

TENDER DOCUMENTS

SUBSECTION 6.32 FORMWORK

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SUBSECTION 6.32 FORMWORK

6.32.1 GENERAL

- 6.32.1.1 This subsection sets out the requirements related to formwork covered by this Contract.
- 6.32.1.2 Any specific requirements related to formwork covered by this Contract are set out in Section 4 *Special Technical Conditions* and on the drawings.
- 6.32.1.3 The requirements related to reinforcing steel are set out in subsection 6.31 *Reinforcing Steel for Concrete*.
- 6.32.1.4 The requirements related to cast-in-place concrete and underwater repairs are set out in subsection 6.33 *Cast-in-Place Concrete*.

6.32.2 REFERENCE STANDARDS

- 6.32.2.1 The **Contractor** shall carry out all formwork in accordance with the requirements of the following standards to which the provisions of the Contract are added:
- 6.32.2.1.1 (ASTM) ASTM International
- ASTM A325-07a *Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength*.
- 6.32.2.1.2 (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*;
 - G40.20-04/G40.21-04 *General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel*;
 - O121-08 *Douglas Fir Plywood*;
 - CAN/CSA-S269.3-M92 (R2008) *Concrete Formwork*;
 - CAN/CSA S6-06 *Canadian Highway Bridge Design Code*;
 - W47.1-03 *Certification of Companies for Fusion Welding of Steel*;
 - W59-03 *Welded Steel Construction (Metal Arc Welding)*.
- 6.32.2.1.3 (MTQ) Ministère des Transports du Québec
- MTQ – *Cahier des charges et devis généraux (CCDG)*.

6.32.3 MATERIALS

6.32.3.1 FORMWORK

6.32.3.1.1 The **Contractor** shall use metal or wood formwork to carry out repairs, in accordance with standard CAN/CSA-S269.3.

6.32.3.1.2 Lumber and plywood shall comply with standard CAN/CSA-A23.1.

6.32.3.1.3 Bolts, nuts and washers used for steel formwork shall be made of high-strength steel in accordance with standard ASTM A325.

6.32.3.1.4 Steel shall be 300W grade steel that complies with standard CSA G40.20/G40.21.

6.32.3.1.5 Welds shall be made in accordance with the requirements of standard CAN/CSA W59.

6.32.3.1.6 The **Contractor** or its subcontractor executing the welding works shall be certified by the Canadian Welding Bureau in accordance with the requirements of standard CSA W47.1, Division 3. Prior to fabricating, the **Contractor** shall provide the Engineer with a document certifying its or its subcontractor qualifications.

6.32.3.1.7 Cut edges of steel plates and framework members shall be smooth and free of cracks, cavities and faults. Edges and holes shall not be cut or pierced manually with a torch. Holes shall be drilled or punched.

6.32.3.2 FORMWORK TIE RODS

6.32.3.2.1 Formwork tie rods shall be steel bars with a diameter greater than 6 mm and shall meet the specifications set out in the *Special Technical Conditions*, as the case may be.

6.32.3.3 BRACKETS

6.32.3.3.1 The vertical walls of formwork shall be connected to each other by metal brackets with a plastic cone at each end.

6.32.3.4 CHAMFER STRIPS

6.32.3.4.1 Wooden chamfer strips shall be free of warping, knots and splitting that could affect the appearance of the surface of the concrete.

6.32.4 EXECUTION

6.32.4.1 PLANNING

6.32.4.1.1 At least fourteen (14) days prior to the start of formwork, the **Contractor** shall provide drawings of the formwork signed and sealed by an engineer who is a member of or is licensed by the Ordre des ingénieurs du Québec and has at least five (5) years of relevant experience.

6.32.4.1.2 Formwork shall meet the requirements set out in standards CAN/CSA-S269.3 and CAN/CSA-A23.1.

6.32.4.1.3 The **Contractor** shall verify on site before formwork fabrication begins all dimensions of the roadway infrastructure components and possible interference with the formwork, including supports and beams and any other obstacles that could hinder the installation of formwork and formwork supports.

6.32.4.2 TIE RODS

6.32.4.2.1 When repairs are being done, formwork can be held in place using prefabricated tie rods attached to the existing concrete that meet the following requirements:

6.32.4.2.1.1 anchor depth: minimum of 200 mm in sound concrete;

6.32.4.2.1.2 tie rod diameter: 12 mm;

6.32.4.2.1.3 tie rod spacing: 600 mm c/c.

6.32.4.2.2 The **Contractor** shall, however, check whether the minimum spacing is sufficient given the placement height, the type of mix or unanticipated loads and the quality of the concrete in which the tie rods are set.

6.32.4.3 BRACKETS

6.32.4.3.1 Brackets shall be positioned so as not to hinder placement of the concrete. They shall be installed on vertical planes at a horizontal distance calculated by the **Contractor's** engineer. The ends shall be cut inside the concrete 40 mm from the surface.

6.32.4.4 CHAMFER STRIPS

6.32.4.4.1 Unless otherwise indicated on the drawings, any sharp edges along surfaces, whether or not they are visible, shall be chamfered to 40 mm.

6.32.4.4.2 The chamfer strips shall be placed so as to leave a clean, neat groove in the concrete along the sharp edges.

6.32.4.4.3 When the chamfer strips are prepared, the **Contractor** shall ensure that they are all equal in cross-section so that the ends of the strips can be matched during installation.

6.32.4.4.4 The chamfer strips shall be installed carefully true to line and grade.

6.32.4.4.5 The chamfer strips shall be coated with a formwork release agent.

6.32.4.5 INSTALLATION OF FORMWORK

6.32.4.5.1 Steel forms shall be assembled and installed by workers possessing "*Compagnon monteur d'acier de structure*" competency cards issued by the Commission de la Construction du Québec (CCQ) and at least five (5) years of experience erecting steel structures.

6.32.4.5.2 Forms shall be held firmly in place, braced and supported so as to withstand the loads they will have to bear, taking into consideration the vibration caused by flow, and shall retain their alignment and shape until the concrete has set.

6.32.4.5.3 Forms shall conform to the shapes, lines and dimensions of the structure shown on the drawings.

6.32.4.5.4 Forms used for placing concrete in adjacent sections of continuous parts of the structure shall be adjusted to provide regular, uniform and smooth finished concrete surfaces.

6.32.4.5.5 Forms shall be watertight and shall not allow any mortar or laitance to flow out.

6.32.4.5.6 The **Contractor** shall make openings in wood forms to permit proper vibration during concreting. Openings are optional in steel forms.

6.32.4.5.7 Openings in forms shall be spaced so as to prevent the concrete from segregating, but shall not be more than 2.5 metres c/c.

6.32.4.5.8 When carrying out overhead repairs, the **Contractor** shall make vent holes in the forms to allow any air trapped in the spaces being concreted to escape.

6.32.4.5.9 Prior to concreting, the **Contractor's** engineer-designer shall inspect all formwork with the Engineer present. The engineer-designer shall provide and sign a written compliance certificate confirming his approval of all the formwork, which includes checking the bottoms of forms to ensure that they are clean.

6.32.4.6 REMOVAL OF FORMS

6.32.4.6.1 The **Contractor** shall not remove forms or form supports and braces until authorization has been obtained from the Engineer.

- 6.32.4.6.2 After the concrete is placed and with the authorization of the Engineer, the **Contractor** may remove the forms provided the following minimum requirements are met, unless otherwise indicated in the *Special Technical Conditions*:
- 6.32.4.6.2.1 soffit of any element: forms shall be left in place for at least seven days; as well, the compressive strength of the new concrete shall have attained 75% or more of the specified twenty-eight (28) day strength;
- 6.32.4.6.2.2 vertical faces of any element: forms shall be left in place for at least three (3) days; as well, the compressive strength of the new concrete shall have attained 60% or more of the specified twenty-eight (28) day strength.
- 6.32.4.6.3 These delays may be extended if the results of tests on samples cured on site are less than the required strength indicated above or in the *Special Technical Conditions*, as the case may be.

END OF SUBSECTION