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5100.2 DESCRIPTION

- 5100.2.1 The work shall consist of the transportation and erection of structural steel in accordance with the plans and this specification.

5100.3 MATERIALS

- 5100.3.1 All materials to be incorporated in the finished structure shall be supplied by the Contractor f.o.b. at the location specified in the special provisions. The Contractor shall check the material delivered against the shipping list and report promptly in writing any shortage or damage discovered. The Contractor shall be responsible for promptly unloading any delivered material, and for any costs arising from a delay in carrying out this responsibility.
- 5100.3.2 Material to be stored shall be placed on skids or blocks above the ground. It shall be kept clean and properly drained. Girders and beams shall be placed upright and shored. Supports for long members shall be placed near enough together to prevent damage from deflection.
- 5100.3.3 The Contractor shall be responsible for properly handling all material during its unloading, storage, hauling, assembly and installation. Damaged material shall be repaired or replaced by the Contractor as directed by the Engineer. The Contractor shall replace any material lost while in their care. The Contractor shall be responsible for the cost of these repairs or replacements.

5100.4 CONSTRUCTION

5100.4.1 Transportation and Erection Plans

5100.4.1.1 The Contractor shall submit transportation, handling and storage drawings to the Engineer for review and approval a minimum of 2 weeks prior to shipping structural steel. The Contractor shall supply an erection plan a minimum of 2 weeks prior to structural steel erection. The Contractor shall erect the structural steel, remove any temporary construction, and do all work required to complete the erection in accordance with the erection plan. Lifting devices shall not be welded to girders.

5100.4.1.2 Girders shall be transported, handled and stored with their webs in the vertical position.

5100.4.1.2.1 Structural steel shall be transported, hauled, and stored on timber blocking. Timber blocking shall be located at positions that prevent damage and/or distortion from deflection.

5100.4.1.2.2 The transportation, handling and storage plan at a minimum, shall include design notes, drawings, rational for the proposed transport position, and statement indicating the proposed method will not damage the girders. Design notes shall include evaluation of the static and dynamic forces and associated stresses during handling, transportation, and storage using a dynamic load allowance of 100%. The stresses shall be in accordance with CSA S6, and the maximum cyclic stress range shall not exceed the constant amplitude fatigue threshold for the appropriate fatigue categories specified in CSA S6.

5100.4.1.2.3 Girders and beams shall be transported in the vertical position. However, these elements may be transported in other positions provided:

- A Professional Engineer (structural discipline) registered in the Province of Saskatchewan performs the analysis and provides a written statement that the proposed

method will not damage the elements and a copy of the same shall be provided to the Engineer.

- Upon arrival at the site and prior to erection, the elements shall be checked by the Engineer to ensure all tolerances are met. The Contractor shall provide an adequate flat storage area for the inspection.
- Any structural steel member damaged during transportation, handling, storage or erection shall be immediately reported to the Engineer. The Contractor shall submit an engineering assessment report and/or field repair procedure(s) prepared by a Professional Engineer registered in the Province of Saskatchewan experienced in evaluation and inspection of damaged steel members prior to erection. Field repairs shall be completed by the Contractor and reviewed and accepted by the Engineer prior to erection, assembly or installation. The Contractor shall also provide three days' notice for access, and facilitate any activities required for an independent assessment by the Engineer if requested. All costs to repair damage to the satisfaction of the Engineer will be the sole responsibility of the Contractor.

5100.4.2 Bridge Girders

5100.4.2.1 Temporary Supporting Structures and Berms

5100.4.2.1.1 The temporary supporting structures and berms shall be designed, constructed and maintained to safely support all loads. Berms shall be constructed in a manner and of such materials that they will not be eroded by stream flow nor introduce silt into the water. The Contractor shall prepare drawings for temporary supporting structures, berms, and for traffic control and accommodation where applicable. All drawings shall bear the seal of a Professional Engineer registered in the Province of Saskatchewan.

5100.4.2.1.2 Temporary supporting structures and/or berms will not be permitted to remain in any stream channel during spring

break-up or run-off periods unless all necessary approvals have been obtained from regulatory agencies.

5100.4.2.1.3 Repair of any damage to other property, such as earth fills and stream banks, resulting from the existence of berms, shall be the responsibility of the Contractor.

5100.4.2.2 Erection Procedure

5100.4.2.2.1 The Contractor shall not erect the structural steel until the substructure concrete has been cured a minimum of three days and achieved 80% of the 28 day specified concrete strength requirement.

5100.4.2.2.2 The Contractor shall prepare and provide to the Ministry a detailed erection procedure a minimum of 2 weeks in advance of the scheduled start of erection. The erection procedure shall include all drawings and documents necessary to describe the following:

- Traffic accommodation strategy, as applicable.
- Access to work, earth berms and work bridges.
- Type and capacity of equipment. Cranes shall be used for handling and erecting structural steel girders.
- Sequence of operation including position of cranes and trucks with members.
- Position of cranes relative to substructure elements such as abutment backwalls, with details of load distribution of wheels and outriggers.
- Lifting devices and lifting points. No drilling of additional holes or any other modifications, including field welding,

shall be made to steel elements other than deck joints.
Lifting devices shall not be welded to the girders.

- Details of temporary works, supporting structures drawings, including:
 - Proposed methods to be used to ensure the required splice elevations and structure shape prior to bolt torquing;
 - Method of providing temporary supports for stability;
 - Top of girder elevations at each bearing and each splice location where appropriate;
- Bolt tightening sequence.
- Grout pad construction.
- Details of release of temporary supporting structures.
- Provide an “As-Built” detailed survey of the substructure showing the following:
 - Location and elevation of all bearing grout pad recesses;
 - Shim height at each bearing location;
 - Top of girder elevations at each bearing (and each splice location where appropriate); and
 - Longitudinal measurements between centrelines of bearings of all substructure units.

5100.4.2.2.3 The erection procedure shall be stamped by a Professional Engineer registered in the Province of Saskatchewan who shall assume full responsibility to ensure that the erection procedure is being followed and complies with the Saskatchewan Employment Act and The Occupational Health and Safety Regulations, 1996.

5100.4.2.2.4 Before erection begins the Contractor shall do a complete superstructure layout by means of chalk lines and markings applied to all substructure units, showing bearing and girder positions in accordance with the layout plan.

5100.4.2.3 Bearings and Anchorage

5100.4.2.3.1 Masonry bearing plates shall not be placed upon bridge seat bearing areas which are improperly finished, deformed or irregular. Bearing plates shall be set level in their exact position.

5100.4.2.3.2 The Contractor shall remove anchor bolt void forming materials, and accurately set the anchor bolts, except where the bolts were cast into the concrete. Any residues on the concrete surfaces, such as oils, grease or other contaminants, shall be removed by sandblasting. All methods and materials for setting anchor bolts and constructing bearing pads shall be subject to the Ministry's review prior to construction. The nuts on the anchor bolts, at the expansion ends of spans, shall be adjusted to permit free movement of the spans.

5100.4.2.3.3 When steel bearings are employed in conjunction with grout pockets in the substructure, the bearings shall be set accurately on galvanized steel shims, and grouted as detailed in the Erection Plans, after the erection has been completed. The shims shall be located so that a minimum of 75 mm grout coverage is provided. When grout pockets are not detailed, the bearing plates shall be set on the properly finished bearing areas in exact position and shall have a full and even bearing on the concrete.

5100.4.2.3.4 When required, field welding adjacent to elastomeric pads shall be performed with care to avoid damage to the elastomer. The temperature of the steel adjacent to the elastomer shall be kept below 120° Celsius. The distance between the weld and the elastomer shall be at least 40 mm.

5100.4.2.4 Straightening Bent Material

5100.4.2.4.1 Straightening of plates, angles or other shapes will not be permitted without a detailed procedure prepared by a Professional Engineer registered in the Province of Saskatchewan, and provided to the Engineer for approval prior to any straightening being undertaken.

5100.4.2.4.2 Following the straightening of a bend, the surface of the metal shall be carefully inspected for evidence of fractures, which may include non-destructive testing.

5100.4.2.5 Assembly

5100.4.2.5.1 The parts shall be accurately assembled as shown on the fabrication drawings and all match-marks shall be followed. The material shall be carefully handled to avoid damage. Hammering, which will injure or distort the members, shall not be permitted. Bearing surfaces and surfaces to be in permanent contact shall be clean before the members are assembled.

5100.4.2.5.2 Splices and field connections shall have one half of the holes filled with bolts and cylindrical erection pins (half bolts and half pins evenly distributed throughout the splice or connection) before bolting.

5100.4.2.5.3 Fitting-up bolts shall be of the same nominal diameter as the bolts, and cylindrical erection pins shall be sized to accurately fit the holes.

5100.4.2.5.4 Should adjustments in elevation of the girder splices become necessary to allow free rotation of the joint, only enough pins or bolts shall be removed as required to accomplish this.

5100.4.2.6 High Tensile Strength Bolted Connections

5100.4.2.6.1 Bolted parts shall fit solidly together when assembled. Contact surfaces, including those adjacent to the washers, shall be descaled or carry the normal tight mill scale. Contact surfaces shall be free of dirt, paint, oil, loose scale, burrs, pits and other defects that would prevent solid seating of the parts. Unless otherwise noted, bolts in

exterior girders shall be installed with the heads on the outside face of the girder web and bolts in all girders shall be installed with the heads on the bottom faces of lower flanges. Nuts for bolts that will be partially embedded in concrete shall be located on the side of the member that will be encased in concrete. Connections shall be assembled with a hardened washer under the bolt head or nut, whichever is the element turned in tightening. Surfaces of bolted parts in contact with the bolt head and nut shall be parallel. For sloped surfaces, bevelled washers shall be used. The bevelled washers shall be designed to produce a bearing surface normal to the bolt axis. Bolts shall be of new quality and stored in weatherproof containers to prevent loss of lubrication or accumulation of dirt. All girders shall be erected with elevations and alignments checked prior to any bolt tightening.

- 5100.4.2.6.2 Tightening of all high strength bolts shall be by the turn-of-nut method. Before final tightening there shall be a sufficient number of bolts brought to a “snug tight” condition to ensure that the parts of the joint are brought into full contact with each other. “Snug tight” is defined as the tightness attained by a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench. Following this initial operation, bolts shall be placed in any remaining holes in the connection and brought to snug tightness. After all bolts have been taken to the snug tight condition, the Contractor shall match mark the outer face of each nut and protruding end of bolt to have a common reference line to determine the relative rotation. All bolts in the joint shall then be tightened additionally by the applicable amount of nut rotation specified below, with tightening progressing systematically from the most rigid part of the joint to its free edges. During this operation there shall be no rotation of the part not turned by the wrench. Amount of rotation of nut relative to bolt, regardless of which is turned shall be:

- 1/3 turn where bolt length is 4 bolt diameters or less
- 1/2 turn where bolt length is over 4 bolt diameters and not exceeding 8 bolt diameters
- 2/3 turn where bolt length exceeds 8 bolt diameters
- tolerance 1/6 turn (60°) over, nothing under
- length of bolt measured from underside of head

5100.4.2.6.3 High strength bolts shall be tensioned only once and shall not be reused. Retightening previously tightened bolts, which may have been loosened by tightening adjacent bolts shall not be considered as reuse. The Contractor shall provide safe and adequate access meeting the requirements of the Saskatchewan Employment Act and The Occupational Health and Safety Regulations, 1996, to all working areas, including all necessary scaffolding to enable the Ministry to carry out its inspection. The Contractor shall provide a competent workman to assist the Ministry in the inspection of bolt tightening work.

5100.4.2.6.4 After installation, exposed surfaces of the bolts, nuts and washers shall be cleaned to remove all traces of oils.

5100.4.2.7 Misfits

5100.4.2.7.1 The correction of minor misfits involving harmless amounts of reaming, cutting and chipping will be considered a legitimate part of the erection. However, any error in the shop fabrication, or deformation resulting from handling and transportation, which prevents the proper assembling and fitting up of parts by the moderate use of drift pins or by a moderate amount of reaming and slight chipping or cutting, shall be reported immediately to the Engineer and approval obtained for the method of correction. The Ministry may require that an Engineer witness the correction. If the contract provides for the complete fabrication and erection, the Contractor shall be responsible for all misfits, errors and damages and shall make the necessary corrections and replacements. If the

contract is for erection only, and provided the corrections required are not as a result of handling by the Contractor, the Contractor will be required to make the necessary corrections and replacements on the basis of extra work under the direction of the Engineer.

5100.4.2.8 Welding

5100.4.2.8.1 Welding, when required, shall be the shielded metal arc welding process done in accordance with the requirements of CSA Standard W59. The welding procedure shall first be approved by the Ministry.

5100.4.2.9 Girder Adjustments

5100.4.2.9.1 It is essential that the girders are erected with utmost attention being given to girder positioning, alignment, and elevation. Adjustment to girder position, bearing location and bearing elevation shall be done in order to achieve as closely as possible the lines and grades shown in the Erection Plan.

5100.4.2.9.2 The Contractor shall ensure that the structural steel is maintained in correct alignment until the adjoining or encasing concrete components have been completed.

5100.4.2.10 Grout Pockets and Grout Pads

5100.4.2.10.1 The Contractor shall fill the grout pockets and construct the grout pads using a flowable grout from the Ministry's Approved Products List. Filling of grout pockets and construction of grout pads shall be done by workers competent in this work.

5100.4.2.10.2 Grout shall be packaged in waterproof containers with the production date and shelf life of the material shown. It shall be mixed, placed, and cured in strict accordance with the manufacturer's recommendations.

5100.4.2.10.3 The method of forming and pouring the grout shall be submitted for review two weeks prior to construction.

Dry-pack methods of constructing grout pads will not be accepted.

5100.4.2.10.4 An approved silane sealer shall be supplied and applied to the exposed grout pad surfaces in accordance with the manufacture's recommendations.

5100.4.2.11 Grouting in Cold Weather

5100.4.2.11.1 When the daily minimum air temperature, or the temperature of the girders, bearings or substructure concrete, in the immediate area of the grouting, falls below 5° Celsius, the following provisions for cold weather grouting shall be affected:

- Before grouting, adequate preheat shall be provided to raise the temperature of the adjacent areas of the girders, bearings and substructure concrete to at least 10° Celsius.
- Temperature of the grout during placing shall be between 10° Celsius and 25° Celsius.
- The grout pads (or girders where appropriate) shall be enclosed and kept at 10° Celsius to 25° Celsius for at least 5 days. The system of heating shall be designed to prevent excessive drying-out of the grout.

5100.4.2.12 Removal of Falsework, Berms, and Clean-Up

5100.4.2.12.1 Upon completion of the erection the Contractor shall remove all earth material or falsework placed in the stream channel or elsewhere during construction. The Contractor shall remove all piling, excavated or surplus materials, rubbish and temporary buildings, replace or renew any damaged fences, and restore in an acceptable manner all property damaged during the execution of its work.

5100.4.2.12.2 The Contractor shall leave the bridge site, roadway and adjacent property in a neat restored and presentable condition. When required, the Contractor shall provide

written evidence to the Ministry that affected property owners or regulatory agencies have been satisfied.

5100.4.2.12.3 All steel shall be left clean and free of oil, grease, mud, dust, road spray or other foreign matter.

5100.4.3 Painting

5100.4.3.1 When specified in the contract, structural steel shall be painted in accordance with the requirements of Specification 5110 – FIELD PAINTING METAL STRUCTURES and with the special provisions and plans.

5100.4.4 Inspection

5100.4.4.1 The Contractor shall provide safe and adequate access to working areas, including all scaffolding necessary to enable the Engineer to carry out the inspection of the erection operation. The Engineer shall observe the installation and tightening of bolts to ensure that all bolts are properly tightened.

5100.5 PAYMENT

5100.5.1 Payment shall be made at the contract lump sum price for STRUCTURAL STEEL ERECTION.

5100.5.2 The contract price for erection of structural steel shall include all labour, materials, equipment, tools, unloading, hauling, and erection necessary for the completion of the work in accordance with the contract.