TENDER DOCUMENTS

SUBSECTION 6.31
REINFORCING STEEL FOR CONCRETE

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SUBSECTION 6.31 REINFORCING STEEL FOR CONCRETE

6.31.1 GENERAL

6.31.1.1 This subsection 6.31 *Reinforcing Steel for Concrete* sets out the requirements related to reinforcing steel, wire mesh and anchor work covered by this Contract.

6.31.1.2 Unless specifically indicated otherwise on the drawings, new reinforcing bars to be supplied and installed by the **Contractor** which are referred to on the drawings and in the specifications are all in metric units. Existing bars identified on the drawings may be identified in metric or imperial units.

6.31.1.3 Any specific requirements related to reinforcing steel, wire mesh and anchor work covered by this Contract are set out in Section 4 *Special Technical Conditions* and on the drawings.

6.31.1.4 The requirements related to formwork are described in subsection 6.32 *Formwork*.

6.31.1.5 The requirements related to cast-in-place concrete are described in subsection 6.33 *Cast-in-place Concrete*.

6.31.1.6 The requirements related to dry-mix shotcrete are described in subsection 6.34 *Shotcrete*.

6.31.2 REFERENCE STANDARDS

6.31.2.1 The **Contractor** shall carry out all reinforcing steel, wire mesh and anchor work in accordance with the requirements set out in the following standards and documents to which the provisions of the Contract are added:

6.31.2.1.1 (ACI) American Concrete Institute

- ACI 315-99 *Details and Detailing of Concrete Reinforcement*.

6.31.2.1.2 (ASTM) ASTM International

- ASTM A185/A185M-07 *Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete*;
- ASTM E1512-01 (2007) *Standard Test Methods for Testing Bond Performance of Bonded Anchors*.

6.31.2.1.3 (CSA) Canadian Standards Association

- CAN/CSA-A23.1-04/A23.2-04 *Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete*;
- CAN/CSA A23.3-04 *Design of Concrete Structures*;

- CAN/CSA-G30.18-M92 (R2007) *Billet-Steel Bars for Concrete Reinforcement*;
- CAN/CSA-G164-M92 (R2003) *Hot Dip Galvanizing of Irregularly Shaped Articles*;
- CAN/CSA S6-06 *Canadian Highway Bridge Design Code*;
- CSA W186-M1990 (R2007) *Welding of Reinforcing Bars in Reinforced Concrete Construction*;
- CSA W48-06 *Filler Metals and Allied Materials for Metal Arc Welding*.

6.31.2.1.4 (CGSB) Canadian General Standards Board

- CAN/CGSB-1.181-99 *Ready-Mixed Organic Zinc-Rich Coating*.

6.31.2.1.5 (MTQ) Ministère des Transports du Québec

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

6.31.3 MATERIALS

6.31.3.1 REINFORCING STEEL

6.31.3.1.1 Unless otherwise indicated on the drawings, all new reinforcing steel shall be 400W grade high-bond deformed-surface steel that complies with standard CAN/CSA G30.18.

6.31.3.1.2 The **Contractor** shall provide proof of compliance of the physical and chemical properties through tests conducted by a Canadian laboratory in accordance with the requirements of standard CAN/CSA G30.18 if the reinforcing steel is not from a Canadian or American steel mill that is certified as meeting standard ISO 9001:2000 *Quality Management Systems – Requirements*.

6.31.3.1.3 Unless otherwise indicated, all reinforcing steel prescribed for construction and repairs shown on the drawings shall be hot dip galvanized in accordance with standard CAN/CSA-G164.

6.31.3.1.4 Steel reinforcing bars shall be cold mechanically bent prior to galvanizing and shall be free of veins, cracks and other defects that can affect their quality.

6.31.3.1.5 Steel reinforcing bars shall be bent before they are galvanized and placed in position into the exact shapes shown on the drawings. The **Contractor** shall check the bending measurements and ensure that the clearance between the formwork and the reinforcing steel is maintained.

6.31.3.1.6 Deformed-surface bars shall be marked as required by standard CAN/CSA G30.18.

6.31.3.1.7 Reinforcing steel shall not be painted.

6.31.3.1.8 The **Contractor** shall provide the Engineer with four copies of the bending lists, on which the reinforcing bars must be numbered and itemized, as well as the placement drawings.

6.31.3.2 ANCHORS

6.31.3.2.1 Anchors shall be made of 400W grade high-bond reinforcing steel that complies with standard CAN/CSA G30.18 and shall be shaped in accordance with standard CAN/CSA-A23.1/A23.2.

6.31.3.2.2 Unless otherwise indicated, anchors specified on the drawings shall be hot dip galvanized in accordance with standard CAN/CSA-G164.

6.31.3.2.3 Anchors shall be of variable length in order to accommodate the different demolition depths.

6.31.3.3 WIRE MESH

6.31.3.3.1 Welded steel mesh shall meet the requirements of standard ASTM A185/A185M for mesh with non deformed-surface steel wire.

6.31.3.3.2 Unless otherwise indicated on the drawings, wire mesh shall be 51 mm by 51 mm, MW9.1 X MW9.1 and hot dip galvanized in accordance with standard CAN/CSA-G164.

6.31.3.3.3 Mesh shall not be painted.

6.31.3.4 CONNECTORS

6.31.3.4.1 Steel wire used to connect reinforcing bars and wire mesh shall be made of annealed steel 1.6 mm in diameter (16 gauges) or bigger.

6.31.3.4.2 Steel wire used with galvanized reinforcing steel shall be galvanized.

6.31.3.5 BAR SPACERS AND BAR SUPPORTS

6.31.3.5.1 Bar spacers and bar supports shall be made of prefabricated concrete with the same composition and strength as the concrete used. The concrete shall be air entrained and chlorine free.

6.31.3.5.2 Wood blocks, bricks and stones shall not be used as bar spacers or bar supports.

6.31.4 INSPECTION AND STORAGE

6.31.4.1 The Engineer reserves the right to inspect the quality of the reinforcing steel and conduct physical tests of samples.

6.31.4.2 Reinforcing steel delivered to the work site shall be identified in accordance with the waybills.

6.31.4.3 The **Contractor** shall ensure that reinforcing steel is stored so as to prevent rust, damage to the protective coating and deformation of the bars.

6.31.4.4 The **Contractor** shall, if required by the Engineer, repair post-galvanizing damage to the coating. The **Contractor** shall make such repairs in accordance with the requirements of standard CAN/CGSB-1.181.

6.31.5 EXECUTION OF WORK

6.31.5.1 PLANNING

6.31.5.1.1 At least fourteen (14) days prior to installation, the **Contractor** shall submit for review drawings indicating the proposed placement of reinforcing steel and anchors.

6.31.5.2 REINFORCING STEEL

6.31.5.2.1 Reinforcing steel shall be free of mud, oil, coating or any other substance likely to reduce the bond with the concrete.

6.31.5.2.2 Reinforcing steel shall be placed in accordance with the requirements of standard CAN/CSA-A23.1/A23.2.

6.31.5.2.3 At the Engineer's request, the **Contractor** shall add extra reinforcing bars if the existing bars to be preserved are so diminished in section by corrosion as to affect the load-bearing capacity of the component.

6.31.5.2.4 Bars shall overlap a minimum of 600 mm in accordance with standard CAN/CSA S6.

6.31.5.2.5 Reinforcing steel shall be connected to anchors placed previously by the **Contractor** or to existing reinforcing steel using connectors as prescribed in paragraph 6.31.3.4 and supported so as to prevent any shifting when the concrete is poured.

6.31.5.2.6 Reinforcing steel shall not be welded to existing or new reinforcing bars or anchors except with written authorization from the Engineer.

6.31.5.2.7 In congested areas or where the bars are large in diameter, the **Contractor** shall avoid overlapping connections by using welded connections or mechanical couplers authorized by the Engineer.

6.31.5.2.8 Electrodes used for welding shall comply with standard W48, class E480XX.

6.31.5.2.9 Reinforcing steel bars that cross one another shall be securely connected at every intersection if the intersections are more than 300 mm a part, and at every second intersection if the intersections are closer.

6.31.5.2.10 All connecting wires used to connect reinforcing bars to one another shall be bent inward so as not to reduce the thickness of the concrete cover.

6.31.5.2.11 Unless specifically indicated in the *Special Technical Conditions* or on the drawings, reinforcing steel shall be placed so as to ensure the minimum coverage in accordance with standard CAN/CSA-A23.1/A23.2.

6.31.5.2.12 Unless otherwise indicated on the drawings, the minimum gap between new reinforcing steel and existing concrete shall be 30 mm.

6.31.5.2.13 Bars shall rest on supports placed no farther apart than 1 m on centre and sized so as to ensure that the required clearance between the reinforcing steel and the formwork is maintained.

6.31.5.2.14 Wood blocks, bricks and stones shall not be used as bar spacers or bar supports.

6.31.5.2.15 During concreting, all vertically placed reinforcing steel bars shall be secured in place at the top.

6.31.5.3 ANCHORS

6.31.5.3.1 Anchors specified on the drawings are required in order to anchor the new concrete to the existing substrate and to connect the new reinforcing steel. Anchors shall be long enough that they can be connected to the bars in their final position indicated on the drawings, taking into account the varying demolition depths.

6.31.5.3.2 Anchors 6 mm in diameter used to attach wire mesh shall develop their anchoring capacity mechanically by penetrating at least 30 mm into sound concrete.

6.31.5.3.3 10M anchors may be installed using cement based grout or epoxy resin according to the manufacturer's instructions. Anchor bars, drilled holes and resin cartridges shall have compatible diameters.

6.31.5.3.3.1 The cement grout or resin mix shall completely fill the anchor holes. Where anchors are placed overhead, precautions shall be taken to prevent loss of material due to gravity.

6.31.5.3.3.2 The grout formula, the technical data sheets pertaining to the resins and the placement method, including the equipment used, shall be submitted to the Engineer for review and comment at least fourteen (14) days before anchor placement begins.

6.31.5.3.4 The location of drill holes and the length of the anchor bars shall be as indicated on the drawings.

6.31.5.3.5 Where the ambient temperature is below 5°C or below the minimum temperature specified by the manufacturer, the epoxy resin cartridges shall be stored in a heated area so that they are at a temperature between 10°C and 25°C when they are used, and the anchor bars shall be preheated immediately prior to placement.

6.31.5.3.6 Anchor holes on vertical surfaces shall be sloped 15° from horizontal with the mouth of the hole uppermost.

6.31.5.3.7 Holes can be drilled using impact or rotary drills, and their diameter shall be the same as the dimensions specified by the anchor manufacturer. Compressed air shall be used to clean drilling debris out of the holes.

6.31.5.3.8 Holes shall be protected from blockage or obstruction using plugs or other means accepted by the Engineer. Holes that become blocked or obstructed before the work is complete shall be cleaned or replaced with other holes.

6.31.5.3.9 Threaded anchors shall be placed for the purpose of conducting pull tests in accordance with the requirements of standard ASTM E1512.

6.31.5.3.10 Mechanical or chemical anchors shall withstand a theoretical pull force specified in the *Special Technical Conditions*. The **Owner**'s test laboratory will test anchors randomly at a rate specified by the Engineer, but not less than 5%, in order to check pull strength. If any anchors do not comply with the minimum pull strength specified in the *Special Technical Conditions*, the **Contractor** shall take corrective measures at its own expense to the Engineer's satisfaction.

6.31.5.3.11 Anchors shall not be subjected to any force within the first twenty-four (24) hours following their placement and shall not be touched or moved during the initial setting period of the resin or grout.

6.31.5.4 WIRE MESH

6.31.5.4.1 Wire mesh shall be placed in accordance with the requirements of standard CAN/CSA-A23.1/A23.2.

6.31.5.4.2 Unless otherwise indicated on the drawings, adjacent mesh shall overlap at least one square.

6.31.5.4.3 Unless otherwise indicated, wire mesh and anchors shall be added for all surfaces to be repaired with shotcrete and shall comply with the requirements set out in the CCDG.

END OF SUBSECTION