

**PART 1 - GENERAL****1.1 DESCRIPTION**

- .1 The specialized Contractor shall provide all the materials, equipment and labour required to perform the detailing, joint design, manufacturing, fitting-up, factory painting, transportation, and installation of the steel framework.
- .2 The specialized Contractor shall also provide all parts to be embedded in concrete as well as the anchor bolts.

**1.2 RELATED SECTIONS**

The specialized Contractor is responsible for obtaining a copy of all the sections of these specifications even if they do not appear to pertain to his speciality. If he does not, it shall be understood that he agrees to the clauses and requirements of all sections in these specifications. The specialized Contractor must consult the table of contents of these specifications to have knowledge of the complete list of the specifications sections.

**1.3 REFERENCES**

- .1 The following standards and publications are mentioned in this section of the specifications. When reference is made to them, they must be consulted:
  - .1 Canadian Standards Association (CSA)
    - .1 CAN/CSA-G40.20/G40.21-04, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
    - .2 CAN/CSA-G164-M92 (C2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
    - .3 CAN/CSA-S16-01 CONSOLIDATION, Limit States Design of Steel Structures as well as CAN/CSA S16S1-05, Supplement no 1.
    - .4 CAN/CSA-S136-01 (C2007), North American Specification for the Design of Cold-Formed Steel Structural Members as well as CAN/CSA-S136S1-04, Supplement.
    - .5 CAN/CSA W47.1-03, Certification of Companies for Fusion Welding of Steel.
    - .6 CAN/CSA W48-01, Filler Metals and Allied Materials for Metal Arc Welding.
    - .7 CAN/CSA W55.3-1965 (R2003), Certification of Companies for Resistance Welding of Steel and Aluminium.
    - .8 CSA W59-03, Welded Steel Construction (Metal Arc Welding).
  - .2 American Society for Testing and Materials International, (ASTM)

## STRUCTURAL STEEL FOR BUILDINGS

- 
- .1 ASTM A36/A36M-00, Standard Specification for Carbon Structural Steel.
  - .2 ASTM A193/A193M-08b, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications .
  - .3 ASTM A307-04, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .4 ASTM A325-02, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
  - .5 ASTM A325M-00, Standard Specification for High-Strength Bolts for Structural Steel Joints (Metric).
  - .6 ASTM A490M-00, Standard Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric).
  - .3 Canadian General Standards Board (CGSB)
    - .1 CAN/CGSB-85.10-99, Protective Coatings for Metals.
  - .4 Canadian Institute of Steel Construction (CISC)/Canadian Paint and Coatings Association – CPCA (formerly the Canadian Paint Manufacturers Association - CPMA).
    - .1 CISC/CPMA 1-73A (1975), A Quick-drying One-coat Paint for Use on Structural Steel.
    - .2 CISC/CPMA 2-75, A Quick-drying Primer for Use on Structural Steel.
  - .5 Master Painters Institute
    - .1 MPI-INT 5.1-04, Structural Steel and Metal Fabrications.
    - .2 MPI-EXT 5.1-04, Structural Steel and Metal Fabrications.
  - .6 The Society for Protective Coatings (SSPC)
    - .1 SSPC-SP 3 (1995), Power Tool Cleaning.
  - .7 National Research Council Canada (NRC)
    - .1 National Building Code of Canada 2010 and Supplement
  - .8 Code de Construction du Québec - Chapter I, Building, and National Building Code - Canada 2010 (amended) as well as the User's Guide - NBC 2010: Comments on the calculation of structures (Part 4 of Division B).

## STRUCTURAL STEEL FOR BUILDINGS

- .2 Unless otherwise specified, perform structural steel work and welding work in compliance with the CAN/CSA-S16-01 and CAN/CSA S136S1-04 Standards.
- .3 The framework welding shall only be performed by a duly approved member of the Canadian Welding Bureau (CWB), in accordance with the requirements of the CAN/CSA W47.1 standard, Division 1 or Division 2.1. Check whether the subcontractor is a certified member of the CWB in the Division concerned, because the Departmental Representative will reject any specialized contractor that does not meet this requirement.

**1.4 DESIGN CRITERIA**

- .1 Structural and jointing details shall be designed in accordance with the requirements of the CAN/CSA-S16, CAN/CSA-S136 and CAN/CSA S136S1-04 standards, so that they can withstand the indicated forces, moments and shear stresses, and accommodate anticipated thermal movements.
- .2 Factory connections shall be welded.
- .3 Unless otherwise indicated on the drawings, the types of bolted joints are as follows:

Components	Types of Connections
Beams, columns	Bearing type
Bracing	Slip critical connections
Trusses	Slip critical connections

- .4 Unless otherwise indicated on the drawings, the stresses to be used in the design of connections are as follows:

Components	Stresses
Beams, columns	The more stringent of two (2) criteria: <ul style="list-style-type: none"> <li>▪ Reaction of the uniform load producing the section's ultimate resisting moment</li> <li>▪ Or 50% of the beam's shear strength</li> </ul>
Columns	<ul style="list-style-type: none"> <li>▪ The section's ultimate compressive strength and shear strength</li> </ul>
Trusses	<ul style="list-style-type: none"> <li>▪ The section's ultimate tensile strength</li> </ul>

- .5 Additional stresses induced on components to be connected:
- .1 All joints shall be designed so that no additional stresses are induced on the components to be connected.

- .2 The Departmental Representative shall reject all details that create torque, bending moment or other stresses.
- .3 The Departmental Representative shall be the only one to decide whether the details submitted are accepted or rejected.
- .4 All modifications relating to changes required by the Departmental Representative shall be at the specialized Contractor's expense.
- .6 For non-standard joints, submit sketches and design notes bearing the seal and signature of a qualified Engineer recognized in the Province of Quebec, Canada.
- .7 Use at least two bolts per bolted joint (including those where anchors are used).
- .8 The depth of a beam joint shall never be less than 50% of the beam.

## 1.5 SHOP DRAWINGS

- .1 Submit the shop drawings to the Departmental Representative.
- .2 Each shop drawing must bear the seal and signature of an Engineer who is a member in good standing of the Ordre des Ingénieurs du Québec.
- .3 Clearly indicate on the shop drawings all forming and assembly details, including cuts, cut-outs, joints, drill holes, threaded anchors, bolts, shear connectors and welds. Use the symbols indicated in the CAN/CSA W59 Standard to represent welds.
- .4 Submit to the Departmental Representative the description of the work methods, the order in which the components are to be assembled, and the type of material intended for use. Even if this formality has been fulfilled and the document submitted, the specialized Contractor remains solely responsible regarding the use of the methods, equipment, delivery mode and safety measures.
- .5 Provide the Departmental Representative with three (3) copies of each complete and detailed shop and erection drawings of the steel framework to be built. The drawings shall be provided in metric units (SI).
- .6 The shop and erection drawings shall contain all the information mentioned in Articles 4.2 and 4.3 of the CAN/CSA-S16 Standard and bear the signature of the person who verified them before their submission to the Departmental Representative.
- .7 The project title as well as the names of the Owner, Architect, Departmental Representative, Expert framework consultant and of the Contractor shall appear on each shop and erection drawing.
- .8 The shop and erection drawings shall be sent soon enough to ensure that the Departmental Representative has at least ten (10) working days to examine them.
- .9 A copy of each drawing shall be returned to the specialized Contractor who, if required, shall revise the annotated drawing(s) and resubmit it (them). If the Departmental Representative determines that the revisions are too numerous or complex, he shall return the drawing(s) without annotating it (them). The Contractor shall be responsible for making any additional copies he requires.

- .10 The specialized Contractor shall only manufacture the framework components after the Departmental Representative has returned the shop and erection drawings.

## **1.6 ASSEMBLY VIDEO**

- .1 The steel framework Contractor, in conjunction with the manufacturer of the pre-stressed concrete components, shall make an assembly video that shows in details the components installation sequences.
- .2 The sequences shall be ordered as to balance the various loads exerted on the main trusses to avoid any twisting.

## **1.7 VERIFICATION OF DIMENSIONS, MEASUREMENTS AND LEVELS**

- .1 Before manufacturing the components of the framework, take and check all the dimensions, measurements and levels on site to compare them with the ones on the drawings or to complete the information shown on the drawings.
- .2 Notify the Departmental Representative of any errors on the construction site or of any incompatibility between the dimensions taken and the instructions provided on the drawings. Await the Departmental Representative's instructions on how to correct the errors and/or make the required adjustments.
- .3 If connecting to an existing framework, check all the dimensions, measurements and levels of the existing framework before producing shop drawings of the new frame that will be connected to it. Adjust the dimensions of the parts to be built to the situation and submit the modifications to the Departmental Representative.

## **1.8 QUALITY ASSURANCE**

- .1 Submit 3 copies of shop trial reports 4 weeks prior to assembly of the structural steel work.
- .1 The shop trial reports shall indicate the steel's chemical and physical properties, as well as other relevant details before it is used for this work,
- .2 The trial reports shall be certified by qualified metallurgists authorized to work in the Province of Quebec, Canada.
- .2 Also provide an affidavit from the manufacturer of the structural steel work certifying that the products, equipment and materials used for this work comply with the relevant standards that apply to the required or indicated products, equipments and materials.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- .1 Use materials free of dirt, rust, scale, pinholes, leafing or any other defect. No used materials shall be accepted.

- .2 General structural steel: in compliance with the CAN/CSA-G40.20/G40.21 Standard of grade 350W
- .3 Hollow Structural Sections (HSS): in compliance with the CAN/CSA-G40.21 and CAN/CSA-S16 Standards, of grade 350W, class H, as indicated on the drawings.
- .4 High-strength bolts, nuts and washers: in compliance with the ASTM A325M or A490M Standard.
- .5 Anchor bolts:
  - .1 Lower strength: in compliance with the CAN/CSA G40.21 Standard, grade 300W and the ASTM A307 Standard, grade A.
  - .2 High-strength: in compliance with the ASTM-A-449 standard with a minimum yield strength of 500 MPa.
- .6 Welding materials: in compliance with the CAN/CSA W59 Standard and the CAN/CSA W48 series Standards and approved by the Canadian Welding Bureau.
- .7 Shear connectors (if required on the drawings): in compliance with the CAN/CSA W59 Standard, Clause 5.5.6 and its Appendix H.
- .8 Non-shrink grout: non-metallic pre-mixed Portland cement-based product, of a consistence appropriate for pouring and capable of achieving at least 50 MPa compression strength at 28 days, subject to the Departmental Representative's approval.
- .9 Paint:
  - .1 1-73A CISC/CPMA: "Quick-drying one-coat paint for use on structural steel", grey colour.
  - .2 2-75 CISC/CPMA: "Quick-drying primer for use on structural steel", grey colour.
- .10 Mechanical anchor bolts (when specified on the drawings) approved by the Departmental Representative. The type required, the diameter and total length are specified on the drawings.
- .11 Hot dip galvanizing: apply a minimum 600 g/m<sup>2</sup> coat of zinc on the indicated areas, in compliance with the CAN/CSA-G164 Standard.
- .12 Touch up paint for galvanized steel: Complies with CAN / CGSB-1.181 with a metal zinc content higher than 87% (% in mass of the non-volatile part) such as the "ZRC Cold Galvanizing Compound" of ZRC Worldwide. Aerosol coatings are not permitted and the dry coating film must contain 95% zinc metal.

## 2.2 FACTORY PAINTING

- .1 Structural steel components shall be cleaned, prepared and coated with a layer of primer at the workshop in compliance with the CAN/CSA-S16 Standard, with the exception of components to be embedded in concrete.
- .2 The components shall be cleaned and freed of millscale, rust, oil, dust and all other foreign material. The surfaces shall be prepared according to the SSPC-SP 3 method.

- .3 A layer of primer shall be applied at the workshop so as to produce a dry film of at least 4 mils thick, on all steel surfaces, with the exception of the following surfaces:
  - .1 surfaces embedded in concrete;
  - .2 surfaces to which shear dowels will be fastened at the construction site;
  - .3 surfaces and edges that are to be welded on site;
  - .4 friction joint contact surfaces;
  - .5 surfaces located below grade and in direct contact with the ground.
- .4 In cases where frame components are not visible in the finished building (structural steel components covered by other construction materials), at the shop, apply on the structural steel a quick-drying one-coat paint for use on structural steel, in compliance with the 1-73A CISC/CPMA Standard. Follow the requirements of this standard regarding the methods to be used, atmospheric conditions to maintain and temperatures to respect when applying the paint.
- .5 In cases where frame components are visible in the finished building (exposed structural steel components later covered with one or two coats of finish paint on site, such as a gymnasium), at the shop, apply on the structural steel a quick-drying primer for use on structural steel, which complies with the 2-75 CISC/CPMA Standard. Follow the requirements of this standard regarding the methods to be used, atmospheric conditions to maintain and temperatures to respect when applying the paint.
- .6 Paint on nuts, bolts, straight edges and angles shall be removed before it is dry.

### **PART 3 - PERFORMANCE**

#### **3.1 FORMING**

- .1 Form the steel components in compliance with the CAN/CSA-S16 Standard and according to the shop drawings submitted.
- .2 Structural members formed of welded sections shall be rejected if they are not shown as such on the shop drawings.
- .3 The use of members whose quality and/or dimensions differ from those shown is strictly forbidden without the Departmental Representative's written permission.
- .4 Drill or punch the bolt holes. All burning or cutting with a torch is forbidden.
- .5 The manufacturing and assembly tolerances are respectively those described in Sections 28.9 and 30.7 of the CAN/CSA-S16 Standard.
- .6 If required, reinforce the openings to maintain the design strength.

- .7 Where indicated on the drawings, continuously seal all steel members with a continuous weld bead and grind the welds.
- .8 Reinforce the girder web with stiffening plates at each girder-column intersection and at each concentrated load location.
- .9 Grind visible welds where required.
- .10 Provide the qualified trades persons with the templates and the parts to be embedded in the concrete or masonry.
- .11 Once the assembly is completed, touch-up the rivets, on-site welds, and bolts as well as burned or scratched surfaces.
- .12 Apply a zinc primer on galvanized surfaces in areas burned as a result of on-site welding work.
- .13 The welding companies shall be certified under the terms of Division 1 of these specifications or Article 2.1 of the CAN/CSA W47.1 Standard regarding fusion welding of steel structures, and/or the CAN/CSA W55.3 Standard regarding resistance welding of structural members.

### **3.2 MARKING**

- .1 Mark the materials in compliance with the CAN/CSA-G40.21 Standard. Do not use die-stamping. When the steel part must not be painted, stamp the mark in locations that will not be visible after assembly.
- .2 Joint markings: at the factory, mark load-bearing assemblies, assembly joints and adjustment joints.

### **3.3 ASSEMBLY**

- .1 The proposed technique, as well as the equipment used to erect the frame are subject to the Departmental Representative's approval. However, this approval shall in no way release the specialized Contractor from his full responsibility regarding the choice of technique and the handling of the equipment that will enable him to perform his work quickly and in complete safety.
- .2 Assemble the steel components in compliance with the CAN/CSA-S16 Standard and according to the shop drawings.
- .3 Assemble the metal structures ensuring that they are square, plumb, aligned, accurately adjusted, and have tight joints and intersections.
- .4 Where indicated on the drawings, continuously seal all steel members with a continuous weld bead and grind the welds.
- .5 Obtain the Departmental Representative's written authorization before cutting or modifying structural steel members on site.
- .6 Once the assembly is completed, touch up the bolts, rivets, welds, and surfaces where the factory-applied galvanization is degraded.

## STRUCTURAL STEEL FOR BUILDINGS

- .7 Deliver, handle and store all steel on site to avoid any damage. Damaged members and joints shall be rejected.
- .8 Take measures so as not to overload on-site structures which are already completed or under construction, beyond the allowable loads indicated on the drawings for these structures.
- .9 Where required on the drawings, weld shear connectors to the load-bearing components of the frame, using steel decking if required, following the manufacturer's instructions.
- .10 Notify the Departmental Representative as soon as possible regarding any defects detected in the assembly of factory-built components and abide by his decision regarding the corrections to be made.
- .11 Straighten slightly deformed components before assembling them on site and replace those that are damaged to the point where the Departmental Representative raises doubts regarding their effectiveness.
- .12 It is strictly forbidden to perform joint welds on site unless they are indicated on the shop drawings or the Departmental Representative has approved them beforehand.
- .13 It is strictly forbidden to drill, cut or modify in any way a component of the frame on site without having obtained the Departmental Representative's written authorization beforehand.
- .14 Galvanized steel framing should not be cut, drilled, or modified in any way on site. If structural modifications are made to the galvanized steel structural framing, they must be returned to the workshop to be re-galvanized.

**3.4 ON-SITE QUALITY CONTROL**

- .1 The Departmental Representative shall have access to the shop at all times to inspect the manufacturing and assembly work performed there.
- .2 The Departmental Representative may require that analytical trials, estimates and calculations be performed. Replace all work or materials found to be defective, at no expense and without any unnecessary project delays.
- .3 At the Departmental Representative's request, provide a factory certificate attesting that the quality of the steel meets the requirements of the contract documents.
- .4 At the Departmental Representative's request, provide him with certified copies of the steel factory inspection reports concerning the chemical and physical properties of the steels used.
- .5 A testing laboratory approved by the Departmental Representative shall inspect and test materials and craftsmanship.
- .6 The Departmental Representative may require that the Laboratory assess certain welds he considers important through visual inspection, or by performing penetrating liquid, magnetic particle, x-ray or ultrasound examinations. Cooperate fully on the performance of these tests and if required make the necessary repairs following these inspections.

- .7 The parts of welds that have been repaired shall be fully re-inspected following the same method used to perform the first inspection.
- .8 The Laboratory shall check the shear connectors using the following method: after welding, the specialized Contractor shall remove the ceramic ring around each connector and the Laboratory shall visually inspect the weld bead. Beads extending less than 360 degrees shall undergo more thorough inspection. These types of connectors shall be tested using a hammer to bend the connector 15 degrees from vertical toward the nearest side of the embedded plate or structural component. Welds that bend without breaking are acceptable. Bent connectors shall not break when straightened after the test. In addition, the Laboratory shall use the same method to conduct random testing on one percent of connectors where the weld bead is visually acceptable. The specialized Contractor shall replace defective connectors at his expense.
- .9 The Departmental Representative may ask the specialized Contractor to check whether the columns are plumb, in his presence. The Contractor shall provide the equipment required to perform this audit.
- .10 The Departmental Representative may ask the specialized Contractor to check the bolted joints, in his presence. High-strength joint shall comply with the CAN/CSA-S16 Standard, clauses 23.7 and/or 23.8.
- .11 The inspection and verification to ensure the framework is aligned, plumb and level shall comply with the CAN/CSA-S16 Standard, clause 29.7.

### **3.5 JOINTS**

- .1 Unless otherwise indicated on the drawings, all factory-built joints shall be welded. If friction joints are specified, high-strength bolts shall be used.
- .2 High-strength bolts shall be used on all friction joints performed on site, in accordance with Section 23 of the CSA-S16-01 standard.

### **3.6 TEMPORARY BRACING**

- .1 Assembly the steel framework, ensuring it is aligned and plumb to specified tolerances. Use temporary bracing for the assembly where necessary to offset any load to which the frame may be subjected, including wind, snow, equipment, and its use.  
  
Leave these braces in place without disturbing them as long as they are required for safety, and until final installation of permanent braces.
- .2 The specialized Contractor shall be responsible for any negligence in adequately anticipating the stresses exerted during assembly of the framework.
- .3 Do not perform permanent bolting, welding or riveting as long as the braced framework has not been properly aligned.
- .4 The specialized Contractor is entirely responsible for the temporary stability of the steel frame.

**3.7 GROUT APPLICATION**

- .1 Where indicated on the drawings, after the framework has been erected and aligned, completely fill the space under column base plates or other supports with the specified non-shrink grout, following the manufacturer's written instructions.
- .2 Install the grout and wait until it has achieved 75% of its specified strength before pouring the concrete slabs on steel decking.

**3.8 ON-SITE PAINTING**

- .1 Unless otherwise indicated, all damaged surfaces and unpainted surfaces in the workshop must be retouched with a paint conforming to ICCA / PSAC 1-73A or ICCA / PSAC 2-75, depending on the case. Prepare surfaces to be retouched in accordance with SSPC SP-3. Retouch for galvanized steel.
- .2 Following approval by the Departmental Representative, galvanized steel framing with surfaces that have been damaged or scuffed during transport, handling or assembly shall be retouched with a zinc-rich paint on the surfaces in question.
- .3 Galvanized steel framing with a damaged surface or cumulative scratches for an element greater than 10 cm<sup>2</sup> shall be disassembled, returned to the workshop to be re-galvanized and re-installed.

**3.9 SUBSTITUTION**

- .1 Do not change the dimension and size of the members shown on the drawings without the Departmental Representative's written authorization. Substitution of members with units stronger than those specified may be accepted at no additional cost.

**END OF SECTION**