

# **TENDER DOCUMENTS**

## **SUBSECTION 6.45 MODULAR TRUSS**

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## SUBSECTION 6.45 MODULAR TRUSS

### 6.45.1 GENERAL

- 6.45.1.1 This subsection describes the requirements relating to the fabrication and installation of modular truss under the prestressed girders of the Champlain Bridge covered by this Contract.
- 6.45.1.2 Any specific requirements pertaining to the modular truss work covered by this Contract are set out on the drawings and in Section 4 *Special Technical Conditions*.
- 6.45.1.3 The requirements relating to steelwork are described in subsection 6.41 *Steelwork*.
- 6.45.1.4 The requirements relating to painting are described in subsection 6.42 *Painting Work*.
- 6.45.1.5 The requirements relating to the construction of scaffolding, platforms and other temporary devices are described in subsection 6.15 *Temporary Structures*.

### 6.45.2 MEASUREMENT UNITS

- 6.45.2.1 The measurement units and respective symbols thereof used in this subsection are described as follows:

| Measurement Unit | Designation | Symbol |
|------------------|-------------|--------|
| length           | meter       | m      |
| length           | millimeter  | mm     |
| mass             | ton         | t      |
| stress, pressure | megapascal  | MPa    |

### 6.45.3 REFERENCE STANDARDS

- 6.45.3.1 The **Contractor** shall carry out the fabrication and installation of modular truss in accordance with the following standards and documents, to which the provisions of this Contract are added:

6.45.3.1.1 (ASTM) ASTM International:

- ASTM A123/A123M *Standard Specification for Zinc (Hot-Dip Galvanized) Coating of Iron and Steel Products;*
- ASTM A143/A143M *Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement;*
- ASTM A193/A193M *Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications;*

- ASTM A194/194M *Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both*;
- ASTM A325 *Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength*;
- ASTM A563 *Standard Specification for Carbon and Alloy Steel Nuts*;
- ASTM B22/B22M *Standard Specification for Bronze Castings for Bridges and Turntables*;
- ASTM F436 *Standard Specification for Hardened Steel Washers*.

6.45.3.1.2 (CSA) Canadian Standards Association:

- CAN/CSA S6 *Canadian Highway Bridge Design Code*;
- CAN/CSA W117.2 *Safety Rules for Welding, Cutting and Related Processes*;
- CAN/CSA W47.1 *Certification of Companies for Fusion Welding of Steel*;
- CAN/CSA W59 *Welded Steel Construction (Metal Arc Welding)*;
- CAN/CSA 3-Z299.3 *Quality Assurance Program – Category 3*.

6.45.3.1.3 (MTQ) Ministère des Transports de Québec:

- MTQ – *Cahier des charges et devis généraux (CCDG) - Construction et réparation*.

6.45.3.1.4 (SSPC) Steel Structures Painting Council:

- SSPC-SP 6/NACE n°3 – *Commercial Blast Cleaning*.

6.45.3.1.5 (FED-STD) US Federal Standard:

- FED-STD-595B *Colors Used in Government Procurement*.

## 6.45.4 MATERIALS

### 6.45.4.1 GENERAL

6.45.4.1.1 The steel plates shall be Grade 350WT, Category 3.

6.45.4.1.2 The WF sections shall be Grade 350WT, Category 3.

6.45.4.1.3 The angles and shims shall be Grade 350W or 350WT.

6.45.4.1.4 Steel plates having a thickness expressed in millimeters may be replaced by plates having an equivalent thickness in the imperial system. The difference between the thicknesses shall be less than 0.7 mm. The dimensions of the details shall be adjusted to take into account the changes in the thicknesses.

- 6.45.4.1.5 The bolts, anchor rods, nuts and washers shall comply with the requirements of subsection 6.41 *Steelwork*. Unless otherwise indicated on the drawings, the **Contractor** shall install a hardened washer under the turned part.
- 6.45.4.1.6 Threaded rods
- 6.45.4.1.6.1 Unless otherwise indicated on the drawings, the threaded rods shall comply with standard ASTM A193/A193M-12b, be Grade B7, with continuous threads.
- 6.45.4.1.6.2 The threaded rods shall be supplied with washers and nuts or double nuts, as indicated on the drawings. All nuts shall be large hexagonal heavy hex Type in accordance with standard ASTM A194/194M and be Grade 2H or in accordance with standard ASTM A563 and be Grade DH.
- 6.45.4.1.6.3 Unless otherwise indicated on the drawings, all washers shall comply with standard ASTM F436.
- 6.45.4.1.6.4 All threaded rods, nuts and washers shall be hot dip galvanized in accordance with standards ASTM A123/A123M and ASTM A143/A143M.
- 6.45.4.1.6.5 Each batch of threaded rods delivered to the worksite shall have an individual batch number and shall bear a label so as to make it possible to identify, with accuracy, each batch at the worksite and date of delivery thereof. All steel received at the worksite without identification will be rejected.
- 6.45.4.1.7 The products authorized under this Contract as zinc-rich shall comply with subsection 6.41 *Steelwork*.
- 6.45.4.1.8 Bearings
- 6.45.4.1.8.1 The bearings shall have an ultimate compressive strength of at least 69 MPa in accordance with the manufacturer's recommendations and shall be the product *Sorbtex Bearing Pad* by Voss Engineering Inc. or equivalent authorized by the Engineer.
- 6.45.4.1.9 Bronze bearings
- 6.45.4.1.9.1 The bronze shall comply with standard ASTM B22/B22M and shall be a C86300 or C91100 alloy.
- 6.45.4.1.9.2 The bronze bearings shall be self-lubricating with regular or trepanned cavities. The cavities shall be arranged in accordance with the pattern ensuring that the successive rows overlap in either direction. The total surface area of the cavities shall be 25% to 35% of the total bearing surface.

- 6.45.4.1.9.3 The lubricant used to fill the cavities shall be solid type and consist of graphite and metal lubricants with a lubricating agent. The use of materials that do not have lubricating qualities or qualities that promote electrolytic reactions is prohibited.
- 6.45.4.1.9.4 The lubricant shall be incorporated into the lubricating cavities under a hydraulic pressure of 85 MPa in order to form dense non-plastic insertions which shall protrude beyond the surface of the bronze bearing by at least 0.25 mm.
- 6.45.4.1.9.5 The bearing surfaces shall be machined and the roughness of the finished surface shall not exceed 3.175 µm for each plate.
- 6.45.4.1.9.6 The coefficient of friction between the bronze self-lubricating plate and the steel upper bearing plate shall not exceed 0.10 when subjected to the maximum load that the plate can sustain.
- 6.45.4.1.9.7 The bronze bearing plate shall be fixed to the underlying base by at least two (2) M16 countersunk head bolts. The fastening details shall be developed by the manufacturer or supplier of the bearings and indicated on the shop drawings.
- 6.45.4.1.10 Trunnions
  - 6.45.4.1.10.1 The trunnions shall be Grade AISI 4140.
- 6.45.4.1.11 Grading panels
  - 6.45.4.1.11.1 The galvanized expanded metal grating shall be 19 mm X 3 mm in size, made of hot rolled galvanized carbon steel and shall be the product *McNICHOLS GW 75A 2* manufactured by McNICHOLS, or equivalent authorized by the Engineer. The grating panels shall be fully supported along all four (4) sides.
- 6.45.4.1.12 Cementitious grout
  - 6.45.4.1.12.1 The cementitious grout shall comply with subsection 6.33 *Cast-in-Place Concrete*.
- 6.45.4.1.13 Epoxy adhesive
  - 6.45.4.1.13.1 The epoxy adhesive shall be the product *Sikadur 31 Hi-Mod Gel* manufactured by Sika Canada Inc. or equivalent authorized by the Engineer.
  - 6.45.4.1.13.2 The placement of the adhesive shall be carried out according to the manufacturer's recommendations.
  - 6.45.4.1.13.3 The epoxy adhesive shall be maintained at a temperature ranging from 20°C to 30°C for a period of twelve (12) hours after placement.

## 6.45.5 SHOP DRAWINGS

- 6.45.5.1 The **Contractor's** design engineer who signs and seals the shop drawings, procedures, methods and design notes shall be a member of the *Ordre des ingénieurs du Québec* (OIQ) and shall have a minimum of ten (10) years of relevant experience in structural steel design.
- 6.45.5.2 The **Contractor** shall prepare shop drawings that indicate the details of the steel components composing the modular truss and supports thereof and any other steel components to be supplied under this Contract including, without however being limited to, the bronze bearings, threaded rods and bearing pads.

## 6.45.6 EXECUTION OF WORK

### 6.45.6.1 GENERAL

- 6.45.6.1.1 All the measurements and dimensions provided on the existing bridge components that are indicated on the drawings shall be considered approximate. The **Contractor** shall conduct a detailed survey of the relevant components on the bridge in order to ensure that the modular truss, truss supports and all associated components are properly adjusted. The **Contractor** shall note that the existing dimensions of the pier caps and piers and the alignment of the anchors may vary from one pier to another.
- 6.45.6.1.2 Following the detailed survey on the site, the **Contractor** shall validate the accuracy of the details indicated on the drawings in function of the measurements taken on site. Should adjustments to details be required in function of existing conditions, the **Contractor** shall review the details and submit the revisions, for review, by the Engineer.

### 6.45.6.2 STEEL SURFACE PREPARATION

- 6.45.6.2.1 All holes drilled at the mill or on worksite shall be accurately drilled perpendicular to the surface. For the holes drilled at the mill, the parts shall be in accordance with the following requirements:
- 6.45.6.2.1.1 before any reaming, 75% of the holes located in the same plane shall allow free passage of a cylindrical joining pin with a diameter of three (3) millimeters smaller than that of the hole;
- 6.45.6.2.1.2 before any reaming, all holes located in the same plane shall allow free passage of a cylindrical joining pin with a diameter of 5 mm smaller than that of the hole;
- 6.45.6.2.1.3 the cylindrical joining pin shall be inserted perpendicularly to the face of the member;

- 6.45.6.2.1.4 at least 85% of the holes reamed or drilled to their full size, contiguous and located in the same plane shall not be decentered by more than 1 mm relative to the holes of the adjacent parts.
- 6.45.6.2.2 All burrs and other deformations on the edges of the drilling holes shall be removed in order to ensure perfect contact between the parts to be assembled. The parts already assembled shall be disassembled to allow for this work.
- 6.45.6.2.3 Before the parts leave the plant, the steel surfaces of the structure made of Type A or AT steel that have not been coated with an anti-corrosion protection process shall be cleaned in accordance with standard SSPC SP 6/NACE n° 3.
- 6.45.6.3 INSTALLATION OF HIGH TENSILE STRENGTH BOLTS
- 6.45.6.3.1 Unless otherwise indicated on the drawings, the installation of the high tensile strength bolts shall comply with standard ASTM A325.
- 6.45.6.3.1.1 The bolts shall be installed in accordance with Appendix 6.41-I *Requirements for Bolt Tightening* of subsection 6.41 *Steelwork*.
- 6.45.6.3.1.2 The holes for the construction bolts shall be punched, sub-punched and reamed or drilled.
- 6.45.6.3.1.3 The trunnions shall be machined to the dimensions indicated on the drawings. The holes shall be drilled into the concurrent parts so that the difference between the diameter and the trunnion does not exceed 1 mm. In locations where the double plates are indicated on the drawings, the double plates shall be welded on the linear plate before drilling the trunnion holes.
- 6.45.6.3.1.4 The temporary bolts shall be replaced with new bolts.
- 6.45.6.4 WELDING
- 6.45.6.4.1 The welding shall comply with Article 10.23.5 *Welding Correction and Repairs to Fracture-Critical Members* of standard CAN/CSA S6. The **Contractor** shall note that the modular truss contains fracture-critical and primary tension members. The fracture control shall comply with Section 10.23 *Fracture Control* of standard CAN/CSA S6.
- 6.45.6.4.2 The **Contractor's** welding procedure and electrode certificates shall be submitted to the Engineer for review.
- 6.45.6.4.3 The filler metal shall develop a tensile strength, ductility, impact resilience and corrosion resistance equivalent to that of the base metal.



- 6.45.6.4.4 The **Contractor** or subcontractor thereof, if any, that carries out the welding shall be certified by the Canadian Welding Bureau (CWB) in accordance with standard CAN/CSA W47.1, in Divisions 1 and 2. This certification shall have been acquired at least five (5) years prior to the award of this Contract.
- 6.45.6.4.5 All welders shall have the qualifications in accordance with standard CAN/CSA W117.2.
- 6.45.6.4.6 The **Contractor** shall take note of the special preparations required on the edges of certain plates for welding thereof as indicated on the drawings.
- 6.45.6.5 DIMENSION TOLERANCES
- 6.45.6.5.1 The final member dimensions shall comply with the tolerances of standard CAN/CSA W59 for dynamically loaded structures.
- 6.45.6.6 FACTORY TEST ASSEMBLY
- 6.45.6.6.1 The truss splice holes shall be drilled during the factory assembly or sub-punched or sub-drilled and then reamed once assembled. The assembly, including the camber, alignment and accuracy in the positioning of the holes shall be inspected by the Engineer before drilling or reaming begins.
- 6.45.6.6.2 The truss hangers shall be tested through a pre-assembly on the truss at the factory to ensure the accuracy of the components to be assembled. The assembly will be inspected by the Engineer before being disassembled. The hanger components shall be identified with the truss to indicate the proper orientation of each part.
- 6.45.6.6.3 The tests may be conducted using black bolts which will remain the property of the **Contractor**.
- 6.45.6.7 MARKING AND TRANSPORTATION
- 6.45.6.7.1 Each truss section and associated components shall be marked, using a method authorized by the Engineer, by an assembly marking or by a number corresponding to the marking shown on the assembly diagram.
- 6.45.6.7.2 Every component with a mass greater than 1 t shall be marked so as to indicate the appropriate mass.
- 6.45.6.7.3 The truss bearings shall be loosely assembled on the girder before being transported, with the required bolts and the rods in place, but without significant stress in the bolts or rods.
- 6.45.6.7.4 The fasteners required for each component shall be packaged and marked to identify the appropriate item.

- 6.45.6.7.5 The members shall be loaded into trucks and vehicles so as not to be damaged during transportation and unloading.
- 6.45.6.7.6 At least fourteen (14) days prior to the scheduled members transportation date, the signed and sealed drawings indicating the transportation method shall be prepared by the **Contractor**'s design engineer and submitted to the Engineer, for review.
- 6.45.6.7.7 The painted or galvanized surfaces damaged during transportation shall be repaired at the **Contractor**'s expense and to the satisfaction of the Engineer.
- 6.45.6.8 WORKSITE ASSEMBLY
- 6.45.6.8.1 The parts that come into contact with the lifting equipment, such as the cables and chains, shall be adequately protected.
- 6.45.6.8.2 The galvanized or metallized surfaces damaged during transportation or installation shall be repaired by the **Contractor**, to the satisfaction of the Engineer, by means of a zinc-rich coating.
- 6.45.6.8.3 The zinc-rich coating shall only be applied only to metal that is completely clean and dry. The **Contractor** shall, using a solvent, remove the grease and oil before applying the zinc-rich coating according to the manufacturer's recommendations. The **Contractor** shall apply two (2) coats of dry film of a minimum thickness of 100 µm or in accordance with the manufacturer's recommendations.
- 6.45.6.8.4 The **Contractor** shall assemble the modular truss on worksite prior to installation thereof.
- 6.45.6.8.5 The **Contractor** shall take all precautions required to prevent damage to the modular truss members and finish during assembly.
- 6.45.6.9 INSTALLATION OF THE MODULAR TRUSS
- 6.45.6.9.1 The **Contractor** shall demolish the concrete of the top of the piers to install the support levers in accordance with the indications on the drawings and with subsection 6.21 *Demolition and Removal*.
- 6.45.6.9.2 The **Contractor** shall install the anchor plates and support bars in accordance with the indications on the drawings.
- 6.45.6.9.3 The **Contractor** shall fill the voids under and around the support bars with a non-shrink grout in accordance with the indications on the drawings and with subsection 6.33 *Cast-in-Place Concrete*.
- 6.45.6.9.4 The **Contractor** shall install the support levers on the piers in accordance with the indications on the drawings.

- 6.45.6.9.5 The **Contractor** shall transport the assembled modular truss to the location where it will be installed.
- 6.45.6.9.6 The **Contractor** shall install the modular truss by connecting it to the support levers through the installation of the hangers and trunnions in accordance with the indications on the drawings.
- 6.45.6.9.7 The **Contractor** shall install the girder saddles and bracings in accordance with the indications on the drawings.
- 6.45.6.9.7.1 The girder saddles shall be held in place by the application of the epoxy adhesive in accordance with the indications on the drawings.
- 6.45.6.9.8 After having installed the modular truss, the **Contractor** shall load the modular truss by placing steel shims at the supports in accordance with the indications on the drawings.
- 6.45.6.10 PAINTING THE STEEL SURFACES
- 6.45.6.10.1 All the steel member surfaces that are not specifically indicated to be galvanized shall be painted with the paint system described in this subsection with the exception of the leveling surfaces and surfaces listed below:
- 6.45.6.10.1.1 the trunnions body and holes for the trunnions;
- 6.45.6.10.1.2 the bearing contact surfaces.
- 6.45.6.10.2 The **Contractor** shall use the galvanic/epoxy resin/polyurethane resin paint system described in Article 6.42.4.2 *Galvanic/Epoxy Resin/Polyurethane Resin Paint System* of subsection 6.42 *Painting Work* to paint all cleaned surfaces of the structural steel.
- 6.45.6.10.3 The leveling surfaces shall be coated with a primer that meets the requirements of a Class B coating in accordance with Table 10.9 of standard CAN/CSA-S6. This primer coat shall be compatible with the system used on the painted structural steel.
- 6.45.6.10.4 Unless otherwise specified by the Engineer, the requirements concerning the working conditions in the enclosures apply at the factory.

6.45.6.10.5 The color of the topcoats shall be Gray 26357, in accordance with standard FED-STD-595B. The following topcoats or equivalent authorized by the engineer, comply with this standard:

| <u>MANUFACTURER</u>     | <u>COLOR CODE</u> | <u>COLOR NAME</u> |
|-------------------------|-------------------|-------------------|
| Ameron Canada           | 2531              | I.M. Gray         |
| Peinture Internationale | RAL 7038          | -                 |
| Peintures Pittsburgh    | PC795             | Concrete          |
| Sherwin-Williams        | SW4022            | Flint Grey        |

6.45.6.10.6 The cleaned steel surface of the trunnion bodies and trunnion holes, the bearing contact surfaces and the leveling surfaces shall be painted with a primer in accordance with Article 6.42.4.2.1 *Primer* of subsection 6.42 *Painting Work*.

6.45.6.10.7 In general, all steel surfaces shall receive the primer coat, even those who are to come into contact with existing steel or concrete.

## 6.45.7 QUALITY CONTROL

6.45.7.1 The **Contractor** shall implement a quality control program in accordance with standard CSA/CAN3-Z299.3.

6.45.7.2 The Engineer will conduct his own quality assurance program by conducting audits on the **Contractor's** quality control program and by means of any other random inspection or check at the discretion of the Engineer. The **Contractor** shall provide samples of any material required by the Engineer.

6.45.7.3 Unless otherwise indicated on the drawings and notwithstanding the requirements of paragraph 6.41.11.3 *Welding* of subsection 6.41 *Steelwork*, the **Contractor** shall conduct and provide the results of non-destructive testing on the welds in accordance with standards CSA W59 and CAN/CSA-S6. The fillet welds shall be tested by the dry magnetic powder particle method and the full penetration welds by X-ray or ultrasound. The scope of the non-destructive testing of the welds, which are at the **Contractor's** expense, shall be as follows:

6.45.7.3.1 butt welds 100% of welds

6.45.7.3.2 full penetration welds at the location of the truss lower member 100% of welds

6.45.7.3.3 fillet welds at the location of the truss diagonal and vertical members 100% of welds

6.45.7.3.4 fillet welds at the location of the truss lower members 100% of welds

- 6.45.7.3.5 fillet welds at the location of the welded assemblies 100% of welds
- 6.45.7.3.6 any welds at the location of plates thicker than 30 mm 100% of welds
- 6.45.7.3.7 any other weld 25% of welds
- 6.45.7.4 The **Owner** may, independently and at its expense, conduct additional non-destructive testing on the welds. If there are welding defects, the **Contractor** shall pay the cost of all inspections carried out before and after the correction of the defects.
- 6.45.7.5 The inspection and non-destructive testing of the welds shall be completed by the **Contractor** within seven (7) days following the completion of the welding work.
- 6.45.7.6 The **Contractor** shall move and support the parts to be inspected. The inspection shall be carried flat with a vertical clearance of at least 1.25 m.
- 6.45.7.7 The **Contractor** shall notify the Engineer of any defects found in the work part of this subsection. No repairs shall be carried out before the authorization has been obtained from the Engineer. The **Contractor** shall submit to the Engineer, in writing for review thereby, the proposed methods to correct the defects. The corrective methods shall include, without however being limited to, the drawings, the sketches and the appropriate procedures.
- 6.45.7.8 Every primary member shall be visually inspected by the Engineer before being shipped from the factory. This audit does not relieve the **Contractor** of its obligations under this Contract.
- 6.45.7.9 The **Contractor** shall conduct and provide the results of the non-destructive testing on all welds in accordance with Article 10.23.6 *Non-Destructive Testing of Fracture-Critical Members* of standard CAN/CSA-S6 subject, however, to the following modifications:
- 6.45.7.9.1 the visual inspection of all welds (100%);
- 6.45.7.9.2 the radiographic or ultrasound inspection of all full penetration welds (100%);
- 6.45.7.9.3 the magnetic particle inspection of all fillet welds (100%).
- 6.45.7.10 The inspection and non-destructive testing of the welds shall be completed by the **Contractor** within seven (7) days of completion of the welding.

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**END OF SUBSECTION**