SPECIFICATIONS FOR BRIDGE CONSTRUCTION

SECTION 12

BRIDGERAIL

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12.1 General

This specification is for the supply, fabrication and installation of steel tube type bridgerail, thrie beam bridgerail, approach rail transition, and handrail. Bridgerail and handrail shall include all work constructed above the top of the bridge deck, curb, parapet, sidewalk, or culvert headwalls, and wing walls, and the supply and placing of anchor bolt assemblies, end connection plates and connection angles. Approach rail transition shall include thrie beam or W-beam guardrail sections, W-thrie beam transition section, terminal connectors, steel or timber guardrail posts, spacers, and guardrail connection and wing end sections where specified.

12.2 Supply and Fabrication

12.2.1 Standards

The fabrication of bridgerail components shall conform to "The American Association of State Highway and Transport Officials (AASHTO), Standard Specifications for Highway Bridges" and the American Welding Society (AWS) - Bridge Welding Code, D1.5.

Where imperial/metric conversions are necessary, the National Standard of Canada, CAN3-Z234.1-79 shall be used as the basis of conversion.

All welding, cutting and preparation shall be in accordance with the American Welding Society (AWS) - Bridge Welding Code, D1.5.

12.2.2 Qualification

The Contractor shall notify the Department and Consultant of any subcontractors in his employ. The Contractor shall remain responsible for the work of the subcontractors. All terms of the contract, such as CWB approval, right of access, etc., shall apply to the subcontractor.

The Fabricator shall be fully approved by the Canadian Welding Bureau (CWB) as per CSA Standard W47.1.

Only welders, welding operators and tackers approved by the Canadian Welding Bureau in the particular category shall be permitted to perform weldments. Their qualifications shall be current and available for examination by the Consultant.

12.2.3 Engineering Data

12.2.3.1 Welding Procedures

Welding procedures bearing the approval of the Canadian Welding Bureau shall be submitted for each type of weld to be used. The welding procedures shall be reviewed by the Department before welding proceeds.

12.2.3.2 Shop Drawings

Shop drawing requirements shall be as per Section 6.2.3.3.

When railing for more than one bridge is included, individual shop and erection drawings shall be submitted for each bridge. Shop drawing mark numbers must be unique for each bridge.

12.2.3.3 Mill Certificates

Mill certificates shall be provided for all material before fabrication commences.

12.2.4 Materials

12.2.4.1 Steel

All steel shall conform to the standard noted on the drawings. The silicon content for various bridgerail and handrail components shall be as follows:

- Structural tubing less than 0.04%
- Structural sections, handrail bars, base plates less than 0.04% or between 0.15% to 0.25%

If substitutions are required they must be accepted by the Department and Consultant. In these cases interpretation of equivalent steel will be as per Appendix "A" of the CSA Standard G40.21 (1976 only).

12.2.4.2 Anchor Bolts

Anchor bolts shall conform to the standard noted on the drawings. The Contractor shall provide mill reports indicating the physical properties of the material to the Consultant.

12.2.4.3 Connection Plate and Angle

Steel for connection plate and angle shall conform to CSA Standard G40.21 Grade 300W or ASTM A36.

12.2.4.4 Grout

Grout for post bases shall be Sika 212 flowable grout or approved equivalent.

12.2.4.5 Approach Rail Transition

Thrie beam or W-beam guardrail sections, W-thrie beam transition section, terminal connectors, steel or timber guardrail posts, spacers, and guardrail connection and wing end sections shall be as specified in Section 14 “Guardrail”.

12.2.5 Welding

12.2.5.1 Filler Metals

Low hydrogen fillers, fluxes and welding practices shall be used throughout. The low hydrogen covering and flux shall be protected and stored as specified by AWS Standard D1.5. Flux cored welding or use of cored filled wires in the submerged arc process or shielding gas processes will not be permitted.

12.2.5.2 Joint Preparation

Preparation of welded joints shall be as indicated on the drawings. Weld areas shall be clean, free of mill scale, dirt, grease, paint and other contaminants prior to welding.

12.2.5.3 Tack and Temporary Welds

Tack and temporary welds shall not be allowed unless they are to be incorporated into the final weld. Tack welds, where allowed, shall be of a minimum length of four times the nominal size of the weld, and shall be subject to the same quality requirements as the final welds. Cracked tack welds shall be completely removed prior to welding over.

12.2.5.4 Backing Bars

Backing bars shall be fitted all around the inside of the joint. The separation of faying surfaces between the backing bars and material to be welded shall not exceed 1 mm, 100% fusion must be obtained into the backing bar including the corners of HSS members.

12.2.5.5 Run-off Tabs

Run-off tabs shall be used at the ends of all welds that terminate at the edge of a member. They shall be tack welded only to the portion of the material that will not remain a part of the structure, or where the tack will be welded over and fused into the final joint. After welding, the tabs shall be removed by flame cutting, not by breaking off.

12.2.5.6 Arc Strikes

Arc strikes are not permitted.

12.2.5.7 Methods of Weldment Repair

Repair procedures for unsatisfactory weldments shall be submitted for review and acceptance by the Department and Consultant prior to repair work commencing.

12.2.5.8 Grinding of Welds

Fillet welds not conforming to acceptable profile shall be ground to the proper profile without substantial removal of the base metal. Grinding shall be smooth and parallel to the line of stress. Caution shall be exercised to prevent over grinding. Acceptability of welds without grinding will be determined by the Consultant.

12.2.6 Fabrication

Fabrication shall be performed in an enclosed area which is adequately heated.

12.2.6.1 Rail Fabrication

All rail splices will be radiographed. Splices shall be completed using properly fitted backing bars. Only one splice per rail section will be permitted, and shall occur in an accepted location, clear of openings and connection holes. All splices shall be ground flush. Rail sections shall be orientated such that the tube seam is always located at the bottom, except for rectangular tube sections which shall have the tube seam oriented towards the bottom or the outside of the bridge. Edges of holes shall be smooth and free of notches or burrs.

12.2.6.2 Rail Sleeve Fabrication

Sleeves shall be square and be properly aligned in the rail end. Corners of the sleeves shall be rounded and smooth to ensure a good fit. Expansion joint sleeves shall be shop bolted to the appropriate rail section after galvanizing.

12.2.6.3 Post Fabrication

(a) W Posts
Posts shall be perpendicular to the base plates, unless otherwise noted on the drawings.

Base plates for the posts shall be flat, have square cut edges and corners with no lips or gouges. Anchor bolt holes shall be drilled accurately in size and location.

The rail post to base plate shall be welded by using 60°C preheat.

(b) HSS Posts
The following requirements shall apply to HSS posts, in addition to the requirements noted under W Posts:

- The tube weld seam shall be kept on the back side of the post.

- The rail post shall be butt welded to the base plate using a backing bar and a full penetration bevel groove weld. The backing bar shall be properly fitted and the post tube prepared to a sharp edged 45 degree chamfer. The groove weld shall be placed in a minimum of two passes by using 100°C of preheat and maintain a root opening of 5 mm.

A rod size no greater than 4.0 mm shall be used for the first pass. A reinforcing fillet weld shall be placed all around the joint.

- Acceptability of the post to base plate weld shall be confirmed by sectioning one fabricated post, chosen at random by the Department and Consultant, for every 50 posts fabricated. In each bridge structure at least one post shall be tested. The Contractor shall be responsible for sectioning and to provide the additional posts to replace those selected for destructive testing.

- Post caps shall be chamfered all around the top and match the contour of the post without burrs or overhang. The caps shall be attached to the posts in the shop after galvanizing. The caps shall fit tightly and include washers under the head of the cap attachment bolts.

12.2.6.4 Anchor Bolts

The threaded ends of all anchor bolts shall be chamfered. All anchor bolts, hardware and anchor bolt template shall be hot dip galvanized, after fabrication in accordance with CSA G164. Nuts shall freely spin on the bolt threads after galvanizing. The anchor bolts shall be shop assembled in cages after galvanizing with bolts aligned square and plumb. Alignment nuts shall not exceed 16 mm in thickness.

12.2.6.5 Tolerances

(a) Sleeve to Rail
Clearance between the rail sections and the sleeves shall be sufficient to ensure an easy fit after galvanizing. The maximum radial clearance allowed around the sleeve when fitted into the rail shall be 1 mm (2 mm total) after galvanizing with the tube seam removed.

Two sleeve test samples shall be made by the Fabricator from the material to be used. Both test sleeves are to be galvanized, with one being retained by the galvanizing subcontractor and the other at the Fabricator's plant. The sleeves shall be used to check the sleeve to rail fit of all rails. In the case of handrail panels, the test samples shall consist of a welded unit with top and bottom tube, and sleeve sections spaced to match the handrail.

(b) Posts
Post assembly lengths shall be within 3 mm of the specified length.

(c) Rails
Individual rail sections shall be straight and true with no evidence of kinks or dents and with a maximum variation from straightness not exceeding 3 mm over a 3 m length. Welded splices shall not be evident in the final product, and shall be straight, kink free and conform to the same section as the adjacent tubing. Bolted splices shall be straight with no offset due to loose fitting sleeves.

(d) Anchor Bolts

The bolts in an anchor bolt assembly shall fit in a template comprised of accurately located holes 2 mm greater in diameter than the anchor bolts. The top of the bolts in the assembly shall be ± 3 mm from a level plane when the threaded portion is plumb. The threaded length shall not be less than specified, nor more than 15 mm greater than that specified.

12.2.6.6 Identification

To assist field erection, shop drawing mark numbers shall be stamped on the rails and posts. Rail mark numbers shall be stamped on the underside of the rail near the ends. Post mark numbers shall be stamped on the underside of the base plates. The areas to be stamped shall be ground to remove mill scale. Stamps shall be a minimum of 12 mm high, and the resulting marks shall be at least 1.0 mm deep to be legible after galvanizing.

12.2.6.7 Galvanizing

Galvanizing shall be by the hot dip method after fabrication, in accordance with the latest edition of CSA Standard G164 with additions and exceptions as described in this specification.

The Fabricator shall provide a smooth finish on all edges and surfaces, and remove all weld spatter and all welding flux residue from the steel components prior to galvanizing. The galvanized finish shall meet the aesthetic requirements of the application and shall have a continuous outer free zinc layer without any significant zinc-iron alloy showing through the outside surface. Lumps, globules or heavy deposits of zinc will not be permitted. Handrails shall be free of any sharp protrusions or edges.

Double dip galvanizing is not advised but will be accepted if a surface finish similar in appearance, colour and quality to that of single dip galvanizing is produced. The lapped area of the double dip shall be straight, the coating smooth, adherent and free of uncoated areas, blisters, flux deposits, dross inclusions, acid and black spots.

Repair of galvanizing shall only be done if bare areas are infrequent, small, and suitable for repair. A detailed repair procedure shall be submitted for review and acceptance prior to its use. It should be noted that repairs may require complete removal of the galvanized coating and regalvanizing. Repair shall be in compliance with ASTM A780, Method A3 Metallizing. The thickness of the metallizing shall be 180 μm, and the repair tested for adhesion. The finished appearance shall be similar to the adjacent galvanizing. The Consultant will determine the acceptability of lapped or repaired areas.

12.2.6.8 Base Plate Corrosion Protection

The bottom face of each base plate shall be protected by a medium grey colour barrier coating accepted by the Consultant, to prevent contact between the zinc and the concrete. The galvanized surface must be roughened prior to application of barrier coating. The surface preparation of the galvanized surface and the dry film thickness (DFT) of the coating shall be in accordance with the coating manufacturer's recommendations. The Consultant will test the adhesion of fully cured coating as per ASTM D3359 "Standard Test Methods for Measuring Adhesion by Tape Test". The method selected for testing (Method A or B) shall depend on the dry film thickness of the coating. The coating manufacturer's product data sheets shall be provided to the Consultant prior to the application of the coating. The adhesion test result shall meet a minimum of "4B" classification i.e. a maximum allowable flaking of 5%.

12.2.6.9 Schedule

The Contractor shall provide and keep current a complete fabrication schedule in a form satisfactory to the Consultant.

12.2.7 Testing and Inspection

12.2.7.1 Testing by the Consultant

Visual, radiographic, ultrasonic, magnetic particle and any other inspection that may be specified or required will be performed by the Consultant or his testing agencies at the Consultant's expense.

The Contractor shall ensure that adequate notice for inspection and testing be given to the Consultant and that access to the work is assured at all times. When required by the Consultant, the Contractor shall provide needed manpower for assistance in checking layout and performing inspection duties.

The Contractor shall be responsible for all travel, boarding and lodging costs incurred by the Consultant to inspect bridgerail being fabricated outside the Province of Alberta. The cost shall also include for a Department's representative to attend the prejob meeting and one additional trip during the course of fabrication.

12.2.7.2 Non-destructive Testing

The methods of non-destructive examination shall be in accordance with the following standards:

- Radiography - AWS Standard D1.5
- Ultrasonic - AWS Standard D1.5
- Magnetic Particle - ASTM Standard E-709
- Dye - Penetrant - ASTM Standard E-165

12.2.7.3 Testing by the Contractor

The Contractor shall be responsible for sectioning and macro-etching the post to base plate weld as specified in “HSS Posts”.

Testing and inspection made necessary by the repair of faulty work shall be paid for by the Contractor. All of the Contractor's records made in the course of quality control shall be open for examination by the Consultant.

12.2.7.4 Notification

The Contractor shall notify the Consultant 48 hours prior to contemplate shipment to facilitate final inspection of the materials. Material that has not been inspected in the fabrication plant will not be paid for until such material has been inspected and accepted. The Contractor may be charged with all expenses incurred for inspection of the material at the site.

12.2.8 Material Handling and Storage

All lifting and handling shall be done using devices that do not mark, mar, damage or distort the galvanized members and assemblies in any way. Galvanized material shall be stacked or bundled and stored to prevent wet storage stain as per the American Hot Dip Galvanizers Association (AHDGA) publication "Wet Storage Stain". Delivery of a damaged product will be a cause for rejection.

12.3 Erection

Anchor bolt assemblies shall be accurately positioned with anchor bolt projections as shown and specified.

The line and grade of the railing shall be true to that shown on the drawings, and not follow any unevenness in the superstructure. It will be necessary to adjust the height and plumbness of each post, in order to compensate for normal superstructure variations, and achieve the desired line and grade on the bridgerail.

Anchor bolts that project less than the full thickness of the nuts, by more than 2 threads, shall be extended. The proposed repair will require the acceptance of the Department and Consultant in writing and the repair shall be done at no cost to the Department. However, if the repair work described above is due to deficiency in the work of others, it will be paid for as Extra Work.

The method of forming and pouring the grout shall be submitted to the Consultant for review and acceptance. Dry-pack methods of constructing grout pads will not be accepted.

Sealer shall be applied to the exposed grout pad surfaces in accordance with Section 4.25 of the specifications for "Cast-in-Place Concrete."

12.3.1 Grouting in Cold Weather

When the daily minimum air temperature, or the temperature of the bridgerail, the bridge substructure or superstructure in the immediate area of the grouting falls below 5°C, the following provisions for cold weather grouting shall be put into place:

(a) Before grouting, adequate preheat shall be provided to raise the temperature of the adjacent areas of the bridgerail, the bridge substructure and superstructure to at least 10°C.

(b) Temperature of the grout during placing shall be between 10°C and 25°C.

(c) The grout pad shall be enclosed and kept at 10°C to 25°C for at least 5 days. The system of heating shall be designed to prevent excessive drying-out of the grout.

12.3.2 Approach Rail Transition

The supply and installation of the approach rail transition including thrie beam or W-beam guardrail sections, W-thrie beam transition section, terminal connectors, steel or timber guardrail posts, spacers, and hardware as shown on the drawings shall be included as Bridgerail. These materials shall be supplied and installed in accordance with Section 14 “Guardrail”, of the Specifications.

12.4 Payment

Payment for **Bridgerail** will be made on the basis of the lump sum price bid for Bridgerail acceptably completed. The price bid shall include full compensation for the cost of furnishing all labour, materials, equipment, tools, and incidentals necessary to supply, fabricate, and erect the bridgerail, including the approach rail transition and guardrail connection and wing end sections where specified. Payment for **Bridgerail** will be made at 80% of the lump sum price bid upon receipt and acceptance of the material at the site. The remaining payment will be made after the bridgerail is suitably installed and accepted by the Consultant.