

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 02 41 16.01 – Structure Demolition
- .2 Section 02 83 10 – Lead-Base Paint Abatement – Minimum Precautions
- .3 Section 09 97 19 – Painting Exterior Metal Surfaces

**1.2 DEFINITIONS**

- .1 Certificate of Conformance: means a document issued by the Quality Verification Engineer confirming that the specified components of the Work are in general conformance with the requirements of the Contract Documents.
- .2 Engineer: means a professional engineer licensed to practice in the provinces of Ontario and Québec.
- .3 Erection Diagrams: means drawings showing the dimensioned layout of the steel structure, from which shop details are made, and that correlate the fabricator's piece markings with the location in the structure.
- .4 Faying Surface: means the mating surface of a member that is in contact with another member to which it is to be joined.
- .5 Fracture Critical Member: means a member, including attachments, in a single load path structure that is subject to tensile stress and whose failure could lead to collapse of the structure.
- .6 Visual Weld Inspector: means an individual who is a Canadian Welding Bureau (CWB) certified Level II or Level III inspector according to the requirements of CSA W178.2 and has documented evidence of professional knowledge, skill, and experience in the inspection of fabrication and erection of steel bridges.
- .7 New Steel: means structural steel that has not previously been used.
- .8 Non-Destructive Testing Technician: means an individual who has documented evidence of training, professional knowledge, skill, and experience in non-destructive testing of structural steel welds and material, and has a valid certificate showing qualification to a Level II or III according to CAN/CGSB 48.9712 and the CWB for the non-destructive testing specified.
- .9 Primary Tension Member: means a primary member or component of a primary member, within a multiple load path structural system, that is subject to tensile stress.
- .10 Snug Tight: Snug tight is the condition that is attained by the full effort of an ironworker using an ordinary spud wrench to bring the connected plies into firm contact. It represents 15% of minimal tension described at clause A.10.1.6.4 of CAN/CSA-S6-14.

**1.3 INCLUSIONS**

- .1 The work under this section, except for the Unit Price items described in paragraph 1.3.2, will not be measured but will be paid as a fixed price item under the lump sum portion of the contract.

The work under the lump sum portion of the contract includes:

- .1 Pin spacer at L25W – Non-destructive investigation
- .2 Diagonal M39W-U40W - Non-destructive testing
- .3 Diagonal U36W-M37W - Non-destructive testing
- .4 Floorbeam 43 – Non-destructive testing
- .5 Girders from nodes 22-23 - Non-destructive testing
- .6 Stringer S3E from nodes 51-52 - Non-destructive testing
- .7 Stringer S3E from nodes 54-55 - Non-destructive testing
- .8 Vertical web patch repair - L10E-M10E
- .9 Vertical angle reinforcement at Floorbeam 14
- .10 Vertical web splice plate repair - L27E-M27E
- .11 Vertical L27W-M27W - Clip corners of web splice plate
- .12 Floorbeam 43 east cantilever web repairs
- .13 Floorbeam 43 west cantilever stiffener plate installation
- .14 Truss 'B' transverse bracing replacement at pier 5
- .15 Floorbeam 13 - Flange replacement
- .16 Floorbeam 14 - Flange replacement
- .17 Floorbeam 22 - Flange replacement
- .18 **(Addendum No. 2)** Stringer S2E replacement – L18-L19 & L23-L24

Costs associated to the work described in this section that does not pertain to the items listed above, or to the items covered in paragraph 1.3.2 below, are also deemed to be included in the lump sum portion of the contract. All work included in the lump sum portion of the contract must be incorporated and detailed in the cost breakdown submitted by the Contractor after contract award as per Section 01 00 10 – General Instructions.

- .2 The following items of work will be paid based on the actual quantities measured on site and unit price quoted in the Bid and Acceptance Form.

For measurement purposes of the following items, a count shall be made of the number (each) of the completed repairs.

- .1 Pin spacer replacement
- .2 Exterior pin plate replacement - Type 1
- .3 Exterior pin plate replacement - Type 2
- .4 Bottom chord bracing gusset plate replacement - Type 1
- .5 Bottom chord bracing gusset plate replacement - Type 2
- .6 Bottom chord bracing gusset plate replacement - Type 3
- .7 Bottom chord bracing gusset plate replacement - Type 4
- .8 Diaphragm Top Flange Replacement at Piers 2 and 3
- .9 Batten plate replacement – Type 1 (batten plate with stiffening angles)
- .10 Batten plate replacement – Type 1 (stiffening angles only)
- .11 Batten plate replacement – Type 2 (batten plate with stiffening angles)
- .12 Batten plate replacement – Type 2 (stiffening angles only)

- .13 Bottom batten plate replacement – Type 3 (batten plate with stiffening angles)
- .14 Top batten plate replacement – Type 3a (batten plate with stiffening angles and clip angles)
- .15 Top batten plate replacement – Type 3b (batten plate with stiffening angles and clip angles)
- .16 Top batten plate replacement – Type 3a/3b (clip angles only)
- .17 Top batten plate replacement – Type 4
- .18 Top batten plate replacement – Type 4a
- .19 Batten plate replacement – Type 5 (batten plate with stiffening angles)
- .20 Batten plate replacement – Type 5a
- .21 **(Addendum No. 2)** Top batten plate replacement – Type 6
- .22 **(Addendum No. 2)** Batten plate replacement – Type 6a
- .23 **(Addendum No. 2)** Batten plate replacement – Type 6b
- .24 Lattice bar replacement - Type 1
- .25 Lattice bar replacement - Type 2
- .26 Lattice bar replacement - Type 3
- .27 Lattice bar replacement - Type 4
- .28 Bottom chord mid-height diaphragm plate replacement
- .29 Bottom chord centre web strengthening - L32W-L33W
- .30 Exterior cover plate replacement – L30W
- .31 Bottom chord exterior web strengthening - L11W-L12W
- .32 Bottom chord full lattice replacement to new X pattern
- .33 Vertical web patch repair - Type 1
- .34 Vertical web patch repair - Type 2
- .35 Vertical bearing block replacement
- .36 Vertical Cross-Frame Brace Repair - Type 1 - Connection replacement
- .37 Vertical Cross-Frame Brace Repair - Type 2 - Connection replacement
- .38 Knee brace replacement - Connection replacement
- .39 Truss sway brace full replacement
- .40 Floorbeam web patch repair at truss vertical
- .41 Floorbeam web patch repair at intermediate locations
- .42 Floorbeam unused clip angle and corbel removal
- .43 Floorbeam top tension strap replacement
- .44 Floorbeams 14 & 22 - Clip angle and filler plate replacement
- .45 Girder bottom flange splice repair at Floorbeam 14
- .46 Existing rivet replacement with bolt
- .47 Existing bolt replacement with bolt
- .48 Repair east lane railing posts at south trestle
- .49 **(Addendum No. 2)** Diagonal web patch repair

For measurement purposes of the following items, a measurement shall be made of the length of the completed repairs to the nearest 0.01 meter.

- .50 Bottom chord flange angle replacement
- .51 **(Addendum No. 2)** Vertical flange angle replacement - Type 1
- .52 **(Addendum No. 2)** Vertical flange angle replacement – Type 2
- .53 **(Addendum No. 2)** Diagonal flange angle replacement – Type 1
- .54 **(Addendum No. 2)** Diagonal flange angle replacement – Type 2
- .55 Vertical Cross-Frame Brace Repair - Type 1 - Angle replacement
- .56 Knee brace replacement - Angle replacement
- .57 **(Addendum No. 2)** Top chord flange angle replacement

All costs related to each of the unit price items shall be included in the unit prices quoted in the Bid and Acceptance Form. The quoted unit prices shall be mean prices to do the work.

Item 1.3.3.43 existing rivet replacement with bolts, and item 1.3.3.44 existing bolt replacement with bolts, are only intended for the replacement of miscellaneous deteriorated rivets and bolts on elements that are not scheduled to be repaired, strengthened, or replaced, as identified by the Departmental Representative. The cost of all other rivet and bolt replacements are included in the cost pertaining to each individual repair detail.

- .3 The fixed price items detailed in the Contractor's cost breakdown, and the unit price items listed in the Bid and Acceptance Form shall be composite items for all costs to complete the work in accordance to the contract documents, including but not limited to:
  - .1 Access including all access equipment and/or access works;
  - .2 Field measurements;
  - .3 Preparation and submission of all documents associated to the work;
  - .4 Templates;
  - .5 Temporary bracings and supports;
  - .6 Protections required to allow the execution of works under the lanes (e.g. covering the grating);
  - .7 The removal and disposal of steel components including rivets and bolts;
  - .8 Grinding off existing welds as required;
  - .9 Marking of steel components;
  - .10 Preparation, supply, fabrication and installation of new steel pieces;
  - .11 Replacement with new bolts including reaming of holes if required;
  - .12 The installation of new bolts to fill the abandoned holes;
  - .13 Drilling existing and/or new structural steel members for new bolts installation;
  - .14 The welding and preheating of structural steel components;
  - .15 All costs related to the work execution (e.g. supervision, security, shelter, lighting, heating, overtime, etc.) depending of the allowed working hours (day, night and/or weekends);
  - .16 Surface preparation and coating of new structural steel according to the requirements of Section 09 97 19;
  - .17 Surface preparation and coating of existing structural steel according to the requirements of Section 09 97 19;

- .18 Galvanization;
- .19 Management and disposal of waste materials from coating removals (spent material that is tested to be non-leachate toxic). In the event that the spent material is tested to be leachate toxic, payment of any costs for the disposal of the spent material as hazardous waste, that are additional to those for disposal as non-hazardous solid industrial waste, shall be paid as Extra Work after receipt of disposal weigh ticket(s).
- .20 Handling, transportation, and delivery costs including of road signs and/or flagmen required upon delivery of equipment and materials;
- .21 Inspection and testing fees;
- .22 Management and administration fees related to the prescribed work;
- .23 Any other labor, equipment or materials required to complete the work required as described herein, and reflected in the contract documents.
- .4 Calculate own quantities for the complete execution of the work as demonstrated in the plans and specifications. Consult the plans in the present contract and all other existing plans made available, and visit the site to establish own quantities and costs.
- .5 All costs, including the cost of access, inspection, and testing, associated with the correction or repairs of rejectable defects are the responsibility of the Contractor.
- .6 Progress payments will only be made after:
  - .1 Completion of work in conformance with the contract documents.
  - .2 Completion of required Quality Control Inspections by the Contractor associated to the work being paid;
  - .3 Submission and acceptance of all documentation required in this specification associated to the work being paid; and,
  - .4 Completion of required Quality Assurance Inspection by the Departmental Representative associated to the work being paid.

#### **1.4 REFERENCES**

- .1 ASTM International
  - .1 ASTM A325M-09, Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength Metric.
  - .2 ASTM F436 Standard Specification for Hardened Steel Washers.
  - .3 ASTM A490M-09, Standard Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints.
  - .4 ASTM A563 Standard Specification for Carbon and Alloy Steel Nuts.
- .2 American Society of Mechanical Engineers
  - .1 ASME B46.1 Surface Texture, Surface Roughness, Waviness and Lay.
- .3 CSA International
  - .1 CSA G40.20/G40.21-04 (R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
  - .2 CAN/CSA G164-M92 (R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.

- .3 CAN/CSA S6-14, Canadian Highway Bridge Design Code.
- .4 CSA S16-09, Design of Steel Structures.
- .5 CSA W47.1-09 (R2014) Certification for Companies for Fusion Welding of Steel.
- .6 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding.
- .7 CSA W59-14, Welded Steel Construction, (Metal Arc Welding).
- .8 CSA W178.1-14 Certification of Welding Inspection Organizations.
- .4 International Organization for Standardization
  - .1 ISO/IEC 17025-2005 General Requirements for the Competence for the Testing and Calibration Laboratories.
- .5 Natural Resources Canada
  - .1 CAN/CGSB 48.9712-2014 Non-destructive Testing, qualification and Certification of Personnel.

## **1.5 DESIGN REQUIREMENTS**

- .1 General:
  - .1 Design shall be according to CAN/CSA S6, the Ontario Structural Manual and the “Manuel de conception des structures du Québec”.
- .2 Welding:
  - .1 Welding design shall be according to CSA W59.
  - .2 Welding procedures shall be according to CSA W47.1 and CSA W59, except where modified by CAN/CSA-S6, Clause 10.24.5.
  - .3 Symbols for welding and non-destructive testing shall be according to CSA W59.

## **1.6 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 General
  - .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 When other authorities are involved in the approval of the design or construction of a highway structure, submissions shall be made at least 5 weeks prior to commencement of work and one additional copy of the submission shall be provided for each authority.
  - .3 The requirements of each authority shall be satisfied prior to commencement of fabrication.
- .2 Product Data
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for structural steel and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit copy of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .3 Field Surveys and Verifications

- .1 All dimensions shown on the Contract Drawings are approximate only. The dimensions provided are based on previous Contract Drawings. However, as with all existing structures, the Contractor can expect and should plan on encountering variances and deviations between information found in the drawings and the site conditions.
  - .2 Actual field conditions may require modifications in construction details. Therefore, verify and confirm all dimensions in the field, prior to preparation of shop drawings for fabrication of any steel component, to ensure proper fit of all new structural components where they are tied to or supported by existing structural elements.
  - .3 All costs and/or delays resulting from the Contractor's failure to conduct the field surveys and verifications of the existing elements are the responsibility of the Contractor.
  - .4 Submit to the Departmental Representative copies of these field surveys and verifications for the review of the Contractor's shop drawings and for inclusion into the Construction records for the project.
  - .5 Report any discrepancy to the Departmental Representative before performing the work. The work must be executed to meet the field conditions, subject to the Departmental Representative's approval.
  - .6 The details shown in the plans with respect to the existing conditions and any variations in those conditions depict the most common and known variations. The plans do not comprehensively show all the variations. Identify variations in the field that are not shown in the plans and submit proposed details for these locations with shop drawing submittals.
- .4 Steel Fabricator Qualifications
- .1 Provide information on a minimum of three (3) similar projects completed in the last five (5) years in accordance with the CHBDC requirements, including project name, client name and contact information, and detailed scope of work.
  - .2 The steel fabricator must hold either the Canadian Institute of Steel Construction (CISC) Steel Structures Certification or Steel Bridges Certification. Proof of certification shall be submitted before commencing work.
  - .3 The selected steel fabricator shall have sufficient capacity and flexibility in their operations to fabricate and deliver the structural steel components within the General Contractor's schedule to complete all other works required by the substantial completion date identified elsewhere in the Contract Documents.
- .5 Shop Drawings and Welding Procedures
- .1 Submit the shop drawings, welding procedures, and an estimate of the fabrication time to the Departmental Representative at least 14 days prior to commencement of fabrication, for review.
  - .2 Prior to making a submission, the seals and signature of a professional Engineer licensed in the provinces in Ontario and Quebec shall be affixed on the shop drawings and welding procedures verifying that the details and procedures are consistent with the Contract Documents.
  - .3 Independently develop and draw shop drawings from the contract plans and field measurements. The Departmental Representative's CAD drawings will not be

made available to be used to develop shop or other required construction drawings.

- .4 Shop drawings shall include at least the following:
  - .1 The date and the names of the persons who carried out the field measurements.
  - .2 Full detail dimensions and sizes of all component parts of the structure based on field measurements. These dimensions shall make allowance for changes in shape due to weld shrinkage, camber, coating, and any other effects that cause finished dimensions to differ from initial dimensions.
  - .3 Erection Marks.
  - .4 All necessary specifications for the materials to be used.
  - .5 Identification of areas requiring special surface treatment.
  - .6 Identification of fracture-critical and primary tension members and component parts. Attachments having welded to the tension zone of a fracture-critical or primary tension member shall be treated as part of that member.
  - .7 Bolt installation requirements, including number of fitting up bolts required at each connection and oversize and slotted holes.
  - .8 Sequence of rivet removal and bolt installations.
  - .9 Details of all welds including welding procedures.
  - .10 Identification of material and welds requiring non-destructive testing, including the limits of the weld undergoing testing and the frequency and type of testing.
  - .11 Temporary welds.
  - .12 Location of shop and field splices.
- .5 The shop drawings must certify that the dimensions and connection details (i.e. bolt spacing) shown are complete and accurately reflect in-situ conditions to allow erection of the new structural components, including but not limited to:
  - .1 Bracing – Confirm existing member lengths, and gusset plate bolt/rivet arrangements at each connection, as well as the clear distance between top and bottom gusset plates
  - .2 Member strengthening plates or channels – Confirm existing bolt/rivet arrangements at ends, overall length of strengthening plate or channel required.
  - .3 Miscellaneous steel repairs (replacement of angles, gusset plates, batten plates, lattice, etc.) – Confirm all existing component sizes, rivet/bolt spacing. Location and length and/or extent of repairs to be as directed by the Departmental Representative. .
- .6 Proposed welding procedures to be stamped and approved by Canadian Welding Bureau.
- .7 Non-standard or non-prequalified welding procedures to be stamped and signed by a welding engineer licensed in the province of Ontario and Québec.
- .8 The fabricator cannot commence fabrication until the Departmental Representative's review is complete and the documents are approved.



- .9 The fabricator cannot commence fabrication until he has received one set of shop detail drawings and welding procedures sealed and signed by an Engineer.
- .10 The fabricator must have a copy of the shop detail drawings and welding procedures at the manufacturing plant during fabrication.
- .6 Removal and Erection Procedure, Diagrams, Drawings and Calculations
  - .1 Submit the removal and erection procedure, diagrams, drawings and calculations of all structural steel work to the Departmental Representative at least 14 days prior to commencement of erection, for review.
  - .2 Prior to making a submission, the seals and signature of a professional Engineer licensed in the provinces in Ontario and Quebec shall be affixed on the removal and erection procedure, diagrams, drawings and calculations verifying that the removal and erection procedure, diagrams, drawings and calculations are consistent with the Contract Documents
  - .3 The removal and erection procedures shall include at least a description of the following:
    - .1 Methods
    - .2 Temporary bracing and strengthening
    - .3 Sequence of removal and erection
    - .4 Type of equipment proposed for use in removing and erecting structural steel.
  - .4 The removal and erection diagrams and drawings shall include at least the following:
    - .1 Principal dimensions of the bridge.
    - .2 Erection marks.
    - .3 Sizes and weights of all members.
    - .4 Field welding requirements, including identification of welds requiring non-destructive testing.
    - .5 Size and type of bolts.
    - .6 Bolt installation requirements, including the number of fitting up bolts required at each connection and identification of oversize and slotted holes.
    - .7 Bracing during erection of structural steel.
    - .8 Treatment at faying surfaces for joints designed as slip critical.
  - .5 Falsework drawings submitted to bear signature and stamp of qualified professional engineer registered or licensed in provinces of Ontario and Quebec, Canada.
  - .6 Verify the access to all proposed structural steel works and inform the Departmental Representative of any access limitations that may require adjustments to the proposed design solutions.
  - .7 Submission of removal and erection procedures, diagrams, drawings and calculations, or their review, shall not relieve Contractors of responsibility for providing proper methods, equipment, workmanship, safety precautions, and full stability of the structure.

- .8 Do not commence erection until the Departmental Representative's review is complete and the documents are approved.
- .9 Do not commence erection until receiving the removal and erection procedures, diagrams, drawings and calculations sealed and signed by an Engineer.
- .10 Have a copy of the erection diagrams and the erection procedure drawings and calculations at the site during erection.
- .7 Mill Test Certificates
  - .1 Prior to the use of any material in fabrication, a copy of the mill test certificates for that material shall be submitted to the Departmental Representative, confirming that the material is according to the Contract Documents.
  - .2 Copies of the mill test certificates for all material to be used in the fabrication shall be available for review at the fabricating plant during fabrication. The certificates shall show that the material is according to the Contract Documents.
  - .3 If the material cannot be identified by mill test certificates, coupons shall be taken and tested and these test certificates shall be made available.
  - .4 When mill test certificates originate from a mill outside of Canada or the United States of America, have the information on the mill test certificate verified by testing at a Canadian laboratory. This laboratory shall be certified by an organization accredited by the Standards Council of Canada to comply with the requirements of ISO/IEC 17025 for the specific tests or type of tests required by the material standard specified on the mill test certificate. The mill test certificates shall be stamped with the name of the Canadian laboratory and appropriate wording stating that the material is according to the specified Contract requirements. The stamp shall include the appropriate material specification number, testing date (i.e., yyyy-mm-dd), and the signature of an authorized officer of the Canadian laboratory.
- .8 Test Reports for Fasteners
  - .1 Proof that the bolts, nuts, and washers meet the chemical composition, mechanical properties, dimensions, workmanship, and head burst as required by ASTM A 325, ASTM A 563, or ASTM F 436 shall be submitted to the Departmental Representative. Verification of the acceptability of assemblage of zinc-coated bolts, nuts, and washers delivered to the job site shall also be submitted to the Departmental Representative.
  - .2 For bolts, nuts, and washers supplied from a manufacturer outside Canada or the United States of America, the above information shall be verified by testing at a Canadian laboratory as outlined in the Mill Test Certificates clause.
- .9 As-Built Drawings
  - .1 Within 14 days of completion of steel work, Contractor must submit As-Built Drawings for approval.
  - .2 For each component including bolts, the as-built drawings must clearly identify the material as to heat number, corresponding mill test certificate, and colour coding or other identifying markings.
  - .3 As-Built Drawings must be prepared concurrently with progress of work.
- .10 Return of Submissions

- .1 Each submission will be returned by the Departmental Representative as one of the following:
  - .1 Returned with the wording that allows for permission to construct. In this case, work can commence on receipt of the drawings by the Contractor.
  - .2 (OPSS906)Returned with the wording that allows for permission to construct as noted. In this case, work can commence on receipt of the drawings by the Contractor. The drawings shall be updated as noted and shall be sealed and signed by an Engineer stating the drawings have been revised according to the noted comments.
  - .3 (OPSS906)Showing only required changes. In this case, the drawings shall be updated as required and the submission process repeated.

## **1.7 QUALITY VERIFICATION ENGINEER**

- .1 The Quality Verification Engineer(s) shall be an intermediate engineer with experience in the design of Structural Steel, or alternatively with demonstrated experience through providing satisfactory quality verification services in which the work was of similar scope to that in the Contract. The Quality Verification Engineer(s) shall be retained by the Contractor to determine if the work is in general conformance with the Contract Documents and to issue Certificate(s) of Conformance. The QVE must be an independent party, and cannot be an employee of the Contractor.

## **1.8 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Provide protective blocking for lifting, transportation and storing.
  - .1 Exercise care during fabrication, transportation and erection so as not to damage steel components.
  - .2 Do not notch edges of members.
  - .3 Do not cause excessive stresses.
- .3 Mark mass on members weighing more than 0.5 tonne.
- .4 The nuts, bolts, and washers shall be supplied and shipped together as an assembly from the same manufacturer.
- .5 Ensure that no portion of steel comes into contact with ground.
- .6 Store in a location where steel will not be subject to surface contamination.
- .7 Replace defective or damaged materials with new.
- .8 Provide Departmental Representative with delivery schedules minimum 7 days prior to shipping.

## **1.9 QUALITY ASSURANCE**

- .1 The Departmental Representative may choose to conduct visual inspection, non-destructive testing, and sampling in the fabricating shop and in the field to confirm the material supplied, fabrication, and erection has been done as specified in the Contract Documents.

- .2 Supply electric power, scaffolding, protection from the weather, and free access for inspection and testing of material, to all aspects of the fabrication, delivery, and erection of the structural steel.
- .3 Assume all costs associated to providing access and to loss of productivity caused by Quality Assurance inspections. The costs are deemed to be included in the overall cost of the contract.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Structural steel: to CSA G40.20/G40.21, grade 350W unless otherwise noted on Contract Drawings or elsewhere. Rolled HSS sections to ASTM A500.
- .2 High strength bolts: to be galvanized ASTM A325 Type 1, unless otherwise noted on Contract Drawings or elsewhere.
- .3 High strength nuts (heavy hex type), and hardened washers: to be galvanized ASTM A563DH and ASTM F436-1 suitable for use with types of bolts being specified.
- .4 Welding electrodes, electrode and flux or electrode and gas combinations shall be low hydrogen (level H16 or less) and shall be according to CSA W47.1, CSA W48, and Section 12 of CSA W59. The weld filler metal in fracture-critical and primary tension members shall meet the Charpy V notch impact energy requirements of CAN/CSA-S6, Table 10.14.
- .5 Hot dip galvanizing: to CAN/CSA G164, minimum zinc coating of 600 g/m<sup>2</sup>.

### **2.2 SOURCE QUALITY CONTROL**

- .1 Submit Departmental Representative copies of certified test reports for Charpy V-notch test, if such tests are required.

## **Part 3 Execution**

### **3.1 OPERATIONAL CONSTRAINTS**

- .1 Pin spacer replacement:
  - .1 Follow the procedure indicated on the Contract Drawings.
  - .2 Removal will NOT be permitted without providing temporary bracing.
- .2 Exterior pin plate replacement:
  - .1 Follow the procedure indicated on the Contract Drawings.
  - .2 Remove and replace only one plate on only one side of the built up section at a time.
- .3 Bottom chord bracing gusset plate replacement:
  - .1 Follow the procedure indicated on the Contract Drawings.
  - .2 Remove and replace only one plate on only one side of the built up section at a time.
  - .3 Removal will NOT be permitted without providing temporary bracing.

- .4 Diaphragm top flange replacement at piers 2 and 3: Follow the procedure indicated on the Contract Drawings.
- .5 Lattice and batten plates:
  - .1 Remove and replace lattice or batten plates on only one side of the built up section at a time.
  - .2 Removal will NOT be permitted without providing temporary bracing.
  - .3 Replace batten plates one half at a time (in two sections) where necessary to meet this requirement.
- .6 Bottom chord mid-height diaphragm plate replacement: Follow the procedure indicated on the Contract Drawings.
- .7 Bottom chord centre web strengthening – L32W-L33W:
  - .1 Follow the procedure indicated on the Contract Drawings.
  - .2 Strengthening of more than one side of a member at a time will NOT be permitted.
  - .3 Strengthening of coincident members (i.e. having the same truss joint designations) on the east and west truss at the same time will NOT be permitted.
  - .4 No live load on the bridge in accordance with the traffic constraints stipulated in Section 01 14 00 - Work Restrictions.
  - .5 Construction loads on the bridge in accordance with the design requirements stipulated in Section 01 54 23 – Temporary Works.
- .8 Exterior cover plate replacement:
  - .1 Follow the procedure indicated on the Contract Drawings.
  - .2 Remove and replace only one plate on only one side of the built up section at a time.
- .9 Bottom chord flange angle replacement:
  - .1 Remove and replace only one flange angle at a time on truss bottom chord.
  - .2 No live load on the bridge in accordance with the traffic constraints stipulated in Section 01 14 00 - Work Restrictions.
  - .3 Construction loads on the bridge in accordance with the design requirements stipulated in Section 01 54 23 – Temporary Works.
- .10 Bottom chord exterior web strengthening – L11W-L12W:
  - .1 Follow the procedure indicated on the Contract Drawings.
  - .2 Strengthening of more than one side of a member at a time will NOT be permitted.
  - .3 Strengthening of coincident members (i.e. having the same truss joint designations) on the east and west truss at the same time will NOT be permitted.
  - .4 No live load on the bridge in accordance with the traffic constraints stipulated in Section 01 14 00 - Work Restrictions.
  - .5 Minimal construction loads on the bridge in accordance with the design requirements stipulated in Section 01 54 23 – Temporary Works.

- .6 Strengthening of west truss bottom chord member L11-L12 must be complete prior to any other structural repairs on the bridge.
- .11 Bottom chord full lattice replacement to new X pattern:
  - .1 Follow the procedure indicated on the Contract Drawings.
  - .2 Remove and replace lattice on only one side of the built up section at a time.
  - .3 Removal will NOT be permitted without providing temporary bracing.
  - .4 Replacement on coincident members (i.e. having the same truss joint designations) on the east and west truss at the same time will NOT be permitted.
  - .5 Construction loads on the bridge in accordance with the design requirements stipulated in Section 01 54 23 – Temporary Works.
- .12 Vertical web patch repair: Follow the procedure indicated on the Contract Drawings.
- .13 Vertical bearing block replacement at truss vertical: Follow the procedure indicated on the Contract Drawings.
- .14 Vertical angle reinforcement at Floorbeam 14: Follow the procedure indicated on the Contract Drawings.
- .15 Vertical web splice plate repair and clipping of corners: Follow the procedure indicated on the Contract Drawings.
- .16 Vertical and diagonal flange angle replacement:
  - .1 Strengthening of more than one side of a member at a time will NOT be permitted.
  - .2 Strengthening of coincident members (i.e. having the same truss joint designations) on the east and west truss at the same time will NOT be permitted.
- .17 Vertical cross-frame brace repair, knee brace replacement and truss sway brace replacement:
  - .1 Follow the procedure indicated on the Contract Drawings.
  - .2 Removal will NOT be permitted without providing temporary bracing.
- .18 Floorbeam web patch repair: Follow the procedure indicated on the Contract Drawings.
- .19 Floorbeam top tension strap replacement:
  - .1 Follow the procedure indicated on the Contract Drawings.
  - .2 Removal will NOT be permitted without providing temporary support of the cantilevers.
  - .3 No live load on the cantilevers in accordance with the traffic constraints stipulated in Section 01 14 00 - Work Restrictions.
- .20 Floorbeam 43 east cantilever repairs and west cantilever stiffener installation: Follow the procedures indicated on the Contract Drawings.
- .21 Truss 'B' transverse bracing replacement at pier 5:
  - .1 Follow the procedure indicated on the Contract Drawings.
  - .2 Removal will NOT be permitted without providing temporary bracing.
- .22 Floorbeams 13, 14 & 22 – Flange angle replacement:

- .1 Follow the procedure indicated on the Contract Drawings.
- .2 Removal will NOT be permitted without providing temporary support of the cantilevers.
- .3 No live load on the bridge in accordance with the traffic constraints stipulated in Section 01 14 00 - Work Restrictions.
- .23 Floorbeams 14 & 22 – Clip angle and filler plate replacement:
  - .1 Follow the procedure indicated on the Contract Drawings.
  - .2 No live load on the bridge in accordance with the traffic constraints stipulated in Section 01 14 00 - Work Restrictions.
- .24 Girder bottom flange splice repair at Floorbeam 14:
  - .1 Follow the procedure indicated on the Contract Drawings.
  - .2 No live load on the bridge in accordance with the traffic constraints stipulated in Section 01 14 00 - Work Restrictions.
- .25 Deteriorated rivet and bolt replacement: Remove and replace no more than 10% of the rivets and bolts in any given member connection at one time.
- .26 Miscellaneous steel components:
  - .1 Do not remove any existing structural steel element not specifically designated on the drawings for removal without the Departmental Representative's written authorization.

### **3.2 PREPARATION**

- .1 Clean steel surfaces as directed by Departmental Representative when staining or defacing occurs.
- .2 Verify location of existing steel components to be strengthened or rehabilitated, before erection of structural steel; report discrepancies to Departmental Representative.
- .3 Verify conditions of substrates previously installed under other Sections or Contracts are acceptable for structural steel installation in accordance with manufacturer's written instructions.
  - .1 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

### **3.3 FABRICATION**

- .1 General:
  - .1 The fabrication shall be according to CAN/CSA-S6-14, Clause A10.1.4, and to the requirements of this specification. Where there is contradiction with the requirements of this specification, this specification shall take precedence.
  - .2 For the purpose of detailing and fabrication, "typical" or "similar" does not necessarily mean "identical".
- .2 Plate Edges (CAN/CSA-S6-14, Clause A10.1.4.3.2)

- .1 All plate edges, re-entrant or end cuts and blocks shall be surfaced to an approximate 3mm radius to prevent paint cracks from forming on sharp corners of structural steel work. All re-entrant cuts shall be 50mm minimum radius, unless otherwise noted.
  - .2 Plasma arc cutting of plates up to and including 20 mm in thickness is permitted. Plasma arc cutting of plates thicker than 20 mm shall not be permitted unless approval is received in writing from the Departmental Representative. When permitted, plasma arc cutting of plates shall use oxygen as the cutting gas and all edges shall be free of dross.
  - .3 Inspection and repair of planar discontinuities shall be according to CSA W59.
  - .4 Corners of oxygen cut girder flanges shall be chamfered 1.5 to 2.0 mm by grinding.
- .3 Straightening Material (CAN/CSA-S6-14, Clause A10.1.4.4)
- .1 Material with sharp kinks shall be rejected. Straightening of bends shall only be done using mechanical means or by the application of controlled heating according to CSA W59. Details of the straightening procedure including testing requirements, signed and sealed by an Engineer licensed to practice in the Provinces of Ontario and Quebec shall be submitted to the Departmental Representative prior to the straightening, for review and approval.
  - .2 Straightening shall only be carried out in the presence of the Departmental Representative's inspector.
  - .3 If necessary, the Departmental Representative shall specify additional testing to be performed by the Contractor. If evidence of damage is discovered, the material shall be rejected and the cost of testing and material replacement shall be at the expense of the Contractor.
  - .4 The Departmental Representative shall be given 7 Days prior notice to arrange for the inspection.
- .4 Bolt holes (CAN/CSA-S6-14, Clause A10.1.4.5)
- .1 Drill the maximum amount of full size holes in required material in the shop. The spacing between existing rivet and bolt holes is not shown on the Contract Drawings as it is variable and approximate. Bolt holes in new structural steel components that are to match locations where rivets or bolts are to be removed shall be field drilled. The Contractor has the option to create an accurate field-measured template in order to drill these holes in the shop. If template method is chosen, a written procedure must be submitted for approval 7 days before commencement of work.
  - .2 Oversize holes shall not be more than 4 mm larger than bolts 22 mm or less in diameter, not more than 6 mm larger than bolts 24 mm in diameter, and not more than 8 mm larger than bolts 27 mm or more in diameter. Oversized washers shall be used with oversized holes. For oversize holes, the distance between edges of adjacent holes or edge of holes and edges of members shall not be less than permitted with conventional holes.
- .5 Identification Marking for Erection (CAN/CSA-S6-14, Clause A10.1.4.8)
- .1 Each member shall carry an erection mark for identification.



- .2 Permanent marking shall be affixed in an area not exposed to view in the finished structure.
- .3 Do not use die stamping.
- .6 Match marking (CAN/CSA-S6-14, Clause A10.1.6.13)
  - .1 Shop mark splices.
- .7 Field splices and locations
  - .1 To approval of Departmental Representative.

### **3.4 WELDED CONSTRUCTION**

- .1 General:
  - .1 All welded construction shall be according to CSA W59 and Clause A10.1.5 of CAN/CSA-S6-14, and to the requirements of this specification. Where there is contradiction, this specification shall take precedence.
  - .2 All welding shall be carried out by welders having a CSA W47.1 identification card valid for the type of welding to be done and for the duration of the welding work.
  - .3 Any company undertaking welded fabrication or erection or both shall be certified according to CSA W47.1, Division 1 or 2.
  - .4 Do welding in shop unless otherwise permitted by the Departmental Representative.
  - .5 Weld only at locations indicated.
  - .6 All welds that are to be made on any structural steel member shall be only as shown in the structural steel shop drawings, and are subject to approval by the Departmental Representative. "All welds" is defined as any weld placed from initiation of fabrication to final acceptance including fabrication, transportation, erection, and construction.
  - .7 All welds shall be continuous unless otherwise noted on the plans.
  - .8 Field welding will only be permitted where shown on the plans. Field welding to structural components will not be permitted unless specifically authorized by the Departmental Representative.
- .2 Processes (CAN/CSA-S6-14, Clause A10.1.5.2)
  - .1 All welds shall be made by manual shielded metal arc or semi-automatic and automatic submerged arc welding processes. Electroslag welding will not be permitted.
- .3 Filler metal
  - .1 All welding shall be performed by electrodes and fluxes that produce filler metal with chemical and physical properties that match the base metal or the new material. All welding procedures and filler metal shall be approved by the Departmental Representative.
- .4 Groove Welds
  - .1 Groove welds shall be complete penetration welds. All butt welds shall be complete penetration groove welds unless otherwise noted.

- .5 Fillet Weld
  - .1 The minimum fillet weld shall be as specified on the Drawings.
- .6 Altering the Sweep of Fracture-Critical and Primary Tension Members
  - .1 The use of heat to alter the sweep of fracture critical or primary tension members shall be subject to approval by the Departmental Representative, prior to the application of heat.
- .7 Submissions for Repair Procedures
  - .1 Canadian Welding Bureau (CWB) accepted welding procedure specifications, data-sheets, and repair procedures for prequalification, signed and sealed by an Engineer licensed in Ontario and Quebec, shall be submitted for approval to the Departmental Representative 14 Days prior to commencement of work.
- .8 Assembly for Welding
  - .1 Assembly for welding shall be according to CSA W59 and the following:
    - .1 Bearing stiffeners shall be vertical under full dead load.
    - .2 Intermediate stiffeners shall be either true vertical or perpendicular to the horizontal work lines used to layout the girder.
    - .3 Bearing stiffeners fitted to bear shall have a minimum bearing contact area of 75% and a maximum separation of 1 mm over the remaining area.
    - .4 Fitted intermediate stiffeners shall have a minimum bearing contact area of 25% and a maximum separation of 2 mm.
- .9 Temporary Welds
  - .1 Temporary tack welds are not permitted.
  - .2 Temporary welds shall not be used on fracture-critical and primary tension members.
  - .3 Temporary welds shall not be used on flange material in compression, unless approved by the Departmental Representative.
  - .4 Temporary welds shall not be used on existing members.
- .10 Preheat, Interpass Temperature, and Heat Input Control
  - .1 When making welding repairs to fracture-critical and primary tension members, the preheat requirements shall be according to CAN/CSA-S6, Table 10.14.
- .11 Profile of Welds
  - .1 Profile of welds shall be according to CSA W59 and the Ontario Structural Manual.
- .12 Corrections
  - .1 Welding corrections and repairs to fracture-critical and primary tension members shall be according to CAN/CSA S6, Clause 10.23.5.
  - .2 Any steel members subjected to shape corrections or straightening shall be allowed to cool in still air.
- .13 Peening

- .1 Peening, when required, shall be subject to approval by the Departmental Representative.
- .14 Stress Relief-Heat Treatment
  - .1 Stress relief-heat treatment temperatures shall be recorded using thermo-couples or other methods acceptable to the Departmental Representative. A record showing temperature and time data of the heat treating operation shall be maintained and be made available to the Departmental Representative upon request.

### **3.5 WELDING INSPECTION**

- .1 General
  - .1 All welding inspection shall be according to CSA W59, and to the requirements of this specification. Where there is contradiction, this specification shall take precedence.
- .2 Identification Cards - Canadian Welding Bureau
  - .1 Prior to commencement of welding, make available to the Departmental Representative the Canadian Welding Bureau's transferable or non-transferable identification cards for each tacker, welder, or welding operator to be employed on the work. Such identification cards shall be currently valid and shall indicate the welding processes and the welding positions at which the personnel are qualified to weld.
- .3 Certification of the Independent Testing Organization
  - .1 The independent organization undertaking welding testing under the Quality Control subsection shall be certified for testing bridges according to CSA W178.1. The certification shall encompass at least the following methods: radiographic, ultrasonic, and magnetic particle.
- .4 Certification of the Non-Destructive Testing Technician
  - .1 The independent organization's non-destructive testing technician undertaking non-destructive testing of welds under the Quality Control subsection shall be certified for testing bridges according to CSA W178.2. Certification shall be to either Level II or III for the methods used, as required by CAN/CGSB 48.9712.

### **3.6 CONDITION ASSESSMENTS WITH NON-DESTRUCTIVE TESTING**

- .1 General
  - .1 An independent testing organization shall carry out all non-destructive testing of the noted defects in the bridge structure by using visual inspection with endoscopic camera, ultrasonic inspection and magnetic particle inspection. Certification of the independent testing organization is defined in section 3.5.3.
  - .2 A non-destructive testing technician shall do the testing. Certification of the non-destructive testing technician is defined in section 3.5.4.
  - .3 Neither the technician nor the independent testing organization shall be changed without the approval of the Departmental Representative.
- .2 Condition Assessments of Noted Defects

- .1 The locations to be tested are identified in the Contract Documents and are summarized as follows:
  - .1 Visual inspection with endoscopic camera of suspected cracks in pin spacers.
  - .2 Ultrasonic inspection of defects in diagonals by phased array.
  - .3 Magnetic particle inspection of defects in stringers, girders and floorbeams.
- .2 Ultrasonic or magnetic particle testing shall be carried out using procedures according to CSA W59.
- .3 Inspection Reports
  - .1 Inspection reports shall bear the seal and signature of an Engineer.
  - .2 Copies of all inspection reports shall be submitted to the Departmental Representative.
  - .3 Reports shall quantify defect (length, depth, opening size) and provide recommendations for repair when required.

### **3.7 WELDING CORRECTIONS AND REPAIRS FOR FRACTURE-CRITICAL AND PRIMARY TENSION MEMBERS**

- .1 General
  - .1 The fabrication weld metal requirements, base metal repairs, and repairs of weld in fracture critical and primary tension members shall be according to CAN/CSA-S6, Clause 10.23.5, and to the requirements of this specification. Where there is contradiction, this specification shall take precedence.
  - .2 All repair procedures requiring approval shall be submitted to the Departmental Representative at least 14 Days prior to commencement of the work.
  - .3 Repair procedures shall be according to CAN/CSA-S6, Clause 10.23.5.
- .2 Approval for Non-Critical Repairs (CAN/CSA-S6-14, Clause 10.23.5.4)
  - .1 Non-critical repairs are those listed in CAN/CSA-S6, Clause 10.23.5.
  - .2 Repair procedures shall be prepared and submitted to the Departmental Representative. Work on the repair shall not commence until the Departmental Representative has given written approval to proceed.
- .3 Approval for Critical Repairs (CAN/CSA-S6-14, Clause 10.23.5.5)
  - .1 Repair procedures that are more severe than those described in CAN/CSA-S6, Subclause 10.23.5.4 are considered critical and shall be individually approved by the Departmental Representative before repair welding proceeds.
  - .2 Critical repairs include those listed in CAN/CSA-S6, Clause 10.23.5.
- .4 Non-Destructive Testing of Fracture Critical Members (CAN/CSA-S6-14, Clause 10.23.6)
  - .1 The fabricator shall maintain documentation of all visual and non-destructive testing for review and confirmation by the Departmental Representative.

Documentation shall be submitted to the Departmental Representative upon completion of the project.

- .5 Repair of Welds
  - .1 Any section of weld that does not meet the acceptance standards shall be removed, re-welded, and re-examined.

### **3.8 BOLTED CONSTRUCTION**

- .1 General
  - .1 Bolted construction shall be according to CAN/CSA-S6-14, Clause A10.1.6, and to the requirements of this specification. Where there is contradiction, this specification shall take precedence.
  - .2 Bolts shall be sufficiently long to exclude threads from the shear plane.
- .2 Bevelled Washers (CAN/CSA-S6-14, Clause A10.1.6.6)
  - .1 Bevelled washers shall be provided for all connections to the sloped faces of rolled sections, and at any other location where the lack of parallelism is sufficient to require it, as stipulated in clause A10.1.6.6.
- .3 Installation of ASTM A325 Bolts (CAN/CSA-S6-14, Clause A10.1.6.7)
  - .1 Submit a bolt tightening procedure to the Departmental Representative prior to field bolting that details the snug tightening procedure for initial tensioning and the final tensioning procedure.
  - .2 Not less than three bolt, nut and washer assemblies from each lot supplied shall be tested in a tension measuring device at the job site at the beginning of bolting start-up to demonstrate that the bolts and nuts from that lot, when used together, can develop tension not less than that provided in the A325/A490 specification for the size and grade. The bolt tension shall be developed by tightening the nut. This testing shall be completed by the Contractor and witnessed and reported by the certified inspection company retained by the Contractor (and approved by the Departmental Representative), and test results must be submitted to the Departmental Representative. Each of the three bolts has to be tensioned following the bolting procedure submitted by the contractor in order to verify that the minimal tension is achieved. Shim used in the calibration device must be as thick as possible in order to limit their number and they can't be washers. Bolt shaft must protrude 3mm out of nut after snug. The calibration certificate of the testing device must be less than 12 months old and must be attached to the bolting procedure.
  - .3 All bolted connections shall be made using high strength bolts conforming to A325 unless otherwise noted on the plans. High strength bolts shall be heavy hexagon structural bolts with semi-finished hexagon nuts. Two hardened washers shall be required, one under each end of bolt. Bolt spacing shall be in accordance with the design drawings, shop drawings, and the requirements of the design specifications.
  - .4 All bolts shall be installed by the "Turn-of-Nut Method" in accordance with CAN/CSA-S6-14 and CSA S16-09. Supply a calibrated (certified) torque wrench to ensure satisfactory tensions are being obtained.

- .5 Bolts shall be placed with bolt head exposed to weather, except that for vertically positioned bolts which have both the head and nut exposed. In these situations, the bolt shall be placed with the head above the nut.
  - .6 When tightening bolts in a joint, bolts are to be brought to a snug tight condition prior to final tensioning. Snug tight is the condition that is attained by the full effort of an ironworker using an ordinary spud wrench to bring the connected plies into firm contact. It represents 15% of minimal tension described at clause A.10.1.6.4 of CAN/CSA-S6-14.
  - .7 When all bolts are snug tight, each bolt in the joint shall be match-marked and inspected before final tensioning. Match-mark the nut, protruding end of the bolt, and steel. Failure to inspect nuts in their snug-tight condition will result in unverifiable Turn-of-Nut execution. Nut marking does not relieve the Contractor's responsibility to inspect the connection twice, before and after the final tensioning.
- .4 Reuse of Bolts (CAN/CSA-S6-14, Clause A10.1.6.10)
- .1 During the erection of steel work, A325 bolts that are tightened and later loosened, may not be reused. Re-tensioning previously tensioned bolts loosened by the tensioning of adjacent bolts is not considered to be reuse.
- .5 Holes Drilled Using Numerically Controlled Machines (CAN/CSA-S6-14, Clause A10.1.6.12)
- .1 As an alternative to the shop trial assembly requirements of CAN/CSA-S6 when numerically controlled machines have prepared the boltholes, a check assembly consisting of the first components of each type of bolthole pattern to be made shall be undertaken to adequately demonstrate the accuracy of the drilling. If the check assembly is satisfactory, further assemblies of like components are not required. If the check assembly is unsatisfactory, the work shall be redone or repaired in a manner acceptable to the Departmental Representative.
- .6 Plasma Arc Cutting of Holes
- .1 Plasma arc cutting of holes shall only be permitted in plates up to and including 20 mm in thickness. Plasma arc cut holes shall be produced by mechanically guided means and the diameter of the holes shall be greater than or equal to the thickness of the plate. When plasma arc cutting of holes is permitted, the cutting gas as well as the shielding gas shall be oxygen and the surface roughness shall not exceed 13 microns (500 micro-inches) as defined in ASME B46.1. Occasional gouges not more than 1.5 mm in depth are permitted. Thermally cut holes shall be 2 mm larger than the nominal diameter of the bolt and the taper shall not exceed 0.5 degrees.

### **3.9 TOLERANCES**

- .1 Dimensional and workmanship tolerances shall be according to CSA W59 and Clause 10.1.7 of CAN/CSA-S6-14, and to the requirements of this specification. Where there is contradiction, this specification shall take precedence.

### **3.10 ERECTION**

- .1 General

- .1 Erection shall be according to CAN/CSA-S6-14, Clause A10.1.10 and other relevant clauses, and to the requirements of this specification. Where there is contradiction, this specification shall take precedence.
- .2 Erection shall not commence until Erection Procedures submitted in conformance with this Section have been returned, approved, by the Departmental Representative.
- .3 The Departmental Representative shall be notified in writing of the starting erection date at least 3 weeks prior to the commencement of field operations. Work shall not be carried out until the Departmental Representative is on site.
- .4 Repairs to erected material shall only be permitted after the Departmental Representative has approved the repair procedure.
- .5 Welding shall not be used to fill misplaced holes.
- .6 Hammering that can damage or distort the members is not permitted.
- .2 Erection Conditions (CAN/CSA-S6-14, Clause A10.1.10.10)
  - .1 Additional permanent material may be provided to ensure that the member capacities are not exceeded during erection, if approved by the Departmental Representative. The additional material shall be shown in the erection diagram.
  - .2 Be responsible to ensure the stability of the existing bridge structure and its components at all times until the structural steel is in its final location with all permanent bracing, connections, and supports in place.
- .3 Falsework (CAN/CSA-S6-14, Clause A10.1.10.2)
  - .1 Falsework shall be in accordance with applicable codes, and Section 01 54 23 – Temporary Works.
  - .2 Temporary bracing method calculations and drawings shall be stamped by a Professional Engineer licensed to practice in the Provinces of Ontario and Quebec. Drawings and calculations shall be submitted to the Departmental Representative prior to the work being performed.
  - .3 Keep all staging and falsework in a safe condition and provide such temporary stairways, gangways, staging, railing or other means of access as the Departmental Representative may direct for a thorough inspection of the work during erection and prior to the final acceptance.
  - .4 Falsework and staging shall meet or exceed all applicable Occupational Health and Safety regulations.
  - .5 Use netting and other means necessary to prevent bolts, tools, etc from falling into the River or onto roadways, pathways, sidewalks, staging areas, etc.
- .4 Field Assembly (CAN/CSA-S6-14, Clause A10.1.10.5)
  - .1 Field connections shall be accurately and securely fitted up before bolts are entered. Drifting shall be only such as to draw parts into position and not sufficient to enlarge holes or distort, kink or sharply bend the metal on any part. No reaming of holes will be permitted unless approved by the Departmental Representative.
  - .2 Employ pneumatic wrenches and high tensile alloy steel bolts (A325) where required to secure the necessary tight fit of parts to be bolted.

- .3 Assembly bolts should be painted red and removed prior to completion of connection. Assembly bolts should not be part of final connection as they are tensioned and loosened repeatedly and thus fall under the "Reuse of bolts" clause of this specification.
  - .4 Excessive hammering which will injure or distort the members will not be permitted.
  - .5 Surfaces in permanent contact shall be power tool cleaned and primed as specified in 09 97 19 – Painting Exterior Metal Surfaces just prior to assembly.
  - .6 Correct minor misfits, using reaming as specified, cutting, clipping and shimming. Any error in shop fabrication, or any deformation resulting from handling or transportation, which prevents the proper assembly and fitting of parts, especially connections to main member materials shall be reported to the Departmental Representative for approval of the method of correction. No correction of misfits of any character shall be made prior to obtaining the approval of the Departmental Representative.
- .5 New Steelwork Attached to Existing Steelwork
- .1 A drift pin should fill every open hole when replacing existing fasteners with required bolts in connecting required material to existing. One existing fastener shall be removed and the hole filled with a drift pin before a second fastener is removed.
  - .2 Once all existing fasteners are removed and replaced with drift pins, the required material shall be put into place. The drift pins shall be removed and replaced one by one with required bolts. Bolts should only be snug tight until all drift pins are removed and replaced with bolts. Only then should the bolts be fully tightened.
  - .3 Temporary bracing shall be used as required. All temporary bracing methods shall be analyzed and approved by a Professional Engineer licensed to practice in the Provinces of Ontario and Quebec.
  - .4 The shop drawings shall show the size and location of connection areas (faying surfaces) and rivet replacement on existing members so they can be laid out on the existing bridge by the Contractor.
- .6 Temporary Bracing for Existing Steelwork
- .1 Temporary bracing shall be used as required by the Contractor's methods to adequately support and stabilize existing steelwork during strengthening and where connections are strengthened or replaced.
  - .2 Welding to existing steelwork is not permitted.
  - .3 Any bolting to existing steelwork shall not reduce the existing net area unless noted otherwise in the contract documents.
  - .4 Temporary bracing method calculations and drawings shall be stamped by a Professional Engineer licensed to practice in the Provinces of Ontario and Québec. Drawings and calculations shall be submitted to the Departmental Representative prior to the work being performed.
  - .5 Any temporary support loads provided by the Departmental Representative are based on the gross section capacity of the members. The loads do not account for current or future loads on the structure or any construction loads.



- .6 Do not use any of the material intended for use in the finished structure for erection or temporary purposes unless such use is provided for on the plans or authorized by the Departmental Representative.
- .7 Upon completion of the steelwork, when bracing is no longer required to provide structural stability, all temporary braces shall be removed.
- .7 Removal of existing bolts and rivets
  - .1 It is anticipated that rivet removal will be required to complete both the designated repairs and additional repairs identified on site.
  - .2 Submit to the Departmental Representative the proposed method of rivet removal. Rivet removal shall not be permitted until the rivet removal method has been approved by the Departmental Representative. Any method such as using a torch, which has the potential of damaging, weakening or changing any property of the adjacent steel, will not be approved and cannot be used.
  - .3 The use of a torch or other methods which melt the rivets will not be permitted. Burning will not be permitted.
  - .4 Existing rivets shall be removed using approved mechanical means that do not cause damage to steel to remain. In the event that the Departmental Representative determines that rivet removal work is resulting in damage to the structure, cease rivet removal operations until modified method of removal has been submitted to the Departmental Representative and approved.
  - .5 It is anticipated that rivets, to be removed, shall have their heads shear off and the shank driven, drilled, cored or jacked out as required by mechanical means. Care shall be taken not to enlarge the rivet hole or to damage the surrounding and remaining material.
  - .6 Heat resulting from any removal method shall not be allowed to damage rivet holes or surrounding material. If heat is generated, methods shall be modified to ensure no damage.
  - .7 Difficult rivet removal is anticipated due to the presence of restricted access to existing rivets. In addition, the multiple plies of material are likely to result in misalignment of holes that will cause rivets to be more difficult to remove. Account for these difficulties and include these factors when pricing the work.
  - .8 Where existing rivets are removed and holes require enlargement due to misalignment, the holes shall be enlarged by not more than 2mm and only after the proposed enlargement is reviewed and approved by the Departmental Representative. Holes shall be enlarged by reaming. Full compensation for enlarging holes up to 2mm shall be considered as included in the contract price for removal of rivets and replacement with bolts or other individual steel repair tender items.
  - .9 At locations where surrounding material is gouged or damaged as a result of the Contractor's operations, the surrounding material shall be repaired, replaced or restored to the Departmental Representative's satisfaction.
  - .10 When a damaged hole is smoothed by light reaming to dress the hole, the cost of light reaming of existing holes shall be incidental to structural steelwork. When reaming of more than 2mm in diameter greater than the nominal rivet diameter and installing an oversized bolt is required for repairs, the cost of reaming, furnishing and installing oversized bolts shall be at the Contractor's expense.

This method of repair shall not be used without prior approval of the Departmental Representative for each rivet hole.

- .11 At locations where small nicks and burrs in the vicinity of the head are created, they can be ground smooth to result in a less than 10:1 slope as long as the bolt will be properly seated and the thickness of the plate to remain is verified by the Departmental Representative. Await permission from the Departmental Representative to proceed.
- .12 At locations where rivet holes contain cracked, torn, or otherwise damaged material due to condition other than the Contractor's operations, immediately contact the Departmental Representative for review before rivet removal. It is likely, where the defect is minor, that the hole shall be reamed to remove the defect and that an oversized bolt shall be used.
- .13 It is likely that lead based paint is present at all metalwork connections between plies and under rivet heads on all portions of the bridge. Therefore, take all necessary precautions to minimize worker lead exposure as required by Health and Safety regulations, Section 01 14 25 – Designated Substances, and Section 02 83 10 – Lead-Base Paint Abatement – Minimum Precautions.
- .14 Paint damaged surfaces in accordance with the requirements of Section 09 97 19 – Painting Exterior Metal Surfaces.
- .15 Existing bolts cannot be reused.
- .16 The plans call for some of the existing rivets in existing connections to be removed and replaced with bolts. In some cases, these existing rivets may have already been replaced with a bolt. In all cases where the plans call for an existing fastener to be removed and replaced with a bolt, the existing fastener shall be removed and replaced with a bolt as specified in the contract plans regardless of the fastener type found in the field.
- .17 There should never be more than one open hole at any given time in a connection when replacing fasteners unless approved by the Departmental Representative, or described elsewhere in these Specifications. Where the plan details show existing fasteners to be replaced with high strength bolts, the existing fastener, rivet or bolt, shall be removed one at a time and replaced with the size and type of bolt shown in the plans.
- .18 Where the rivets in an existing connection are replaced with bolts, the capacity of the connection may be considered as follows:
  - .1 Case 1: where only a few existing fasteners in a connection are replaced with bolts, each bolt is assumed to have a capacity equal to a rivet;
  - .2 Case 2: during construction, if a connection temporarily is composed of a mix of drift pins, rivets, and bolts, the bolts (friction) and drift pins (bearing) are assumed to have a capacity per unit equal to the rivets (bearing) capacity per unit; and,
  - .3 Case 3: if all the rivets in an existing connection are replaced with bolts, the capacity of the connection is based on the capacity of the bolts or the section, whichever is smaller.
- .19 Holes left as a result of existing steelwork removal shall be filled with ASTM A325 bolts.
- .8 Removing Existing Steelwork

- .1 Demolition and salvaging: This work consists of the removal of existing bridge steelwork as shown on the contract plans and provides for the mandatory scrapping and recycling of the removed steelwork by a facility approved by the Departmental Representative in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal. The facility shall be advised in writing (with copies to the Departmental Representative) about the possible presence of lead in existing coating at faying surfaces and possibly other hazardous substances.
  - .2 Ensure that all necessary safety precautions are taken to minimize workers lead exposure levels when performing demolition work, as required by all applicable regulatory authorities, and as indicated in Section 01 14 25 – Designate Substances, and Section 02 83 10 – Lead-Base Abatement – Minimum Precautions.
- .9 Field Drilling of Required Holes
- .1 Allowable tolerance for bolt holes:
    - .1 Match holes for rivets and bolts to line up so that dowel 2 mm less in diameter than hole passes freely through assembled members at right angles to such members.
    - .2 Finish holes not more than 2 mm in diameter larger than diameter of rivet or bolt unless otherwise specified by Departmental Representative.
    - .3 Centre-to-centre distance between any two holes of group to vary by not more than 1 mm from dimensioned distance between such holes.
  - .2 Drilling of required holes in the field shall be by approved methods. The following method is approved:
    - .1 All new holes to be made in the field shall only be drilled full size. Sub-drilling and reaming will not be accepted for new holes. Reaming may be used in the case of existing rivet holes when approved by the Departmental Representative. Whenever possible, reamers shall be directed by mechanical means. Reamed or drilled holes shall be cylindrical and perpendicular to the face of the member.
    - .2 Any burrs created during removal of existing fasteners, or during drilling or reaming shall be removed.
    - .3 Drilling full size holes shall be done using an existing member or a steel template with the utmost care as to position and angle.
    - .4 When holes are reamed or drilled, 85% of the holes in any group shall, after reaming or drilling, show no offset greater than 1 mm between adjacent thickness of metal.
    - .5 Heating to improve the alignment of holes shall not be allowed.
    - .6 Tack welds for the purpose of holding steel parts together while bolting takes place shall not be permitted under any circumstances whatsoever.
    - .7 All existing steel shall be cleaned prior to commencing of any drilling operations.
    - .8 No flame cutting of any holes will be permitted.
  - .3 Mispunched or misdrilled members, and any error that prevents the proper assembly and fitting of parts shall be reported and the proposed method of

correction shall be submitted to the Departmental Representative for review. Corrective measures shall not commence until the submitted proposal is accepted by the Departmental Representative.

.10 Additional Repairs

- .1 It is anticipated, and shall be assumed by the Contractor, that additional deterioration of the structural steel will be discovered, and the number of locations requiring repair shall be increased.
- .2 It is expected that a Contractor capable of completing this contract will have experienced similar issues on other projects and that the discovery of such areas shall be allowed for when scheduling the work. Multiple work areas shall be available so that the Contractor can continue to work and allow time for the Departmental Representative to provide direction in a timely manner with minimal delay.
- .3 If the Contractor identifies areas that are critical to the project schedule which he suspects will be deteriorated to the point where repairs are possibly required, identify them to the Departmental Representative early in the project so that direction can be given and the Contractor can maintain the schedule.
- .4 If significantly deteriorated members or components, other than those identified in the contract documents, are found with more than 20% loss of section, immediately contact the Departmental Representative.

.11 Handling of Existing Material

- .1 Perform all work with care so that any existing materials which are to remain in place or be reused, will not be damaged.
- .2 Should the Contractor damage any existing materials which are to remain in place or to be reused, the damaged material shall be repaired or replaced in a manner satisfactory to the Departmental Representative at own cost.
- .3 During removal, take all necessary actions to ensure that none of these removed materials are permitted to fall into the river, or onto roadways, pathways, sidewalks, staging areas, etc. Be responsible for any damage caused by falling debris and remove fallen debris as directed by the Departmental Representative.

.12 Fire Control

- .1 No welding will be permitted in the field without a Fire Control Plan submitted by the Contractor and reviewed by the Departmental Representative.

.13 Coatings

- .1 Coating of all new steel components and existing structural steel components at repair locations shall be in accordance with the requirements of Section 09 97 19 – Painting Exterior Metal Surfaces.
- .2 Any coating damaged by erection procedures (i.e. use of material as templates, etc.) or construction activities shall be repaired (touched-up) in accordance with Section 09 97 19 - Painting Exterior Metal Surfaces.

**3.11 QUALITY CONTROL**

.1 General

- .1 Quality control shall be according to CAN/CSA-S6, Clause A10.1.8, and to the requirements of this specification. The acceptance standards of CSA W59 for dynamically loaded structures shall also apply. Where there is contradiction, this specification shall take precedence.
- .2 In addition to quality control measures instituted by the Contractor, be responsible for the quality control procedures specified herein.
- .3 Provide suitable facilities for carrying out inspection and tests required.
- .2 Qualifications
  - .1 Fabricators shall be certified in Division 1 or Division 2.1 of CSA W47.1-03 for welded fabrication. Division 2.1 fabricators shall retain a qualified professional welding engineer for the duration of the work.
  - .2 Prior to commencement of welding, make available to the Departmental Representative, the Canadian Welding Bureau's transferable or non-transferable identification cards for each tacker, welder or welding operator, to be employed on the work. Such identification cards shall be currently valid and shall indicate the welding process and the positions which the personnel are qualified to weld.
- .3 Visual Weld Inspection
  - .1 The Contractor's visual weld inspector shall carry out full visual inspection.
- .4 Non-Destructive Testing (CAN/CSA-S6-14, Clause A10.1.8.2)
  - .1 General
    - .1 An independent testing organization shall carry out all non-destructive testing of the welds for bridge structures by using radiographic, ultrasonic, magnetic particle, and liquid penetrant test methods.
    - .2 A non-destructive testing technician shall do the testing.
    - .3 Neither the technician nor the independent testing organization shall be changed without the approval of the Departmental Representative.
  - .2 Notification of Testing
    - .1 The independent testing organization shall be given at least 5 Days notice of when the work is ready for testing. Such notice shall include the type and quantity of work to be tested.
  - .3 Testing of Welds
    - .1 Radiographic, ultrasonic, or magnetic particle testing shall be carried out using procedures according to CSA W59.
    - .2 The amount and location of welding to be tested shall not be less than:
      - .1 Visual inspection of all welds.
      - .2 Radiographic or ultrasonic inspection of groove welds in flanges and webs of built-up girders:
        - .1 Flange splices in tension or stress reversal zones: 100% of all welds.
        - .2 Flange splices in compression zones: 100% of the weld of 1 in 4 splices.
        - .3 Web splices for 1/2 the depth from the tension flange: 100% of the weld length for each weld.

- .4 Web splices for 1/2 the depth from the compression flange: 100% of the weld length of 1 in 4 splices.
    - .3 If defects are found during testing of compression zones, two additional zones shall be tested for each zone exhibiting defects.
    - .4 Magnetic particle inspection of web-to-flange fillet welds:
      - .1 Submerged-arc welds - 25% of length of each weld.
      - .2 Semi-automatic welds - 50% of length of each weld.
      - .3 Manual welds - 100% of length of each weld.
    - .5 Magnetic particle inspection of fillet welds in connection plates and stiffeners to which diaphragms or cross bracing are attached:
      - .1 For 1/2 the depth from the tension flange: 100% of weld length of each weld.
      - .2 Transverse welds on tension flanges: 100% of weld length of each weld.
    - .6 Arc strikes shall be lightly ground and checked for cracks by magnetic particle inspection.
  - .3 Radiographic and ultrasonic testing shall be performed prior to the assembly of the flanges to the webs.
- .5 Repair of Welds (CAN/CSA-S6-14, Clause A10.1.8.4)
- .1 The section of weld that does not meet the acceptance standards shall be removed, re-welded, and re-tested.
- .6 Identification of Structural Steel (CAN/CSA-S6-14, Clause A10.1.8.5)
- .1 A record for each component shall be kept to identify the material as to heat number, corresponding mill test certificate, and colour coding or other identifying markings.
- .7 Inspection Reports
- .1 Inspection reports shall bear the seal and signature of an Engineer licensed to practice in the provinces of Ontario and Quebec.
  - .2 Copies of all inspection reports shall be submitted to the Departmental Representative.
- .8 Certificates of Conformance:
- .1 Prior to releasing any steel component from the fabrication shop, submit to the Departmental Representative a Certificate of Conformance sealed and signed by a Quality Verification Engineer. The Certificate shall state the steel component has been fabricated in accordance with the contract documents. The QVE shall witness the inspection of the work.
  - .2 When temporary support is installed, submit to the Departmental Representative a Certificate of Conformance sealed and signed by a Quality Verification Engineer prior to proceeding with the work associated to the temporary support. The Certificate shall state the temporary support has been installed in accordance with the Contract Documents and the contractor's engineered drawings. The QVE shall witness the inspection of the temporary support. For subsequent inspections of similar temporary supports, the QVE may delegate the inspection

to another engineer where it is consistent with prudent engineering practice to do so, and the function is performed under the supervision of the QVE.

- .3 Within 7 days of completing the installation of the new steel of a member, submit to the Departmental Representative a Certificate of Conformance sealed and signed by a Quality Verification Engineer. The Certificate shall state that the Work, in handling, installing, protecting and cleaning of steel, has been carried out in general conformance with the signed and sealed shop details, welding procedures, erection diagrams, erection procedure drawings, and Contract Documents. This certificate must clearly identify which member is concerned by the certificate, the nature of the work performed and reference the relevant documents, such as the associated erection and bolting procedures. The QVE shall witness the inspection of the work.

### **3.12 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

### **3.13 ENVIRONMENTAL PROTECTION**

- .1 All work including containment of debris and cleaning activities shall be done in accordance with the requirements of Section 01 35 43 – Environmental Procedures.
- .2 Do not disturb river banks or embankments without prior written permission of Departmental Representative.
- .3 Use netting and other means necessary to prevent bolts, tools, etc from falling into the River, or onto roadways, pathways, sidewalks, staging areas, etc..

### **3.14 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

**END OF SECTION**