume on each girder until satisfactory control is re-established.

Readings shall be taken at locations 600 mm from both ends, at mid-span, and at intervals not exceeding 5 metres along the length of the girder.

For I-girders, readings shall be taken at each location, as detailed below:

a) Top of web, both sides.

b) Bottom of web, both sides.

c) Mid-height of each side of bottom flange for CPCI-Girders, and on top of each side of bottom flange, 150 mm from the edge of the flange for NU girders.

d) Underside of girder, located at 150 mm from both edges of flange.

For box girders, readings shall be taken at each location, as detailed below:

a) Top of web, exterior sides.

b) Bottom of web, exterior sides.

c) Underside of girder, located at 400 mm from both edges of flange.

**909.07.21 Dimensional Measurements**

The Contractor shall carry out measurements on each girder to determine compliance with tolerance requirements. Girders shall meet the tolerances specified in Table 1.

**909.07.22 Access for Quality Assurance**

Electrical power, scaffolding, protection from the weather, and unhindered access for inspection and testing of all fabrication, delivery, and installation of girders shall be provided to the Contract Administrator or Owner's representative.

For the purposes of cover meter and dimensional measurements, all debris and obstructions shall be removed.

**909.07.23 Delivery**

The Contract Administrator shall be notified in writing 3 Business Days prior to delivery of the girders.

Delivery shall include transportation and storage of the girders. Transportation and storage of the girders shall be according to CAN/CSA A23.4. The delivery shall include loading of the girders, transportation, unloading, and storage at the storage site.

Girders shall be loaded for shipping in such a manner that they can be transported and unloaded at their destination without being damaged or exposed to stresses for which they were not designed.

Girders shall be handled and transported with their webs in a vertical plane, and the points of support during loading and unloading, lifting, storing, and transporting shall be according to the Working Drawings.

Girders, when stored, shall be stored in such a manner to avoid excessive stress or other damage.

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

**909.07.24 Installation**

The Contract Administrator shall be notified in writing of the installation date at least 3 Business Days prior to the commencement of field installation operations. Installation shall be according to the Working Drawings.

The work shall consist of installation and stabilization of the girders during construction. Girders shall be lifted and placed in a manner to ensure they are not overstressed, unstable, or unsafe at any time.

A copy of the Working Drawings shall be kept on the site during installation of the girders.

The installation tolerance of girders shall be ± 15 mm on the bearing in both the longitudinal and transverse directions.

For box girders placed side-by-side, accumulated tolerance differences shall be distributed equally along the width of the structure. The maximum accumulated increase or decrease in total width of the girders shall not exceed 70 mm with 35 mm maximum on either side.

The forces resulting from the lifting devices acting on the girders shall not be inclined to the vertical at an angle greater than 30 degrees. All lifting devices for girders shall be removed or cut off to maintain the specified cover prior to placement of concrete in the deck.

I-girders and other girders that may experience stability problems during construction shall be braced individually by attaching each end to the substructure, as a minimum, immediately upon installation and according to the Working Drawings.

**909.07.25 Repair of Defects and Deficiencies Repairable by Standard Methods**

Any individual girder having one or more of the defects and deficiencies identified in Table 2 shall be repaired according to the repair method specified. Such repairs do not require proposals or Owner approval. Where more than one of the defects or deficiencies listed in Table 2, excluding bugholes, are located in the same area in the girder, a repair proposal shall be submitted. All causes, preventative actions, and corrective actions, including repair methods and materials used, shall be documented and submitted in the precast report.

**909.07.25.01 Assessment of Repair**

When defects or deficiencies occur, at the discretion of the design Engineer, a visual inspection may be conducted or other measures required, such as cores to be taken to assess the effectiveness of the repairs.

The filling of core holes shall be according to OPSS 1350.

**909.07.26 Certificate of Conformance**

Within 5 Business Days of installing all the girders within a stage, a Certificate of Conformance sealed and signed by a Quality Verification Engineer shall be submitted to the Contract Administrator. The Certificate shall identify the girders and state that the work has been carried out in general conformance with the signed and sealed documents, which include the Working Drawings, supporting documents, and Contract Documents.

**909.07.27 Material Sampling for Acceptance Testing**

**909.07.27.01 Sampling of Steel Reinforcement**

Samples of steel reinforcement shall be provided to the Owner according to OPSS 905 when requested.

If required, samples shall be delivered to:

Head, Concrete Section
Ontario Ministry of Transportation
145 Sir William Hearst Avenue, Room 15
Downsview, Ontario, M3M 0B6

**909.07.27.02 Sampling of Water, Admixtures, and Cementing Materials**

When requested by the Owner, samples of all cementing materials, admixtures, and water shall be obtained and delivered for testing by the Owner. If required, samples of admixtures and water shall be delivered to the Regional Quality Assurance laboratory and samples of cementing materials shall be delivered to:

Head, Concrete Section
Ontario Ministry of Transportation
145 Sir William Hearst Avenue, Room 15
Downsview, Ontario, M3M 0B6

**909.07.27.03 Sampling of Hardened Concrete for Acceptance Testing**

**909.07.27.03.01 General**

Test specimens shall consist of cylinders cast from plastic concrete for determination of compressive strength and cores removed from completed girders for determination of air void system parameters of hardened concrete and rapid chloride permeability. Test specimens shall be delivered to the designated laboratory for testing by the Owner.

Girders shall be sampled on a lot basis according to Table 4 of this specification.

**909.07.27.03.02 Cylinders for 28-Day Compressive Strength Testing**

Sets of cylinders, as defined in Table 4, shall be cast for 28-Day compressive strength testing by the Owner.

All concrete test cylinders shall be cast in new, single-use moulds conforming to the requirements of CSA A23.2-1D and made of plastic, with a lid. The lids shall be chemically and physically compatible with the concrete and shall provide watertight closure for the moulds.

Concrete test cylinders shall be cast, cured, and transported to the designated laboratory according to CSA A23.2-3C with the exception that cylinders shall be cured with the girder prior to delivery to the laboratory. Cylinders shall be delivered to the laboratory for demoulding.

Test information shall be recorded on MTO form PH-CC 322. A copy of the form shall be submitted with each set of the concrete cylinders along with a transmittal form and the Form A of the concrete mix design for the girder.

**909.07.27.03.03 Coring**

The number of cores removed from a girder shall be according to Table 4.

Cores shall be removed at the plant or on site when the girder is between 7 to 10 Days of age. Cores shall be removed in the presence of the Contract Administrator or Owner's representative. The girder from which core samples shall be taken shall be randomly selected from the lot by the Contract Administrator.

Coring shall be carried out according to CSA A23.2-14C. Cores shall not contain reinforcement or other embedded material. A covermeter capable of detecting the type(s) of reinforcing materials in the girder shall be used to establish the location of reinforcement and other embedded material prior to coring.

Cores shall be taken from locations selected by the Contract Administrator as follows:

a) For I-girders, cores shall be from the middle quarter of the girder length, in the upper half of the web, outside of the flange area.

b) For box girders, cores shall be taken at random locations of the top slab.

The Contract number, lot number, and girder identification number shall be marked legibly on each core with durable ink. Each core shall be placed in a plastic bag, sealed to prevent loss of moisture, fitted with a security tag by the Contract Administrator. Cores shall be transported to the designated laboratory within 24 hours of coring with a transmittal form and the Form A of the concrete mix design for the girder. Cores shall be transported in a manner to avoid damage.

The core holes shall be filled, within 3 Days, according to the Filling of Core Holes subsection of OPSS 1350, with concrete or a proprietary patching material from the Owner's pre-qualified products list.

Concrete used to patch core holes shall have comparable properties to that of the concrete used in the girder.

### 909.07.28 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

## 909.08 QUALITY ASSURANCE

### 909.08.01 General

The acceptance of girders shall be according to the requirements of this specification, including satisfactory completion of all repairs, if applicable. Girders not meeting the requirements of the Contract Documents shall be deemed unacceptable and shall not be included in the Work.

Acceptance for compressive strength, air void system parameters, and rapid chloride permeability shall be on a lot basis. Lot size, of the lesser of either 7 consecutive Days' production or 4 consecutively produced girders, shall be confirmed with the Contract Administrator prior to commencing production.

For Contracts requiring high-volume production, the use of a larger lot size may be proposed, up to a maximum of 20 girders per lot produced over no more than 7 consecutive Days, and shall be subject to the approval of the Owner. The established lot size shall remain consistent for the duration of the Contract

### 909.08.02 Lot Size and Samples for Compressive Strength, Air Void System, and Rapid Chloride Permeability

Acceptance of 28-Day compressive strength shall be based on testing of cylinders.

Acceptance testing of air void system and rapid chloride permeability shall be performed on cores removed from the girders. Testing of cores for air void system shall commence when the sample is delivered to the designated laboratory.

The sample type and size, and number of samples per lot shall be according to Table 4.

### 909.08.03 Acceptance of Concrete Compressive Strength

Compressive strength of cylinders, for acceptance, shall be determined according to LS-426 for concrete with silica fume and high strength concrete, and according to LS-407 for all other concrete.

#### 909.08.03.01 Basis of Acceptance

28-Day compressive strength of a lot shall be considered acceptable when it meets all of the following:

a) The average of the set of three cylinder compressive strengths shall be equal to or greater than the specified 28-Day compressive strength.

b) No individual cylinder test shall be more than 4.0 MPa below the specified 28-Day compressive strength.

Unacceptable lots shall be rejected and replaced.

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

**909.08.03.02 Referee Testing of Compressive Strength**

Referee testing of compressive strength may only be invoked by the Contractor within 5 Business Days of receipt of the acceptance test result.

Referee testing of compressive strength shall be carried out on a set of three cores taken by the Contractor from the girder which the acceptance cylinders represent. The Contractor shall remove the cores in the presence of the Contract Administrator. The cores shall be 100 mm in diameter and 220 mm long or full depth, whichever is less. The core extraction shall be according to the Coring subsection of this specification, with the exception that if the girders have not been delivered to the construction site, coring shall take place at the precast plant in the presence of the Contract Administrator. Referee cores shall be obtained and transported to the referee laboratory designated by the Owner within 3 Business Days of invoking referee testing.

The referee laboratory shall be designated by the Owner based on the applicable roster and cores shall be tested according to CSA A 23.2-9C on moisture conditioned cores.

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, the acceptance test result is confirmed, and the acceptance test result shall be used in the determination of acceptance of the lot. 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 the referee test result shall replace the acceptance test result in the acceptance requirements of this specification. 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.

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

**909.08.04 Acceptance of Air Void System in Hardened Concrete**

Testing of air void system shall be according to LS-432. One half of the sample shall be tested to determine the acceptability of the lot. The other half of the sample shall be retained by the Owner for audit purposes.

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

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

Lots with samples with a spacing factor greater than 0.200 mm and less than or equal to 0.250 mm shall be considered unacceptable and shall be repaired according to Table 2.

Lots with samples with a spacing factor more than 0.250 mm or air content less than 3.0 % shall be rejected and replaced.

**909.08.04.01 Referee Testing of Air Void System in Hardened Concrete**

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

**909.08.05 Acceptance of Rapid Chloride Permeability**

Cores shall be tested for rapid chloride permeability according to LS-446. Three 50-mm long test specimens shall be prepared for each core:

a) One specimen shall be tested immediately after the core is delivered to the laboratory. Results shall be provided to the Contractor for information purposes as they become available.

b) Two specimens shall be tested between 28 and 32 Days of age to determine acceptance of the lot. The acceptance test result for the lot shall be the average of the two 50-mm long samples tested between 28 and 32 Days of age. The test result shall be used to determine the acceptance of the lot.

Lots with rapid chloride permeability less than 2,500 coulombs are considered acceptable. Lots with a rapid chloride permeability result greater than 2,500 coulombs and less than or equal to 3,500 coulombs shall be considered unacceptable but with the agreement of the Owner may be permitted to remain in the Work with a payment adjustment. The payment adjustment shall be calculated according to the Basis of Payment section.

Lots with rapid chloride permeability results exceeding 3,500 coulombs shall be rejected and replaced.

For concrete lots containing silica fume, rapid chloride permeability less than 1,000 coulombs are considered acceptable. Lots containing silica fume with a rapid chloride permeability result greater than 1,000 coulombs and less than or equal to 2,000 coulombs shall be considered unacceptable but, with the agreement of the Owner, may be permitted to remain in the Work with a payment adjustment. The payment adjustment shall be calculated according to the Basis of Payment section.

Lots containing silica fume with rapid chloride permeability results exceeding 2,000 coulombs shall be rejected and replaced.

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

**909.08.05.01 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 for rapid chloride permeability shall be carried out on a new core taken by the Contractor from the same girder from which the acceptance sample was obtained. A core for referee testing shall be removed in the presence of the Contract Administrator, for each disputed lot, at a location no more than 1 meter from the location from which the disputed acceptance core was removed. The core shall be 100 mm in diameter and 220 mm long or full depth, whichever is less. The core extraction shall be according to the Coring subsection of this specification. Referee cores shall be obtained and transported to the referee laboratory designated by the Owner within 3 Business Days of invoking referee testing.

The referee laboratory shall be designated by the Owner based on the applicable roster and cores shall be tested 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, the acceptance test result is then 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 then not confirmed, and the referee test result shall replace the acceptance test result in the acceptance requirements of this specification.

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.

**909.08.06 Acceptance of Water, Admixtures, and Cementing Materials**

Acceptance of water, admixtures and cementing materials shall be according to OPSS 1350.

**909.08.07 Acceptance of Concrete Temperature**

Girders that meet the temperature requirements of this specification during production, the curing period, and, if applicable, the cold weather protection period, are considered acceptable. Girders that do not meet one or more of the temperature requirements of this specification are considered unacceptable and shall be rejected and replaced.

Each girder for which the highest temperature has been maintained below 65.0 °C during the moist curing, moisture retention, and protection periods and which meets all other requirements of the Contract Documents shall be eligible for a payment bonus. The bonus shall be $1,000 for each girder, up to a maximum of $10,000 in total for all of the girders in a single structure. A girder which is rejectable or fails to fully meet the requirements of the Contract Documents shall not be eligible for a bonus.

**909.08.08 Acceptance of Surface Finish**

All girders meeting the surface finish requirements of this specification shall be considered acceptable. A proposal may be submitted by the Contractor for unacceptable surface finish, according to the All Other Defects and Deficiencies section of this specification, subject to the approval of the Owner.

**909.08.09 Dimensional Verification and Concrete Cover Measurements**

The Contract Administrator shall carry out measurements to confirm compliance with the requirements of Table 1.

If a girder fails to meet the requirements specified in Table 1,

a) It shall be rejected and replaced, and

b) A consultant shall be retained by the Owner, at the Contractor's expense, to verify all other girders are within the tolerances of Table 1.

If a girder fails to meet the dimensional tolerances in Table 1, it shall be rejected and replaced; the Contractor may submit a proposal for remediation or for use of the girder, subject to the approval of the Owner.

**909.08.10 Defects and Deficiencies**

**909.08.10.01 General**

Defects and deficiencies are classified as follows:

a) Defects and deficiencies repairable by standard methods.

b) Defects and deficiencies causing rejection.

c) All other defects and deficiencies.

**909.08.10.02 Defects and Deficiencies Repairable by Standard Methods**

Any individual girder having one or more of the defects and deficiencies listed in Table 2 shall be deemed unacceptable and the girder shall be repaired according to Table 2. When more than one of the defects or

deficiencies listed in Table 2 is located in the same area in the girder, the Contractor shall be required to submit a repair proposal for acceptance according to the All Other Defects and Deficiencies clause.

**909.08.10.03 Defects and Deficiencies Causing Rejection**

A girder having any one of the following defects and deficiencies shall be rejected and replaced:

a) If concrete temperature exceeds 70 °C at any time during the curing period.

b) For I-girders, if there is honeycombing, voids, cavities, spalls, delaminations, or cracks in the concrete within a bearing surface area defined by the contact area of the bearing plus 30 mm on all sides, except when the bearing area of the girder is fully encased in concrete.

c) For box girders, if there is honeycombing, voids, cavities, spalls, or delaminations in the concrete within a bearing surface area defined by the contact area of the bearing plus 30 mm on all sides, except when the bearing area of the girder is fully encased in concrete.

d) If there is a crack in the bottom flange that extends through to the opposite face, unless the entire crack is located at the end of the girder and will be fully encased in concrete.

e) If breakage of strand wires exceeds the limit permitted in CAN/CSA A23.4.

f) If the sweep of the girder on site and in position without any intermediate bracing is in excess of 1.5 mm/m length of girder.

g) If cover does not meet specified requirements except as indicated in the All Other Defects and Deficiencies section of this specification.

**909.08.10.04 All Other Defects and Deficiencies**

The Contractor shall submit a proposal for repair or remediation to the Contract Administrator for acceptance, when,

a) A girder has defects or deficiencies that are not identified as rejectable or included in Table 2 in the list of defects and deficiencies repairable by standard methods; or

b) More than one of the defects or deficiencies listed in Table 2, except for bugholes, are located in the same area in the girder; or

c) Three occurrences of the same defect are present in the girder; or

d) There is the presence of pour lines or cold joints; or

e) Unacceptable surface finish; or

f) The compressive strength of the lot is lower than specified, but not lower than 4 MPa below the specified strength; or

g) Dimensional tolerances of the girder do not meet the requirements of this specification; or

h) Failure to maintain moist curing has occurred.

The repair proposal, signed and sealed by an Engineer, shall include, as a minimum,

a) Description of the girder 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 defects on durability, structural adequacy, and integrity of the girder or on the structure.

d) A detailed repair plan, including material, 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 girder shall be met.

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

If the repair proposal is deemed acceptable, the girder shall be repaired according to the proposal. The Contractor shall not carry out any repairs without the prior acceptance of the proposal by the Contract Administrator. If the repair proposal is deemed unacceptable, the girders shall be rejected and replaced.

In addition, the repair proposal shall be signed and stamped by an Engineer, including, as a minimum, assessment of any impact on the durability, structural adequacy, and integrity of the girder or on the structure, of either low or high cover, and submitted to the Contract Administrator for acceptance, when,

a) Low cover at soffit of girders at locations other than bearing cutouts: any cover readings less than 40 mm and greater than 35 mm.

b) High cover at soffit of girders at locations other than bearing cutouts: any cover readings less than 70 mm and greater than 60 mm.

c) High cover at all locations other than between bearing cutouts on soffit of girders: any cover readings less than 55 mm and greater than 45 mm.

For low cover at all locations except girder soffits between bearing cutouts, the girder may be sealed for cover readings between -5 mm and -10 mm of the specified cover, according to Table 2 of this specification.

If the Engineer's assessment is deemed acceptable by the Contract Administrator, the girders shall be accepted according to the Engineer's assessment. If deemed unacceptable, the girders shall be rejected and replaced.

## 909.10 BASIS OF PAYMENT

### 909.10.01 Prestressed Concrete Girders (Type) Fabrication - Item<br>Prestressed Concrete Girders Containing Silica Fume (Type) 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.

Rejected girders shall be replaced at no additional cost to the Owner.

Girders 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 girders.

**909.10.02 Payment Adjustment for Rapid Chloride Permeability**

The payment adjustment shall be calculated based on individual lots and applied as follows:

Payment adjustment = lot quantity x (C-2500)/5

Where:

| | | |
|---|---|---|
| Payment adjustment | = | payment adjustment of a lot ($) |
| C | = | rapid chloride permeability of a lot (coulombs) |
| Lot quantity | = | volume of concrete in a lot ($m^3$) (calculated based on plan dimension) |

The payment adjustment for concrete containing silica fume shall be calculated based on individual lots and applied as follows:

Payment adjustment = lot quantity x (C-1000)/5

Where:

| | | |
|---|---|---|
| Payment adjustment | = | payment adjustment of a lot ($) |
| C | = | rapid chloride permeability of a lot (coulombs) |
| Lot quantity | = | volume of concrete in a lot ($m^3$) (calculated based on plan dimension) |

**909.10.03 Prestressed Concrete Girders (Type) Delivery - Item**
**Prestressed Concrete Girders Containing Silica Fume (Type) Delivery - 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.

**909.10.04 Prestressed Concrete Girders (Type) Installation - Item**
**Prestressed Concrete Girders Containing Silica Fume (Type) 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 1**
**Tolerances**

| Item | Tolerances |
|---|---|
| Length:<br>Straight-line measurement taken horizontally at the mid-height of girder | ± 1.0 mm/m; not to exceed ± 25 mm maximum |
| Overall Depth | ± 8 mm for depths up to 600 mm<br>± 12 mm for depths over 600 mm |
| Flange Depth and Web Width for Girders Without Voids | Flange depth ± 5 mm<br>Web width -5/+10 mm |
| Flange Depth and Web Width for Girders With Voids | Flange depth ± 10 mm<br>Web width ± 10 mm |
| Width:<br>Flanges and Box Girders | ± 10 mm |
| Sweep:<br>I-girders, spaced box girders, and spaced hollow slab girders<br>Abutting box and hollow slab girders | 1 mm/m length of girder.<br><br>± 10 mm |
| Squareness and Plumbness | 1 in 200 maximum |
| Camber Difference:<br>Between adjacent girders spaced apart<br>Between adjacent girders placed side-by-side | <br>25 mm<br>15 mm |
| Hold-Down Position Along Length | ± 300 mm |
| Void and Diaphragm Position Along Length | ± 25 mm |
| Concrete Cover Over Steel Reinforcement | Unless otherwise specified in the Contract Documents, the tolerance for concrete cover over steel reinforcement shall be -5/+15 mm |
| Stirrup Projection | -10/+15 mm |

**TABLE 2**
**Defects and Deficiencies Repairable by Standard Methods**

| Repairable Defects and Deficiencies | Condition | Repair Method |
|---|---|---|
| Bugholes | Bugholes with depth greater than 5 mm and all dimensions at the surface not exceeding 25 mm, or<br>depth less than or equal to 5 mm and any dimension at the surface greater than 50 mm and not exceeding 100 mm. | a) Prior to filling bugholes, surfaces shall be blasted with high pressure water to remove any weak or loose material.<br>b) Bugholes shall be filled with a proprietary patching material placed and cured according to the manufacturer's instructions. |
| Honeycombing, Voids, Cavities, Spalls, and Delaminations | Any area less than an equivalent area of 300 x 300 mm with no reinforcing steel or strand exposed.<br><br>Cumulative total area of this type of repair shall not exceed 10 % of each face of the girder. | a) Square all sides of the repair area.<br>b) Saw cut perimeter of removal area to a depth of 10 mm or to the depth of reinforcing steel or strands, whichever is less.<br>c) Remove all loose concrete using a chipping hammer or hand tools.<br>d) Insert corrosion resistant wire mesh and anchors.<br>e) Abrasive blast-clean all concrete surfaces to be patched according to OPSS 929.<br>f) Remove all dust and loose material from the prepared surface by using compressed air.<br>g) Moisten area to be repaired.<br>h) Fill repair area with concrete or a proprietary patching material.<br>i) Cure concrete according to moist curing requirements of this specification. Cure proprietary patching material according to the manufacturer's recommendations. |
| Low Cover (all girder surfaces except girder soffits between bearing cutouts) | Low cover readings between -5 mm and -10 mm of the specified cover. | The entire surface of the girder shall be sealed, with an acceptable sealer, except areas against which new concrete is to be placed or in contact with bearings. Where sealing of an exterior girder is required all exterior girders in the same line of girders shall be sealed for consistency of appearance. |
| Air Void System Parameters | Any lot with spacing factor greater than 0.200 mm, but less than or equal to 0.250 mm. | The entire surface of all the girders of the lot shall be sealed, with an acceptable sealer, except areas against which new concrete is to be placed or in contact with bearings. Where sealing of an exterior girder is required, all exterior girders in the same line of girders shall be sealed for consistency of appearance. |
| Sweep | Sweep greater than 1.0 mm /m length but less than or equal to 1.5 mm/m length. | Push or pull the girders to within tolerance. Girders that can be brought into tolerance and maintained at that position without visible signs of distress shall be accepted. Girders greater than or equal to 1,900 mm in depth shall be pulled or pushed at both the top and bottom flange. |

**TABLE 3**
**Concrete and Air Temperature Measurements**

| Temperature | Location of Thermocouple for Concrete and Ambient Temperature |
|---|---|
| Internal | • I-Girders:<br>  ○ Centroid of bottom flange at mid-span (1), for maximum temperature<br>  ○ Middle of web, 1 m from each end of the girder (2)<br><br>• Box Girders:<br>  ○ Mid-depth at the centroid of solid section at each end of the girder (2), for maximum temperature<br>  ○ Middle of bottom slab at mid-span (1) |
| Surface | • For each internal thermocouple above, a corresponding thermocouple shall be installed at the closest adjacent concrete surface. This thermocouple shall be imbedded in the concrete within 5 mm of the surface of the concrete (3) |
| Air Temperature | • Air temperature next to the concrete within the enclosure at each end of the girder (2) |
| Note: Number of thermocouples shown above in parentheses, total for each girders = 8 | |

**TABLE 4**
**Sampling for Acceptance Testing**

| Element Type | Sample Type and Size | Number of Samples per Lot |
|---|---|---|
| Prestressed Precast Girders | Cylinders<br>100 mm diameter and 200 mm long | One set of 3 cylinders for 28-Day compressive strength. The girder for which the cylinders shall be cast shall be randomly selected from the Lot.<br>(for acceptance testing) |
| | Cores*<br>100 mm diameter<br>220 mm long or full depth, whichever is less | One set of 2 cores, for acceptance testing of air void system parameters (1) and rapid chloride permeability (1). |

***** Cores to be taken from a single girder in the Lot

**Appendix 909-A, November 2016**
**FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS**

**Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.**

## Designer Action/Considerations

No information provided here

## Related Ontario Provincial Standard Drawings

No information provided here.

**AMENDMENT TO OPSS 909, NOVEMBER 2016**

Special Provision No. 109S24 January 2025

**909.04 DESIGN AND SUBMISSION REQUIREMENTS**

**909.04.01 Design Requirements**

**909.04.01.01 General**

Clause 909.04.01.01 of OPSS 909 is amended by the addition of the following:

The jacking force shall be calculated to achieve the theoretical prestressing force in the strand, immediately prior to transfer, as specified on the Contract Documents.

In determining the jacking force, losses due to chuck slip, bed shortening and bulkhead rotation, including abutment tilt, temperature variation, deflected strand friction, sequential strand stressing, and initial relaxation of strand prior to transfer shall be included. Deflected strand friction may be taken as nil where pin rollers are used at the bulkheads (hold-ups) and swivel pin roller devices are used at hold-down locations. Relaxation loss need not to be taken as greater than 15 MPa. During jacking, the strand may be stressed up to 0.80 fpu.

**909.04.02.05 Precast Report**

Clause 909.04.02.05 of OPSS 909 is deleted in its entirety and replaced with the following:

**909.04.02.05 Manufacturer's Certificate of Conformance and Precast Report**

A MTO form PH-CC-821, Manufacturer's Certificate of Conformance and a precast report shall be submitted to the Contract Administrator for each shipment of girders at least 5 Business Days prior to shipping from the precasting plant.

The precast report shall contain the following information:

a) List of girders in the shipment, including their ID number, lot number, and description.

b) The mill certificates for the strands, along with the elongation calculations based on the actual material properties specified in the mill certificate of the strands used in the work.

c) Summary of all measurements and inspections carried out prior to concrete placement to verify compliance with the Contract Documents including reinforcement placement, hold-down positions and other pre-pour checks.

d) Record of the jacking force, elongations, and corrections.

e) Temperature records for formwork and steel at the time of concrete placement

f) Temperature control records, including location of thermocouple wires and graphical plots verifying that neither the maximum temperature limit or maximum allowable temperature difference have been exceeded.

g) Record of inspection of moist curing.

h) Summary of material test results for plastic concrete: air content, slump, and concrete temperature.

i) Summary of material test results for hardened concrete: transfer strength, confirmation of the projected 28-Day compressive strength. If test results are not available at the time of shipping, they may be submitted within 4 Business Days following completion of testing.

j) Summary of all measurements and inspections required by this specification, including the concrete cover, crack measurement summary, tolerances, and surveys for geometric control.

k) Documentation confirming that all repairable defects have been identified, evaluated, and repaired as detailed in the Repair of Defects and Deficiencies Repairable by Standard Methods clause.

l) When steam curing is used, test results indicating that time of initial set was determined, unless standard delay periods are used, according to the Steam Curing and Other Application of Heat clause.

A MTO form PH-CC-701, Request to Proceed shall be submitted to the Contract Administrator before the delivery of each shipment of girders to the site.

The girders shall not be delivered to the site until the Contract Administrator has received the Manufacturer's Certificate of Conformance, the precast report, Request to Proceed, and issued a MTO form PH-CC-702, Notice to Proceed.

**909.07 CONSTRUCTION**

**909.07.06 Placing of Sheaths and Anchorages**

Clause 909.07.06 of OPSS 909 is amended by the addition of the following:

When debonding of strands are specified in the Contract Documents, only rigid unsplit polymer sheathing shall be used. Soft flexible split plastic sheathing shall not be permitted.

**909.07.26 Certificate of Conformance**

Subsection 909.07.26 is deleted in its entirety and replaced with the following:

**909.07.26 Inspection after the Installation of the Girders**

A MTO form PH-CC-701, Request to Proceed shall be submitted to the Contract Administrator, for each structure, after the installation of all girders within a construction stage.

The next operation shall not proceed until a MTO form PH-CC-702, Notice to Proceed has been received from the Contract Administrator.

**909.08 QUALITY ASSURANCE**

**909.08.10 Defects and Deficiencies**

**909.08.10.04 All Other Defects and Deficiencies**

Clause 909.08.10.04 of OPSS 909 is amended by is amended by deleting point h) in its entirety and replacing it with the following:

h) Failure to maintain moist curing has occurred; or

i) Has horizontal or inclined cracks in the web, where the maximum width of crack is greater than 0.2 mm but less than 0.3 mm.

Horizontal or inclined cracks in the web, where the maximum width of crack is less than 0.2 mm, shall not be considered a defect or deficiency.

WARRANT: Always with OPSS 909, Construction Specification for Prestressed Concrete - Precast Girders.

# CONSTRUCTION SPECIFICATION FOR MODULAR BRIDGE STRUCTURES FOR TEMPORARY INSTALLATIONS

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## 918.01 SCOPE

This specification covers the requirements for the design, supply, construction, maintenance, and removal of modular bridge structures used for temporary installations, including ramps, bank seats, decking, sidewalks, and railings.

### 918.01.01 Specification Significance and Use

This specification is written as a provincial-oriented specification. Provincial-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

### 918.01.02 Appendices Significance and Use

Appendices are not for use in provincial Contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

## 918.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

**Ontario Provincial Standard Specifications, Construction**

OPSS 501 Compacting
OPSS 906 Structural Steel for Bridges
OPSS 907 Structural Wood Systems
OPSS 908 Metal Traffic Barriers and Metal Railings for Structures

**Ontario Provincial Standard Specifications, Material**

OPSS 1601 Wood, Preservative Treatment, and Shop Fabrication

**Ontario Ministry of Transportation Publications**

Structural Manual

**CSA Standards**

CSA S6-14 Canadian Highway Bridge Design Code

## 918.03 DEFINITIONS

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

**Bank Seats** means mud sills, timber matting and other components to support the base plates and ramps.

**Modular Bridge** means a superstructure comprised of commercially available standard proprietary prefabricated components that can be assembled and disassembled on site.

**Temporary Installation** means an installation that maintains traffic at a construction site for a length of time not exceeding three years.

## 918.04 DESIGN AND SUBMISSION REQUIREMENTS

### 918.04.01 Design Requirements

The modular bridge structure shall be designed according to the Contract Documents, CAN/CSA S6 and the Structural Manual except that:

a) The following requirements of the CAN/CSA S6 are not mandatory:

i. Traffic lane widths, side clearance, and sidewalks.
ii. Deck crossfall and drain outlets.
iii. Limitation of maximum deflection.
iv. Designing floor beam and diaphragms for jacking.
v. Provision of a protective coating.
vi. Fatigue.
vii. Accessibility for inspection and coating, the avoidance of pockets, and the provision of drain holes in pockets and their filling with waterproofing.
viii. Camber.
ix. Provision of two bolts at the end of bracing members.
x. Nuts with safety pins or snap rings may be used instead of hexagonal recessed nuts or hexagonal solid nuts with washers.

b) In addition to the requirements of CAN/CSA S6, a minimum of three girders or two pairs of trusses shall be used to form the main load carrying system of the bridge.

### 918.04.02 Submission Requirements

#### 918.04.02.01 Working Drawings, Procedures & Certifications

The following documents, bearing the seal and signature of a design Engineer and a design-checking Engineer, shall be submitted to the Contract Administrator at least 7 Days prior to commencement of the installation of the modular bridge, for information purposes only:

a) Working Drawings of the modular bridge.

b) Launching, installation and removal procedures.

c) A letter and design calculations certifying that the modular bridge has been designed according to the Contract Documents.

d) Where modular bridge components are fabricated outside of Canada, a letter shall be submitted certifying that the materials used, and the fabrication of the modular bridge components are according to the Contract Documents.

e) Where the load carrying capacity of the modular bridge or any of its components has been established by testing, the load test reports provided by the manufacturer of the modular bridge shall be submitted confirming the bridge satisfies the requirements of the Evaluation Section of CAN/CSA S6, using a Reliability Index (β) not less than 3.75.

Where previously used components are utilized in the modular bridge, a letter signed and sealed by an Engineer shall be submitted certifying that all used components are in good structural condition and free from any damage or defects that could adversely affect their load carrying capacity and performance.

When other authorities are involved in the approval of the design or construction of the modular bridge, 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 of each authority shall be satisfied prior to commencement of the work.

**918.04.02.02 Notice of Installation**

A written notice shall be submitted to the Contract Administrator at least 7 Days prior to the installation of the modular bridge superstructure.

## 918.05 MATERIALS

**918.05.01 General**

All materials and components shall be according to the Working Drawings.

**918.05.02 Modular Bridge Components**

All modular bridge steel components shall be fabricated according to the requirements of OPSS 906.

The use of modular bridge components that have been used previously is permitted provided they are free from damages or defects that could adversely affect their load carrying capacity and performance.

**918.05.03 Hardware**

The hardware used in the assembly and installation of the modular bridge shall be according to the modular bridge manufacturer's requirements.

**918.05.04 Structural Steel**

Any structural steel components that are not part of the modular bridge shall be designed and constructed according to OPSS 906.

**918.05.05 Wood**

Wood shall be according to OPSS 1601. Preservative treatment of wood is not required. Fasteners and hardware for wood construction shall be according to OPSS 907.

### 918.05.06 Railings

Railings shall be according to OPSS 908 or an equivalent modular bridge manufacturer railing system.

## 918.07 CONSTRUCTION

### 918.07.01 General

Documentation indicating that the modular bridge Superintendent who shall be in charge of the installation of the modular bridge has had experience and has successfully performed these duties on at least 3 similar bridges shall be submitted to the Contract Administrator at least 7 Days prior to installation of the modular bridge.

### 918.07.02 Construction of Bank Seats

Fill under bank seats shall be compacted according to OPSS 501 to a minimum of 95% of the maximum dry density.

### 918.07.03 Installation and Removal of Modular Bridge

The modular bridge, including bank seats, shall be assembled, installed, and removed according to the Working Drawings, procedures and Contract Documents.

### 918.07.04 Certificate of Conformance

Upon the completion of construction of the modular bridge, a Certificate of Conformance bearing the seal and signature of a Quality Verification Engineer shall be submitted to the Contract Administrator. The certificate shall state that the modular bridge has been constructed in general conformance with the Working Drawings, procedures and Contract Documents.

### 918.07.05 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

### 918.07.06 Modular Bridge Maintenance

For the duration of the Contract, excluding seasonal shutdown, the modular bridge, including bearings, bank seats, ramps, decking, sidewalks, railing, approaches, and substructure elements shall be inspected, and have any deficiencies corrected, to ensure its structural integrity, safety and performance are not compromised.

## 918.10 BASIS OF PAYMENT

### 918.10.01 Temporary Modular Bridge - Item

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

For payment purposes, the construction of the modular bridge shall constitute 50% of the work of the tender item.

**AMENDMENT TO OPSS 918, APRIL 2017**

Special Provision No. 109S27 March 2018

**918.07 CONSTRUCTION**

**918.07.04 Certificate of Conformance**

Subsection 918.07.04 of OPSS 918 is deleted in its entirety and replaced with the following:

**918.07.04 Inspection after the Completion of the Construction of the Modular Bridge Structure**

A Certificate of Conformance shall be submitted to the Contract Administrator upon the completion of construction of the modular bridge structure.

WARRANT: Always with OPSS 918, Construction Specification for Modular Bridge Structures for Temporary Installations.

# CONSTRUCTION SPECIFICATION FOR STRUCTURE REHABILITATION-CONCRETE REMOVAL

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## 928.01 SCOPE

This specification covers the requirements for the removal of concrete from existing structures, except by means of pressurized water, hydrodemolition, in order to facilitate structure rehabilitation.

### 928.01.01 Specification Significance and Use

This specification is written as a provincial-oriented specification. Provincial-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.

### 928.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

## 928.02 REFERENCES

When the Contract Documents indicate that provincial-oriented specifications are to be used and there is a provincial-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.PROV, unless use of a municipal-oriented specification is specified in the Contract Documents. When there is not a corresponding provincial-oriented specification, the references below shall be considered to be to the OPSS listed, unless use of a municipal-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

**Ontario Provincial Standard Specifications, Construction**

OPSS 905 Steel Reinforcement for Concrete

**CSA Standards**

CAN/CSA S6-06 Canadian Highway Bridge Design Code

## 928.03 DEFINITIONS

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

**Certificate of Conformance** means a document issued by the Quality Verification Engineer confirming that the specified components of the Work are in general conformance with the requirements of the Contract Documents.

**Concrete Crusher** means a piece of equipment fitted with a hydraulic attachment, such as a scissor type jaw, used for the removal of concrete.

**Concrete Removal - Full Depth** means concrete removals that typically apply to full or partial length removals of entire thickness of curbs, sidewalks, medians, wingwalls, concrete barrier walls and parapet walls, ballast walls, and approach slabs. This also applies to localized removals extending the full thickness of slab decks and culverts.

**Concrete Removal - Partial Depth, Type A** means concrete removals that typically apply to the top surface of decks, including removals over round voids in post tensioned structures; sidewalks; curbs; and culvert and tunnel floor slabs and the top and inside faces of concrete barrier and parapet walls.

**Concrete Removal - Partial Depth, Type B** means concrete removals that typically apply to deck soffit and fascia of bridge decks, soffit of the top slab of culverts and tunnels, girders, diaphragms, and outside face of concrete barrier walls and parapet walls.

**Concrete Removal - Partial Depth, Type C** means concrete removals other than the ones specified for Concrete Removal - Partial Depth, Type A and Type B, and typically apply to abutments, wingwalls, pier columns and caps, bearing seats, retaining walls, and vertical walls of culverts and tunnels.

**Concrete Removal Sequence** means a specified order of concrete removals within a stage to ensure structural adequacy, stability, and integrity throughout construction.

**Concrete Removal - Structural Component** means concrete removals that typically apply to full or partial length removals of entire thickness of decks, girders, diaphragms, pier columns, and pier caps that have an impact on the structural adequacy, stability, and integrity of a structure.

**Engineer** means a professional engineer licensed by the Professional Engineers Ontario to practice in the Province of Ontario.

**Layer - Reinforcing Steel** means two or more reinforcing bars placed in a plane parallel to a concrete face.

**Mat - Reinforcing Steel** means two layers of reinforcing steel, in different directions, tied together.

**Quality Verification Engineer (QVE)** means an Engineer retained by the Contractor qualified to provide the services specified in the Contract Documents.

**Rehabilitation** means any modification, alteration, or improvement to a structure or its components that is designed to correct defects or deficiencies.

**Reinforcing Steel** means deformed steel bars used in the reinforcing of concrete and includes splice bars.

**Scarifying** means the removal of concrete from the top surface of a structure, to a specified depth achieved by the milling action of cutting teeth fitted to a rotating head.

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

**Structure** means any bridge, culvert, tunnel, retaining wall, wharf, dock, guideway, or any part thereof or other reinforced concrete component designed to carry loads, including high mast pole footings and sign support footings.

## 928.04 DESIGN AND SUBMISSION REQUIREMENTS

### 928.04.01 General

The Contractor shall meet all design and submission requirements from other authorities, as specified in the Contract Documents. The requirements of these authorities and the Owner shall be satisfied before commencement of concrete removals.

**928.04.02 Design Requirements**

The structural design and evaluation shall be carried out according to CAN/CSA S6.

The design assumptions for structural design and evaluation shall accurately represent the condition of the structure during construction, including the effect of concrete removals on load distribution and member resistance, support location and restraints, construction loads and construction staging, and shall be based on the existing structure drawings.

The weights of construction equipment shall be based on the manufacturer's specifications. The minimum dynamic load allowance for rig-mounted breakers and concrete crushers shall be 0.4. The load factors for construction live loads shall be the same as for highway live loads.

**928.04.03 Submission Requirements**

**928.04.03.01 Access to Work Areas, Platforms, and Scaffolding**

When access to work areas, work platforms, and scaffolding are to be provided, the Contractor shall submit to the Contract Administrator detailed drawings, for information purposes, prior to the installation.

**928.04.03.02 Working Drawings**

The Contractor shall submit 3 sets of Working Drawings to the Contract Administrator at least 7 Days prior to the commencement of the concrete removals, for concrete removal, complete deck and concrete removal, structural component, for information purposes only. The Contractor shall have a copy of the Working Drawings on site at all times while the work is being carried out.

All Working Drawings shall contain the following:

a) Layout and description of concrete removal sequences and temporary supports.

b) Clearances at existing and proposed structures.

c) The locations, loadings, and detailed descriptions of heavy equipment and vehicles to be supported on existing structures.

d) Seal and signature of the design Engineer and design check Engineer employed or retained by the Contractor, and a statement certifying that based on the existing drawings of the structure that the serviceability limit state and ultimate limit state requirements of CAN/CSA S6 are satisfied when any one or more of the following are proposed by the Contractor:

    i. Existing structures supporting rig-mounted breakers, concrete crushers, cranes, any other heavy equipment, and vehicles that would induce higher load effects than normal traffic on a structure.
    ii. Removal sequence different from the one specified in the Contract Documents or when the Contract Documents do not specify a removal sequence.

e) Identify stages of work that require interim inspection by the Quality Verification Engineer (QVE) for the safe execution of concrete removal, such as:

    i. Installation of temporary support.
    ii. Installation of temporary protection for traffic, pedestrians, and property.
    iii. Structural strengthening or modification.
    iv. Removal of existing dead load or earth pressure, or both.

**928.04.03.03 Concrete Removal Equipment**

The Contractor shall submit identification of equipment and the manufacturer's published specifications for all concrete removal equipment to be used to the Contract Administrator, at least 7 Days prior to the commencement of the concrete removal operation.

**928.04.03.04 Saw Cutting Details**

When it is intended to cut full thickness through a concrete component by the use of sawing equipment, the Contractor shall submit saw cutting details to the Contract Administrator, at least 7 Days prior to the intended commencement of the saw cutting operation. The details shall include the following:

a) Depth and location of sawcuts.

b) Method used to prevent any contact with components that are to remain in place.

c) Method of collecting and managing the effluent from the saw cutting operation.

**928.04.03.05 Traffic and Pedestrian Protection**

Unless otherwise specified in the Contract Documents, the Contractor shall submit a description of the traffic and pedestrian protection plan to the Contract Administrator, at least 7 Days prior to the commencement of the concrete removal operations.

**928.06 EQUIPMENT**

**928.06.01 Air Hammers**

Air hammers shall be hand-held and meet the following requirements:

a) Chipping hammers shall have a maximum weight of 9.0 kg prior to any handle modification and a maximum piston stroke of 102 mm.

b) Jack hammers shall have a maximum weight of 14.0 kg.

c) All hammers shall have the manufacturer's name and part or model number engraved on them by the manufacturer. All information must be clearly legible.

The manufacturer's published specifications shall be the sole basis for determining weight and piston stroke.

**928.06.02 Rig-Mounted Breakers**

Rig-mounted breakers using pneumatically driven equipment shall only be fitted with a moil point and produce a maximum energy of 1,000 Joules per blow as per manufacturer's specification.

**928.06.03 Sawing Equipment**

The sawing equipment shall be capable of sawing the concrete along the lines and to the depths specified in the Contract Documents.

**928.06.04 Scarifiers**

Equipment used for scarifying shall be capable of removing a minimum of 6 mm of concrete from the top surface of the structure in one pass.

The maximum weight of a scarifier used on bridge decks shall not exceed 26 tonnes.

**928.06.05 Straight Edges**

Two commercially made metal straight edges, 1.5 m and 3 m in length, shall be supplied.

## 928.07 CONSTRUCTION

**928.07.01 General**

Concrete shall be removed to the depth and demarcated boundaries as specified in the Contract Documents or as directed by the Contract Administrator.

Upon completion of the concrete removals in the demarcated areas, the Contractor shall notify the Contract Administrator for inspection of the removal areas. Additional areas of concrete removal identified by the Contract Administrator shall be removed as directed by the Contract Administrator.

**928.07.02 Access to Work Area, Work Platform, and Scaffolding**

Adequate access shall be provided to the work area, work platform, and scaffolding as required, for the following:

a) Concrete surveys by the Contract Administrator.

b) Inspection of work and measurement of the quantities by the Contract Administrator.

c) Quality Assurance and acceptance inspections by the Owner.

d) Performance of the Contractor's work, including concrete removals.

**928.07.03 Concrete Surveys**

**928.07.03.01 General**

The Contractor shall schedule operations so as to ensure there is no interference with the concrete surveys.

**928.07.03.02 Covermeter Survey**

The Contractor shall allow the Contract Administrator to carry out a bridge deck covermeter survey for all asphalt-covered decks when concrete removals from the top surface of the deck are specified in the Contract Documents.

The Contractor shall notify the Contract Administrator 24 hours prior to the commencement of the scarifying operation.

The covermeter survey shall be carried out as follows:

a) When the deck is specified to be patched, complete the survey after the waterproofing is completely removed from the top surface of the deck.

b) When an overlay is specified in the Contract Documents, complete the survey after the first pass of the scarifying equipment.

**928.07.03.03 Concrete Removal Surveys**

**928.07.03.03.01 General**

The Contractor shall submit a written notification to the Contract Administrator to carry out all applicable concrete removal surveys. The notification shall state that the Contractor has completed the work specified in the Work Requirements clause for the concrete removal surveys specified and has installed all accesses to the work area, including work platforms and scaffolding required by the Contract Administrator to carry out the surveys.

When the location and extent of removals are not completely defined in the Contract Documents, the Contract Administrator shall carry out one or both of the following concrete removal surveys as part of determining and demarcating the actual location and extent of removals:

a) Visual and Delamination Survey

   A visual and delamination survey shall be carried out for all concrete removals.

   When a structure has an existing overlay that is not to be completely removed, the Contract Administrator shall carry out the delamination survey twice. The first survey shall be carried out on the top surface of the entire overlay. The second survey shall be carried out on the top surface of the original deck within the removal area, after the existing overlay has been removed.

   When a structure has an existing overlay that is to be completely removed, the Contract Administrator shall carry out the delamination survey after the overlay is completely removed.

b) Corrosion Potential Survey (Half-Cell)

   A corrosion potential survey shall be carried out on all surfaces when concrete is to be removed based on corrosion potential criteria when specified in the Contract Documents.

When full depth removals are specified in the Contract Documents, the concrete removal surveys on the top of the deck and soffit shall be completed to determine and demarcate the full depth concrete removal areas.

Concrete removals shall not proceed until all the applicable concrete surveys have been completed, reviewed, and written permission to proceed has been given by the Contract Administrator.

**928.07.03.03.02 Work Requirements**

Prior to the concrete removal surveys, the Contractor shall carry out all applicable work as follows:

a) Scarifying **-** Complete the scarifying operations.

b) Refacing with Uniform Concrete Removal - Complete the uniform removal of concrete.

c) Removal of Waterproofing, Asphalt, and Coatings - All existing waterproofing membrane, asphalt, and coatings shall be removed in such a way to prevent damage to the existing concrete surface.

d) Concrete Removal by Corrosion Potential - The Contract Administrator shall select two widely separated locations for each portion of the structure when the reinforcing steel is continuous. The reinforcing steel within these locations shall be exposed for a length of 150 mm and a clearance of 25 mm all around the bar.

Immediately prior to the commencement of the concrete removal surveys, all equipment shall be removed and all debris and standing water cleared from the surfaces to be surveyed.

**928.07.03.03.03 Time Requirements**

The time required by the Contract Administrator to complete the concrete removal surveys, including review of the surveys by the Owner, shall be as specified in Table 1 and shall commence upon receipt of the Contractor's written notification to carry out the concrete removal surveys. When the area of a structure exceeds the maximum area surveyed for the time period shown, the time period specified in Table 1 shall be extended on the basis of prorating the area, rounded up to the nearest Business Day.

The maximum time period required to complete the concrete surveys does not include any days of inclement weather or days when the air temperature is below 5 °C.

**928.07.04 Scarifying**

**928.07.04.01 General**

The portion of the structure to be scarified and the depth of scarifying shall be according to the Contract Documents.

Prior to scarifying, all sand and debris shall be removed from the top surface of the structure to be scarified. The maximum depth of scarifying in any one pass of the scarifying equipment shall be 10 mm. After the scarifying operation, areas of the structure not scarified to the specified depth shall be re-scarified until the specified depth is achieved.

When the specified depth of scarifying is greater than 10 mm, the Contractor shall allow the Contract Administrator a 24-hour period to complete the covermeter survey prior to commencing the second pass of the scarifying.

The portion of the curb face, barrier or parapet wall, and all existing concrete surfaces that have not been scarified against which new concrete is to be placed shall be uniformly roughened by means of scabbling, chipping hammer, or bushhammering. A surface profile of 5 mm $\pm$ 2 mm shall be achieved by exposing the aggregates across the entire surface.

All material resulting from the scarifying operation shall be removed from the deck immediately after each pass of the scarifying equipment.

**928.07.04.02 Protection of Reinforcing Steel**

The Contractor shall immediately notify the Contract Administrator of any exposed reinforcing steel visible on the concrete surface prior to and at any time during the scarifying operation. Operations shall be adjusted to avoid contacting the reinforcing steel with the scarifying equipment.

The Contract Administrator shall demarcate an area around any exposed reinforcing steel. The concrete shall be removed from within the demarcated area to the depth specified for the adjacent scarifying area using chipping hammers or as directed by the Contract Administrator.

Exposed reinforcing steel shall not be cut, removed, or damaged.

**928.07.05 Reinforcing Steel in Concrete Removal Areas**

When the cutting, bending, and removal of reinforcing steel is specified in the Contract Documents, the work shall be done as part of concrete removals. The cutting and bending of reinforcing steel shall be according to OPSS 905.

When the area of concrete removal with exposed reinforcing steel exceeds 2 $m^2$, the reinforcing steel shall be retied at every second intersection point and shall be supported to maintain the steel mat in its original location. Supports shall be placed as required and tied securely to the reinforcing steel according to OPSS 905.

**928.07.06 Equipment Restrictions**

**928.07.06.01 General**

Only equipment specified shall be permitted for the removal of concrete.

Construction equipment shall be permitted on the structure provided that all of the following conditions are met:

a) Contamination by oil or other deleterious substances shall be prevented. Contaminated concrete shall be removed according to the procedures specified in the Concrete Removal - Partial Depth Type A, B, and C clause.

b) Vehicles, runways, and equipment other than hand held equipment shall not be supported by reinforcing steel.

c) Heavy vehicles such as ready mix concrete trucks or dump trucks shall not be permitted on any portion of the deck, within a span, once concrete removals within the deck have commenced in that span.

**928.07.06.02 Concrete Removal - Partial Depth Types A, B, and C**

Only chipping hammers shall be used for all partial depth concrete removals.

**928.07.06.03 Concrete Removal - Complete Deck, Deck Joint Assemblies, Full Depth, and Structural Component**

**928.07.06.03.01 Sawing Equipment**

The use of sawing equipment, except for perimeter treatments of concrete removal areas shall not be permitted for the removal of concrete:

a) Within the lap length of reinforcing steel to remain in place.

b) Within 100 mm from the edges and faces of structural steel members and concrete components to remain in place.

Prior to making sawcuts in a concrete deck close to the areas of existing structural steel members and other components that are to remain, the concrete surface shall be delineated by a qualified surveyor to locate the underlying edges and the faces of structural steel members and other components so not to damage the structural steel members and other components while saw cutting the concrete as specified.

**928.07.06.03.02 Chipping Hammers**

The use of chipping hammers shall be permitted in all areas of concrete removal.

**928.07.06.03.03 Jack Hammers**

The use of jack hammers shall not be permitted for the removal of concrete:

a) For partial depth removals.

b) Within 100 mm from concrete to remain in place.

c) Within 25 mm of any reinforcing steel to remain in place.

d) Within 100 mm from the edges and faces of structural steel members to remain in place.

**928.07.06.03.04 Rig-Mounted Breakers**

The use of rig-mounted breakers shall not be permitted for the removal of concrete:

a) In concrete barrier and parapet walls, and deck slabs supported by concrete girders, unless the girders are to be removed.

b) In concrete barrier and parapet walls supported by steel beams, unless the deck slab is to be removed.

c) Within the deck joint assembly.

d) Located within a distance from concrete to remain in place equal to the sum of 600 mm and the specified lap length of reinforcing steel to remain in place.

e) Within 600 mm from the edge and faces of structural steel members including shear studs to remain in place.

**928.07.06.03.05 Concrete Crusher**

The use of a concrete crusher shall not be permitted for the removal of concrete:

a) Within 2 m of concrete to remain in place.

b) Within 1 m of reinforcing steel to remain in place.

c) Within 300 mm from the edge and faces of structural steel members, including shear studs to remain in place.

**928.07.07 Concrete Removal**

**928.07.07.01 General**

Concrete removal shall not be permitted within 1 m of newly placed concrete until the newly placed concrete has attained a compressive strength of 20 MPa.

Concrete shall be removed in such a manner to prevent damage to the concrete to remain in place and debonding of reinforcing steel beyond the demarcated removal area. Reinforcing steel, prestressing tendons, shear connectors, structural steel, Utilities, and all other components that are to remain in place shall not be damaged or loosened. Concrete debris shall be removed from the concrete removal area on an ongoing basis.

**928.07.07.02 Concrete Removal - Partial Depth Types A, B, and C**

**928.07.07.02.01 Perimeter Treatment of Concrete Removal Areas**

The perimeter treatment of a partial depth concrete removal area shall be prepared according to the rehabilitation method to be used as follows:

a) Concrete Overlay or Refacing - The perimeter of the removal area shall have a 1H:1V sloped face for the full depth of the removal area. The perimeter shall not be sawcut.

b) Shotcrete - Prior to carrying out concrete removal operations, the perimeter of the removal area shall be sawn to a depth of 10 mm or to the depth of the reinforcing steel, whichever is less. The perimeter of the removal area shall have a face perpendicular to the original concrete surface for the specified depth of the removal area.

c) Concrete Patches - Prior to carrying out concrete removal operations, the perimeter of the removal area shall be sawn to a depth of 25 mm or to the depth of the reinforcing steel, whichever is less. The perimeter of the removal area shall have a face perpendicular to the original concrete surface for the specified depth of the removal area.

**928.07.07.02.02 Depth of Concrete Removal Areas**

For existing concrete overlays to be patched, concrete shall be removed to the top surface of the original deck in the demarcated areas to allow the Contract Administrator to conduct a second delamination survey.

Concrete removal shall extend below the reinforcing steel within the boundaries demarcated by the Contract Administrator in the following areas:

a) The entire area of spalls and delaminations.

b) The areas of concrete components when corrosion potential of the reinforcing steel is more negative than minus 0.35 volts, as determined by the corrosion potential survey.

c) All areas of exposed reinforcing steel.

Concrete in these areas shall be removed to a uniform depth of 25 mm behind the first layer of reinforcing steel.

Concrete surrounding the second layer of reinforcing steel shall also be removed locally to provide a minimum clearance of 25 mm all around the reinforcing steel.

Concrete removal beyond the second layer of reinforcing steel shall be carried out only when directed by the Contract Administrator.

For all other concrete removals demarcated by the Contract Administrator, including scaling and honeycombing, concrete shall be removed as follows:

a) To sound concrete, when an overlay or refacing is specified in the Contract Documents.

b) To sound concrete for a uniform depth of at least 50 mm, when an overlay or refacing is not specified in the Contract Documents.

**928.07.07.03 Concrete Removal - Complete Deck, Full Depth, and Structural Component**

Prior to carrying out concrete removals, the perimeter of the demarcated removal area shall be sawn to a depth of 25 mm or to the depth of the reinforcing steel, whichever is less, except for localized full depth repairs in the deck.

Prior to carrying out the concrete removals for localized full depth repairs in the deck, the perimeter of the removal area on the top surface of the deck shall be sawn to a depth of 25 mm or to the depth of the reinforcing steel, whichever is less. After concrete removals from the top of the deck are completed, the perimeter of the removal area along the soffit shall be squared off by saw cutting to a depth of 25 mm or to the depth of the reinforcing steel, whichever is less. The concrete removals shall be completed from the soffit using chipping hammers.

**928.07.07.04 Concrete Removal - Deck Joint Assemblies**

The existing deck joint assemblies including joint filler materials and surrounding concrete shall be removed according to the requirements of this specification and the Contract Documents.

**928.07.08 Remedial Work**

The Contract Administrator shall be notified immediately in writing if any of the following work related defects are present along with an explanation of the cause and extent of the defect:

a) Damage to concrete beyond demarcated removal areas.

b) Damage to concrete not specified for removal and damage to reinforcing steel to remain in place.

c) Damage to structural steel and other components that are to remain in place.

d) Contaminated concrete.

e) Work that does not conform to the requirements of the Contract Documents.

All work related defects shall be repaired. A proposal for the remedial work to correct defects shall be submitted to the Contract Administrator for review. The Contractor shall not proceed with repairs until approval of the proposal has been received.

Repairs shall be made to the approval of the Contract Administrator.

**928.07.09 Certificate of Conformance**

A Certificate of Conformance shall be submitted by the Contractor upon completion of the designated concrete removal for each structural component and complete deck. The certificate shall be sealed, signed, and dated by the Quality Verification Engineer. The certificate shall state that the Work has been carried out in general conformance with the Working Drawings and the Contract Documents.

**928.07.10 Management of Excess Material**

Management of excess material shall be according to the Contract Documents.

## 928.08 QUALITY ASSURANCE

### 928.08.01 General

After the concrete removals are completed in the areas designated for removal, the work shall be inspected by the Contract Administrator to:

a) determine and demarcate any additional removals within and along the perimeter of the demarcated areas.

b) verify that the concrete has been removed to the depth and dimensions specified in the Contract Documents or as approved by the Contract Administrator.

c) identify any work related defects in the work.

All work related defects and deficiencies shall be corrected as outlined in the Remedial Work subsection.

### 928.08.02 Acceptance

The following work related defects are unacceptable and shall be subject to remedial work:

a) Damage to concrete beyond demarcated removal areas.

b) Damage to concrete not specified for removal and damage to reinforcing steel to remain in place.

c) Damage to structural steel and other components.

d) Contaminated concrete.

e) Work that does not conform to the requirements of the Contract Documents.

## 928.09 MEASUREMENT FOR PAYMENT

### 928.09.01 Actual Measurement

#### 928.09.01.01 Scarifying

Measurement of scarifying shall be by area in square metres of the structure surface area to be scarified.

Measurement shall not be made of the roughened portions of curb faces, concrete barrier and parapet walls or of areas that require a second scarifying due to the Contractor's method of operation.

The total area shall be calculated to the nearest 0.1 $m^2$.

#### 928.09.01.02 Concrete Removal - Partial Depth Types A, B, and C

##### 928.09.01.02.01 General

Measurement of partial depth concrete removal shall be by area or volume as specified in the Contract Documents.

##### 928.09.01.02.02 By Area

Measurement shall be of the area of concrete removed in square metres.

The total area shall be calculated to the nearest 0.1 $m^2$.

**928.09.01.02.03 By Volume**

Measurement for payment shall be of the volume of concrete removed for the depth specified or to the depth approved by the Contract Administrator.

Material removed locally 25 mm around the second layer of reinforcing steel shall not be measured. However, if the Contract Documents specify a uniform removal below the second layer of reinforcing steel, measurement for payment shall be of the volume of concrete removed to the specified depth.

After concrete removal is completed, verification of concrete removal depths shall be completed by the Contract Administrator on a grid system that best describes the profile at the particular area.

Measurement shall be taken by placing a straight edge across the removal area and measuring the distance from the straight edge to the top of the remaining concrete surface, as follows:

a) A minimum of three measurements for each removal area less than or equal to 1.0 $m^2$.

b) A minimum of ten measurements for every square metre for each removal area greater that 1.0 $m^2$.

The depths for each removal area shall be measured and averaged to the nearest millimetre.

The total volume shall be calculated to the nearest 0.1 $m^3$.

**928.09.01.03 Concrete Removal - Full Depth**

Measurement of the full depth concrete removal shall be by volume in cubic metres. Alternatively, full depth concrete removal may be a lump sum item.

The total volume shall be calculated to the nearest 0.1 $m^3$.

**928.10 BASIS OF PAYMENT**

**928.10.01 Scarifying - 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.

When exposed reinforcing steel necessitates concrete being removed from within the demarcated areas to the depth specified for the adjacent scarifying using chipping hammers, such work shall be paid as Extra Work.

**928.10.02 Access to Work Area, Work Platform, and Scaffolding - Item**
**Concrete Removal - Complete Deck - Item**
**Concrete Removal - Deck Joint Assemblies - Item**
**Concrete Removal - Full Depth - Item**
**Concrete Removal - Partial Depth Type A - Item**
**Concrete Removal - Partial Depth Type B - Item**
**Concrete Removal - Partial Depth Type C - Item**
**Concrete Removal - Structural Component - 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.

When the Contract does not contain a separate tender item for access to the work area, work platform and scaffolding, the Contract price for the concrete removal items shall include full compensation for all labour, Equipment, and Material to provide access to work area, work platform, and scaffolding.

Payment for the appropriate tender item Concrete Removal - Partial Depth Type A, Concrete Removal - Partial Depth Type B, or Concrete Removal - Partial Depth Type C or any combination of the three shall include full compensation for all labour, Equipment, and Material to remove concrete locally around the second layer of reinforcing steel to provide a minimum 25 mm clearance around the reinforcing steel.

When the replacement of corrosion damaged reinforcing steel is required, such work shall be paid as Extra Work.

Work related defects repaired as remedial work shall be completed at no extra cost to the Owner.

**TABLE 1**
**Time Requirements for Concrete Removal Surveys**

| Concrete Component | Maximum Area Surveyed Per Time Period $m^2$ | Time Period Business Days |
|---|---|---|
| Bridge deck surface, including sidewalks, concrete barrier, and parapet walls. | 3,000 | 3 |
| Bridge deck soffit, including fascias. | 1,500 | 3 |
| Abutments, wingwalls, and retaining walls. | 1,000 | 2 |
| Piers | 500 | 2 |
| Culverts | 500 | 2 |

**Appendix 928-A, April 2012**
**FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS**

**Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.**

**Designer Action/Considerations**

No information provided here.

**Related Ontario Provincial Standard Drawings**

No information provided here.

**AMENDMENT TO OPSS 928, APRIL 2012**

Special Provision No. 109S32 March 2018

**928.03 DEFINITIONS**

Section 928.03 of OPSS 928 is amended by the deletion of the definitions for Certificate of Conformance and Quality Verification Engineer.

**928.04 DESIGN AND SUBMISSION REQUIREMENTS**

**928.04.03.02 Working Drawings**

Clause 928.04.03.02 of OPSS 928 is amended by deleting point e) in its entirety and replacing it with the following:

e) Identify stages of Work that require inspection by the Contractor's Engineer for the safe execution of concrete removal, such as the installation of temporary support; and installation of temporary protection for traffic, pedestrians, and property.

A Request to Proceed shall be submitted to the Contract Administrator upon completion of the Working Drawings and prior to the concrete removal operation.

The concrete removal shall not proceed until a Notice to Proceed has been received from the Contract Administrator.

**928.07 CONSTRUCTION**

**928.07.09 Certificate of Conformance**

Subsection 928.07.09 of OPSS 928 is deleted in its entirety and replaced by the following:

**928.07.09 Inspection after Concrete Removal**

When the safe execution of concrete removal operation requires Work such as the use of temporary supports or temporary protection for traffic, pedestrians and property, a Certificate of Conformance shall be submitted immediately after installation to the Contract Administrator.

A Request to Proceed shall be submitted to the Contract Administrator upon completion of the designated concrete removal for the complete deck and each structural component. The next operation shall not proceed until a Notice to Proceed has been received from the Contract Administrator.

WARRANT: Always with OPSS 928, Construction Specification for Structure Rehabilitation - Concrete Removal.