TENDER DOCUMENTS

SUBSECTION 6.41
STEELWORK

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SUBSECTION 6.41 STEELWORK

6.41.1 GENERAL

6.41.1.1 This subsection sets out the requirements related to steelwork covered by this Contract.

6.41.1.2 Any specific requirements related to the steelwork covered by this Contract are set out in Section 4 *Special Technical Conditions*.

6.41.1.3 Any requirements related to painting are set out in subsection 6.42 *Painting.*

6.41.2 REFERENCE STANDARDS

6.41.2.1 The **Contractor** shall carry out steelwork in accordance with the requirements set out in the following standards and documents to which the provisions of the Contract are added:

6.41.2.1.1 (ANSI) American National Standards Institute / (NAAMM) National Association of Architectural Metal Manufacturers:

- ANSI/NAAMM MBG 531-00 *Metal Bar Grating Manual (Sixth Edition).*

6.41.2.1.2 (ASME) American Society of Mechanical Engineers:

- ASME B18.21.1 - 1999 *Lock Washers (Inch Series).*

6.41.2.1.3 (ASTM) ASTM International:

- ASTM A53/A53M-07 *Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless;*
- ASTM A108-07 *Standard Specification for Steel Bar, Carbon and Alloy, Cold Finished;*
- ASTM A153/153M-05 *Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware;*
- ASTM A307-07b *Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength;*
- ASTM A325-07a *Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength;*
- ASTM A325M-08 *Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength [Metric];*
- ASTM A434-06 *Standard Specification for Steel Bars, Alloy, Hot-Wrought or Cold-Finished, Quenched and Tempered;*

- ASTM A449-07b *Standard Specification for Hex Cap Screws, Bolts, and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use;*
- ASTM A490-08a *Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength*;
- ASTM A490M-04ae1 *Standard Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints [Metric];*
- ASTM A500/A500M-07 *Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes,* grade C*;*
- ASTM A510-07 *Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel;*
- ASTM A563-07a *Standard Specification for Carbon and Alloy Steel Nuts;*
- ASTM A563M-07 *Standard Specification for Carbon and Alloy Steel Nuts [Metric];*
- ASTM A1011/A1011M-08 *Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength;*
- ASTM F436-07a *Standard Specification for Hardened Steels Washers;*
- ASTM F436M-04 *Standard Specification for Hardened Steel Washers [Metric];*
- ASTM F593-02(2008) *Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs;*
- ASTM F738M-02(2008) *Standard Specification for Stainless Steel Metric Bolts, Screws, and Studs;*
- ASTM F1852-07 *Standard Specification for Twist Off Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength;*

6.41.2.1.4 (CSA) Canadian Standards Association:

- CAN/CSA G40.20-04/G40.21-04 *General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel;*
- CAN/CSA-G164-M92 (R2003) *Hot Dip Galvanizing of Irregularly Shaped Articles;*
- CAN/CSA S6-06 *Canadian Highway Bridge Design Code*;
- CAN/CSA S16-01(R2007) *Limit States Design of Steel Structures;*
- CAN/CSA W47.1-03 *Certification of Companies for Fusion Welding of Steel;*
- CAN/CSA W48-06 *Filler Metals and Allied Materials for Metal Arc Welding;*

- CAN/CSA W59-03 *Welded Steel Construction (Metal Arc Welding);*
- CAN/CSA W178.2-08 *Certification of Welding Inspectors*;
- CAN3 Z299.3-85 (R2006) *Quality Assurance Program – Category 3.*

6.41.2.1.5 (MTQ) Ministère des Transports du Québec

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

6.41.2.1.6 (SSPC) Society for Protective Coatings

- SSPC-SP 11, *Power Tool Cleaning to Bare Metal*;

6.41.3 MATERIALS

6.41.3.1 GENERAL

6.41.3.1.1 Structural steel shall conform to the requirements of standard CAN/CSA G40.21.

6.41.3.1.2 Atmospheric corrosion resistant weldable steel shall be Type A conforming to standard CAN/CSA G40.21.

6.41.3.1.3 Fracture critical members and primary tension members shall be Type AT, WT or QT steel conforming to standard CAN/CSA G40.21.

6.41.3.1.4 For AT, WT or QT notch tough type steel and electrodes, the test temperature and impact energy requirements for the fracture toughness requirements (Charpy V-notch tests) shall conform to tables 10.12, 10.13 and 10.14 of standard CAN/CSA S6.

6.41.3.1.5 All steel components shall be new and free of deformations, rust and flaws, such as cracks, nicks or sharp edges.

6.41.3.1.6 Unless otherwise indicated in the *Special Technical Conditions,* the **Contractor** shall ensure that the threads for connection bolts and anchor bolts are not intercepted through the shear planes along faying surfaces.

6.41.3.1.7 The fabrication tolerances for steel components shall meet the requirements of standard CAN/CSA S6.

6.41.3.2 STRUCTURAL STEEL AND HOLLOW STRUCTURAL SECTIONS

6.41.3.2.1 According to the specifications on the drawings or the *Special Technical Conditions*:

6.41.3.2.1.1 steel used for plates and rolled members shall conform to standard CAN/CSA G40.21, grade 300W, 350W, 350WT or 350AT;

6.41.3.2.1.2 hollow structural sections (HSS) shall conform to standard CAN/CSA G40.21, grade 350W, class H, or standard ASTM A500/A500M, class C;

6.41.3.2.1.3 steel for the main bars of grating shall conform to standard ASTM A1011/A1011M; steel for the cross bars of grating shall conform to standard ASTM A510; grating materials and fabrication shall conform to the requirements of ANSI/NAAMM MBG 531;

6.41.3.2.1.4 steel for guardrail pipes shall conform to standard ASTM A53/A53M and shall have a minimum yield strength of 207 MPa;

6.41.3.2.1.5 all steel components to be installed permanently shall be galvanized in conformity to standard CAN/CSA-G164 if they are not intended to receive a paint coating or any other coating according to the requirements of the *Special Technical Conditions*.

6.41.3.3 STEEL BOLTS, ANCHOR RODS, NUTS AND WASHERS

6.41.3.3.1 According to the indications on the drawings or the *Special Technical Conditions*, steel bolts, anchor rods, nuts and washers shall conform to the following applicable standards:

6.41.3.3.1.1 BOLTS

6.41.3.3.1.1.1 ASTM A325 and ASTM A325M

- Type 1: medium-carbon steel bolts.
- Type 3: steel bolts with enhanced corrosion resistance.

6.41.3.3.1.1.2 ASTM A490 and ASTM A490M

- Type 1: alloy steel bolts.
- Type 3: steel bolts with enhanced corrosion resistance.

6.41.3.3.1.1.3 ASTM F593

- Stainless steel bolts, 304 or 305 alloy, designed for such applications as mounting a bracket on a pole.

6.41.3.3.1.1.4 ASTM F738M

- Metric stainless steel bolts, Property Class A1-50, designed for such applications as mounting a bracket on a pole.

6.41.3.3.1.1.5 ASTM F1852

- Type 1: medium-carbon steel bolts.
- Type 3: steel bolts with enhanced corrosion resistance.

6.41.3.3.1.2 BOLTS AND ANCHOR RODS

6.41.3.3.1.2.1 ASTM A307

- Grade A: general-purpose bolts and anchor rods.
- Grade B: bolts and anchor rods designed for assembling mechanical joints in cast iron pipes.
- Grade C: bent or straight anchor rods designed for structural anchoring.

6.41.3.3.1.2.2 ASTM A434

- Grade BB or BC: high-strength alloy steel anchor rods. Minimum yield strength and the minimum tensile strength shall conform to standard ASTM A449, taking into account the diameter of the rods to be fabricated. The tensile strength shall be below 1,000 MPa. Welding of this steel is not permitted. Nuts shall be type DH conforming to standard ASTM A563 or A563M.

6.41.3.3.1.2.3 ASTM A449

- Type 1: medium-carbon anchor rods. The tensile strength shall be below 1,000 MPa. Welding of this steel is not permitted.

6.41.3.3.1.2.4 CAN/CSA G40.21

- Grade 350W steel: intended for such applications as anchor rods on signage and lighting structures.

6.41.3.3.1.3 NUTS

6.41.3.3.1.3.1 ASTM A563 and ASTM A563M

- The nuts to be used are identified as “Recommended” in Table X1.1 “Nut and Bolt Suitability Guide” in the above-mentioned standard.

6.41.3.3.1.4 WASHERS

6.41.3.3.1.4.1 ASTM F436 and ASTM F436M

- Type 1: carbon steel washers.
- Type 3: steel washers with enhanced corrosion.

6.41.3.3.1.4.2 ASME B18.21.1

- Lock washers

6.41.3.3.2 Galvanization of bolts and anchor rods shall conform to standard ASTM A153/153M or standard CAN/CSA-G164 except for bolts which have to meet the requirements of standard ASTM F1852.

6.41.3.3.3 Bolts which conform to standard ASTM A490 or standard ASTM A490M shall not be galvanized or have an electrolytic coating.

6.41.3.3.4 The threaded part of anchor rods may be fully or partly galvanized.

6.41.3.3.5 Nuts shall be galvanized and shall conform to standard ASTM A563 or standard ASTM A563M.

6.41.3.3.6 Washers shall be galvanized in conformity to standard ASTM F436 or standard ASTM F436M.

6.41.3.3.7 Nuts and washers shall have the same finish as bolts and anchor rods.

6.41.3.3.8 Bolts shall not be reused.

6.41.3.3.9 Metric bolts may be replaced with equivalent or higher size imperial bolts provided the nuts and washers and the tools used are the appropriate gauge.

6.41.3.4 WELDING ELECTRODES

6.41.3.4.1 Welding electrodes shall be base electrodes conforming to standard CAN/CSA W48.

6.41.3.4.2 Storage and preparation of electrodes shall conform to standard CAN/CSA W59.

6.41.4 SOURCE OF STEEL

6.41.4.1 CERTIFICATE OF CONFORMITY

6.41.4.1.1 For every delivery of steel, bolts, nuts, washers or anchor rods and at least fourteen (14) days prior to their use, the **Contractor** shall provide the Engineer with a certificate of conformity.

6.41.4.1.1.1 The certificate of conformity for steel shall include the following information for each production batch:

- name of steel mill;
- date and place of fabrication;
- nominal dimensions;
- grade;
- category;
- cast number;
- results of analyses, tests and quality control measures;
- production batch number.

6.41.4.1.1.2 The certificate of conformity for bolts, nuts, washers and anchor rods shall include the following information for each production batch:

- manufacturer's name;
- date of fabrication;
- identification of marking;
- nominal dimensions;
- grade of steel;
- category;
- cast number;
- results of analyses and tests;
- information on coating;
- production batch number.

6.41.4.1.1.3 A production batch comprises structural steel components of the same type, grade, category and dimensions from the same cast.

6.41.4.1.1.4 Samples used for physical tests shall be available from the steel mill for inspection by the Engineer.

6.41.4.2 STOCK STEEL

6.41.4.2.1 Where steel is from stock, the **Contractor** shall justify the quality of the materials by providing the Engineer with stamps and certificates from the manufacturer guaranteeing that the steel meets the prescribed requirements.

6.41.4.2.2 The Engineer reserves the right to select components to undergo testing at the **Contractor**'s expense.

6.41.4.2.3 In the absence of mill test certificates for all stock steel, the **Contractor** shall provide the Engineer with a certificate indicating that the steel meets the prescribed requirements.

6.41.4.3 IMPORTED STEEL

6.41.4.3.1 The **Contractor** shall provide the Engineer with a declaration of compliance with the prescribed requirements signed by the Canadian supplier of steel imported from a country other than the United States of America.

6.41.4.4 MARKING

6.41.4.4.1 Structural steel shall be marked as required by standard CAN/CSA G40.21.

6.41.4.4.2 Bolts, nuts, washers and anchor rods shall be marked as required by the applicable reference standard.

6.41.4.5 STEEL TESTING METHODS

6.41.4.5.1 Steel shall be tested using the methods prescribed in the current ASTM standards.

6.41.4.6 DELIVERY, HANDLING AND STORAGE

6.41.4.6.1 During fabrication, transportation and assembly, all necessary precautions shall be taken to prevent damage to steel components. Specifically, the **Contractor** shall ensure that:

6.41.4.6.1.1 the edges of components are not nicked;

6.41.4.6.1.2 components are not subject to excessive loads;

6.41.4.6.1.3 any protective spacers required during transportation, lifting and storage of components are supplied and installed;

6.41.4.6.1.4 no part of any steel component comes into contact with the ground;

6.41.4.6.1.5 components and their protective coating are protected from any damage.

6.41.4.7 DELIVERY INSPECTION

6.41.4.7.1 The **Owner** reserves the right to inspect steel components on delivery according to the requirements set out in standard CAN/CSA G40.21.

6.41.4.7.1.1 Plates and hollow sections shall be big enough to allow 200 mm by 75 mm samples to be taken; the 200 mm dimension shall be in the direction of rolling.

6.41.4.7.1.2 The cast number shall be marked on pieces cut from plates with the Engineer present.

6.41.4.7.1.3 Samples of bolts, nuts, washers and anchor rods shall comprise three (3) pieces of the same type.

6.41.5 SHOP DRAWINGS

6.41.5.1 At least fourteen (14) days before any materials are ordered or any components are fabricated, the **Contractor** shall submit to the Engineer for review shop drawings and detailed design notes for new steel structures and components; the drawings and notes shall bear the seal and signature of an engineer who is a member of the Ordre des ingénieurs du Québec and has at least five (5) years of experience in the design of structures.

6.41.5.2 Shop drawings shall include at least the following information:

6.41.5.2.1 a description of the work methods, temporary bracing and supports, stages of assembly and type of equipment proposed to assemble the structural steel components;

6.41.5.2.2 the main dimensions, the location of the various components and the identifying marks;

6.41.5.2.3 all fabrication and assembly details, including shop joints, cuts, counter-profiles, assemblies, holes, bearing plates, threaded anchors and rivets;

6.41.5.2.4 designs and drawings of temporary supports, props and braces proposed in accordance with article 6.41.6.2 *Temporary supports, props and braces*; the design loads shall be indicated on the shop drawings;

6.41.5.2.5 the number of the welding procedure and the type of non-destructive testing of the welds in the tail of the welding symbol for each welded assembly;

6.41.5.2.6 details of the layout and spacing of bolts.

6.41.5.3 Documents outlining the welding procedures and data sheets shall be approved and bear the seal of the Canadian Welding Bureau and shall be signed and sealed by an engineer who is a member of the Ordre des ingénieurs du Québec and has the qualifications described in paragraph 6.41.5.1.

6.41.5.4 Drawings of temporary shoring shall bear the seal and signature of an engineer who is a member of the Ordre des ingénieurs du Québec.

6.41.5.5 The **Contractor** may not make any changes to materials or structural details set out in shop drawings reviewed by the Engineer without first obtaining written authorization from the Engineer.

6.41.5.6 All values and dimensions indicated on Contract drawings shall be considered approximate.

6.41.5.7 Before preparing its shop drawings, the **Contractor** shall conduct a detailed site survey of all existing components in order to determine their exact dimensions and validate the values and position of the assembly holes shown on the drawings. The **Contractor** shall conduct such a survey wherever the same detail applies.

6.41.5.8 The **Contractor** shall note that the dimensions of steel components and the layout of bolts can vary from place to place for each repair where the same detail is shown on the drawings.

6.41.5.9 If, following the detailed survey of components, the dimensions obtained are substantially different from those indicated on the drawings or if the site conditions do not allow the work to be performed as indicated on the drawings and in the specifications, the **Contractor** shall notify the Engineer and follow the Engineer's instructions.

6.41.5.10 The fact that the documents and components referred to in the preceding paragraphs are reviewed by the Engineer does not relieve the **Contractor** of its responsibilities under the Contract, including, but not limited to, its responsibility to supply appropriate materials and equipment, adopt suitable work methods, ensure quality work, and apply adequate safety measures.

6.41.6 EXECUTION

6.41.6.1 GENERAL

6.41.6.1.1 The **Contractor** shall supply labour, machinery, equipment, tools and temporary structures for the fabrication and installation of steel components as prescribed by the drawings and specifications.

6.41.6.1.2 All components shall be assembled and installed by workers with "journeyman steelworker" competency cards from the Commission de la construction du Québec (CCQ) and at least five (5) years of experience in erecting steel structures.

6.41.6.1.3 New components shall be fabricated so as to ensure a perfect fit with the existing elements to be retained.

6.41.6.1.4 Shop-made steel components shall not be modified or welded on site. Any component that is modified or welded on site shall be removed and replaced with a shop-made component.

6.41.6.1.5 All new steel components shall be free of deformations, rust and flaws, such as cracks, nicks, sharp edges, ruts and welding splatters.

6.41.6.1.6 The **Contractor** shall not damage or soil components adjacent to work areas and shall repair, restore and clean to the Engineer's satisfaction any component or part affected by the work.

6.41.6.1.7 Where steel components are being replaced and details of the connections are not shown on the drawings, the new connections shall be identical to the existing ones in terms of dimensions and number of bolts. However, rivets shall be replaced with bolts of the same diameter.

6.41.6.2 TEMPORARY SUPPORTS, PROPS AND BRACES

6.41.6.2.1 The **Contractor** shall ensure that the work methods used to replace steel components do not jeopardize the strength and/or stability of the components or the overall integrity of the structure.

6.41.6.2.2 Before removing rivets or bolts holding components to be replaced or disassembled, the **Contractor** shall supply and install any temporary supports, props and braces needed to maintain the strength and stability of the structure and adequate transfer of loads to the bearing components and foundations. These temporary supports shall remain in place until the new components are permanently installed.

6.41.6.2.3 The **Contractor** has full responsibility for the design, supply, maintenance and removal of all temporary supports and devices.

6.41.6.2.4 Temporary supports and devices shall be designed in accordance with the requirements of standard CAN/CSA S6*.* Temporary supports shall be designed so as to bear the weight of the supported parts and any other load that may be applied to the structure.

6.41.6.2.5 Braces needed to compensate temporarily for the absence or disassembly of cross bracing and other members likely to carry compression or tension loads shall be designed to provide the same compressive or tensile strength as the member replaced or temporarily disassembled.

6.41.6.2.6 Temporary fasteners and braces needed to compensate for the partial disassembly of the ends of members shall be designed so as to provide strength equal to the capacity of the disassembled components, including, but not limited to, rivets, bolts and plates.

6.41.6.2.7 After temporary braces are installed and before the steel components of the roadway infrastructure for which temporary bracing has been provided are removed, the **Contractor**'s engineer/designer shall submit an inspection report certifying that the temporary braces conform to the drawings of the interim structures. Temporary roadway infrastructures shall be inspected with the Engineer present.

6.41.6.2.8 All loads, including bending, shearing and twisting loads, shall be taken into account in designing supports, props and braces.

6.41.6.3 SURFACE PREPARATION

6.41.6.3.1 Existing steel surfaces that will be in contact with the new steel shall be cleaned in conformity to standard SSPC-SP 11 in preparation for application by the **Contractor** of a coat of primer paint to the interface in order to obtain a better coefficient of friction.

6.41.6.3.2 Galvanized steel surfaces that will come into contact when the assembly is bolted together shall be cleaned manually with a wire brush in order to dull the finish but without polishing the zinc coating.

6.41.6.3.3 The cut edges of steel plates and members shall be smooth and free of cracks, pits and splits. Burrs and bulges shall be removed with a grinder. Where components have to be painted or given a metal coating, sharp edges shall be rounded to a radius of at least 1.5 mm.

6.41.6.3.4 Cutting or piercing metal parts on site using a torch is prohibited.

6.41.6.3.5 Shear cutting is permitted only for steel plate up to 20 mm thick where the steel has a nominal yield strength below 350 MPa and is permitted only for steel plate up to 16 mm thick where the steel has a nominal yield strength of 350 MPa or more.

6.41.6.3.6 Flame cutting in the shop shall be done using mechanical guides. The work shall be done continuously, without stopping and restarting, in order to obtain an even cut surface.

6.41.6.3.7 The methods that will be used to cut steel on site shall be submitted to the Engineer for review prior to the work.

6.41.6.3.8 Holes shall be drilled or punched.

6.41.6.3.9 For assemblies produced on site, holes shall be drilled with a bit to the final diameter using a metal template.

6.41.6.3.10 All holes made in the shop or on site shall be accurately drilled perpendicular to the surface.

6.41.6.4 REMOVAL OF RIVETS

6.41.6.4.1 The **Contractor** shall remove rivets in accordance with the following requirements and so as to ensure that the existing materials to be preserved are not damaged:

6.41.6.4.1.1 shear the head off the rivet using a pneumatic shear and remove the stem of the rivet using a pneumatic punch and or by drilling with a magnetic drill. Ensure that the rivet heads are retrieved;

6.41.6.4.1.2 rivet heads shall not be cut using a torch unless authorized by the Engineer;

6.41.6.4.1.3 repair, replace or restore steel structures damaged by the work to the satisfaction of the Engineer.

6.41.6.4.2 When rivets are being replaced with bolts, the **Contractor** shall take into account that the holes in the steel components may not be perfectly aligned. Some of the holes in existing components may have to be reamed to accommodate the bolts.

6.41.6.5 INSTALLATION OF HIGH TENSILE STRENGTH BOLTS

6.41.6.5.1 The installation of high-strength bolts shall conform to standard ASTM A325 or standard ASTM A490, as indicated on the drawings or in the *Special Technical Conditions*.

6.41.6.5.2 Bolt holes that are to be drilled in new materials intended to be aligned with existing holes shall be shop drilled to a diameter 6 mm smaller than the final dimension required on the drawings and reamed on site to the final dimension once the components have been aligned and assembled.

6.41.6.5.2.1 If the components are more than 6 mm out of alignment, the new steel will not be accepted and will have to be repaired or replaced by the **Contractor** at no additional cost to the **Owner**.

6.41.6.5.2.2 The diameter of the finished holes shall not be more than 2 mm bigger than the diameter of the bolts they are to hold.

6.41.6.5.3 A template shall be used to drill new holes in existing materials.

6.41.6.5.4 Unless otherwise indicated on the drawings or in the *Special Technical Conditions*, boltholes in new materials needed to adjust the alignment and elevation shall be shop drilled and shall be oblong.

6.41.6.5.5 Holes shall be aligned using drift pins, and the components shall be held together using a sufficient number of pre-assembly bolts. Up to 20% of the holes on a given joint may be aligned using drift pins.

6.41.6.5.6 Any bolt or rivet holes left empty once the new materials are in place shall be filled with new high-strength bolts of the appropriate size.

6.41.6.5.7 Unless otherwise indicated on the drawings or in the *Special Technical Conditions,* nuts shall be installed on the less visible side of the steel structure.

6.41.6.5.8 Unless otherwise indicated on the drawings or in the *Special Technical Conditions* relating to bolt tensions, high-strength bolts shall be installed and tightened using the “Turn of the nut” method.

6.41.6.5.9 The **Contractor** shall, if necessary before fully tightening the bolts, install filler plates between the new steel components and the existing members in order to ensure perfect contact between all the components.

6.41.6.5.10 Any bolts that come loose after final tightening shall be replaced with new bolts.

6.41.6.5.11 The threaded end of a bolt shall extend at least 3 mm beyond the outer face of the nut once the nut is tightened.

6.41.6.5.12 Unless otherwise indicated in the *Special Technical Conditions*, on the drawings or by instructions from the Engineer, the **Contractor** shall install washers as follows:

6.41.6.5.12.1 a hardened washer on the turned part;

6.41.6.5.12.2 a hardened washer under the part in contact with the existing steel, whether or not that part is turned;

6.41.6.5.12.3 washers shall be bevelled as needed to ensure perfect contact between all the components.

6.41.6.5.13 Bolts shall be painted on site after being degreased where paint is used as the protective coating. Furthermore, when A490 and A490M bolts are used, they shall be painted on site after being degreased.

6.41.6.5.14 All temporary bolts shall be marked with red paint.

6.41.6.6 WELDING

6.41.6.6.1 Shop welding shall conform to standard CAN/CSA W59.

6.41.6.6.2 The **Contractor** or any of its subcontractors who carry out welding work shall be certified by the Canadian Welding Bureau in accordance with the requirements of standard CAN/CSA W47.1. Division 1 or division 2 is required for steel frames; however, division 3 is sufficient for deck joints, drains, interface drains, barriers and railings.

6.41.6.6.3 The qualification certificate shall be obtained before fabrication begins, and certification shall be maintained throughout the fabrication period.

6.41.6.6.4 Welders, checkers and welding machine operators shall hold appropriate competency cards based on the welding position and the type of electrodes and welding method used. These competency cards shall be issued by the Canadian Welding Bureau in accordance with the requirements of standard CAN/CSA W47.1. Welders shall have at least five (5) years of welding experience.

6.41.6.6.5 Where welds are made in conditions where contraction or distortion stresses can reduce the strength or cause deformation of the members, the **Contractor** shall submit to the Engineer for review the following methods: a method detailing the welding sequence and methods for controlling distortion, including but not limited to, pre-heating, post-heating, heating between passes and specification of welds, in accordance with standard CAN/CSA W59.

6.41.6.6.6 The **Contractor** shall provide details of specific preparation of the edges of some plates for welding to ensure that the work conforms to the prescribed standards.

6.41.6.6.7 Fillet welds shall have the minimum width prescribed in standard CAN/CSA S6 and shall be detailed on the shop drawings submitted by the **Contractor**.

6.41.6.6.8 Welding of existing steel components of the structure is prohibited.

6.41.6.6.9 Unless otherwise indicated on the drawings, the **Contractor** shall not perform field welding without the written authorization of the Engineer, and then only in the manner and in the places specified in the authorization.

6.41.6.6.10 Prior to welding, the steel surfaces shall be cleaned to bare metal. After welding, remove any surface defects and grind any sharp edges. The **Contractor** shall ensure that all flux and welding splatters are removed.

6.41.6.6.11 Welds shall be made prior to painting, galvanization or metallization.

6.41.6.6.12 When welding is complete, the adjacent steel surfaces shall be brushed to remove any splatters and loose welding material from the metal.

6.41.7 QUALITY CONTROL

6.41.7.1 At least fourteen (14) days prior to the start of steelwork, the **Contractor** shall submit to the Engineer for review and comments the quality control program it plans to implement in carrying out steelwork.

6.41.7.2 The **Contractor** shall implement its quality control program in accordance with the requirements of standard CAN/CSA3 Z299.3. The program shall indicate all checks that will be made in carrying out the following steps:

6.41.7.2.1 receiving of materials;

6.41.7.2.2 fabrication and assembly of components;

6.41.7.2.3 shipping, receiving and unloading at the work site;

6.41.7.2.4 installation of finished components.

6.41.7.3 The **Contractor** shall notify the Engineer at least fourteen (14) days before the start of fabrication of the components concerned.

6.41.7.4 The **Contractor** shall allow the Engineer to access any work area at any time and shall provide any information and assistance required.

6.41.7.5 Inspection of work by the Engineer does not relieve the **Contractor** of its obligation to perform the work in accordance with the requirements set out on the drawings and in the specifications.

6.41.7.6 Destructive testing may be required by the Engineer to determine the tensile and bending limits of welded assemblies.

6.41.7.7 The **Contractor** shall ensure that all welds made on steel components are fully (100%) visually inspected (before, during and after welding) in conformity to standard CAN/CSA W59 by a certified Level 2 welding inspector, in accordance with the requirements of standard CAN/CSA W178.2. The inspector shall be hired by the **Contractor**. A copy of the visual inspection report shall be submitted to the Engineer for review.

6.41.7.8 For welding where division 3 is sufficient, the welding inspector may be replaced by a welding supervisor certified in accordance with the requirements of standard CAN/CSA W47.1.

6.41.7.9 The minimal non-destructive testing to be performed by the **Contractor** is identified in the *Special Technical Conditions*. These tests are at the **Contractor**'s expense.

6.41.7.10 The results of non-destructive testing shall be recorded in a written report to be submitted to the Engineer at least twenty-four (24) hours before the components leave the mill.

6.41.7.11 The **Owner** may conduct additional non-destructive testing of welds independently and at its own expense. In the event of welding defects, the **Contractor** shall cover the cost of any inspections of welds carried out before and after the defects are corrected.

6.41.7.12 The **Contractor** shall move and support the components to be inspected. Generally, inspections shall be carried out flat with vertical clearance of at least 1,25 m.

6.41.7.13 The Engineer shall be informed of any defects found in the work. The **Contractor** shall not make any repairs before obtaining authorization from the Engineer. The **Contractor** shall submit to the Engineer in writing for review the methods it plans to use to correct the defects. The corrective methods shall include drawings, sketches and appropriate welding procedures.

6.41.7.14 Every repaired component shall be inspected by the Engineer before being shipped from the shop.

6.41.7.15 The **Contractor** may not ship any component from the shop without written authorization from the Engineer.

6.41.7.16 Regardless of the method the **Contractor** uses to tighten the bolts and after confirming with the Engineer the final tightening by the **Contractor**, 10% of all the bolts in a given assembly, but not fewer than two (2) bolts, shall be checked jointly by the **Contractor** and the Engineer using a calibrated torque wrench according to the inspection process set out in standard CAN/CSA S6.

END OF SUBSECTION