SECTION 424

SUPPLY AND INSTALLATION OF STRUCTURAL PLATE ARCH

INDEX

424.01 SCOPE

This specification covers the requirements for the supply, installation, and backfilling of a structural plate arch to extend an existing structural plate arch or new construction.

The structural arch shall be of the size, thickness, and type specified in the contract documents.

The provision of footings for the arch is covered under Section 450.

Should headwalls be required, then they shall be covered separately under Section 451.

424.02 SUBMITTALS

All submittals for the structure shall be received, reviewed and accepted by the Department prior to fabrication of the structure. All issued for construction submittals shall be received 2 weeks prior to the start of construction. The Contractor shall allow a minimum of 2 weeks for shop drawing review.

The Contractor is reminded of General Condition 41.3 and their responsibility to review, stamp, date and sign shop drawing submittals.

The manufacturer shall provide a copy of the certificate of compliance for Corrugated Steel Structures. The manufacturer's certificate of compliance shall be issued by an independent 3rd party certification agency who are accredited by the Standards Council of Canada, confirming that the manufacturer produces certified corrugated steel pipe products in accordance with CSA G401.The steel structure shall have two identifier plates attached to the upper ends of the structure or individual plates containing the Certifying Agency's logo, CSA logo, manufacturer name, serial / project number and supply year.

Mill certificates for the material, as well as other Quality Assurance documentation related to the design and fabrication of the structure shall be available upon request

424.03 ENVIRONMENTAL PERMITS AND AUTHORIZATIONS

Authorization from the Department of Fisheries and Oceans Canada's Fish and Fish Habitat Protection Program is required for work in or near any watercourse or water body deemed to be viable fish habitat.

Where required by Fisheries and Oceans, a downstream pool shall be provided at the culvert outlet.

Work is to be carried out in accordance with all requirements stipulated by regulatory agencies whose approval is required. This includes, but is not limited to, the Department of Fisheries and Oceans Canada, Transport Canada's Navigation Protection Program and the Water Resources Division of the Department of Environment, Climate Change and Municipalities.

Where unwatering is required, the contractor shall carry out this work in accordance with Section 180.

The Contractor shall be aware of the requirements of Division 8.

424.04 MATERIALS

424.04.01 Fabrication

Structural components shall be carefully formed to the corrugation profile and curved to the required radius along the inner crest, in the manufacturer's plant.

Fabrication of all steel components must meet the requirements of CAN/CSA G401 or ASTM A761, as applicable.

424.04.02 Materials for Steel Structures

Steel plate to conform to the latest version of CSA G401.

Corrugated steel structural plate shall meet the general requirements as specified in CSA G401.

For galvanized structures, a zinc coating shall be applied after fabrication. The coating must provide a minimum coating weight of 915 grams per square metre total on both sides of the corrugated steel plates and base channels in accordance with CSA G401.

For structures that are specified by the Department to have a thermoplastic copolymer coating; a thermoplastic copolymer coating shall be applied to both sides of the corrugated steel plates and base channels in accordance with CSA G401.

Bolts and nuts for the structural plate connections shall be heavy hex, meeting the requirements of CSA G401. Anchor bolts shall meet CSA G401. All fasteners and anchor bolts shall be zinc coated in accordance with CSA G401.

For thermoplastic copolymer coated structures all fasteners shall be in accordance with the latest version of CSPI Technical Bulletin Issue Twenty-Three.

Steel for base channels, if required, to conform to CSA G401.

424.04.03 Materials for Aluminum Structures

Aluminum plates to conform to the latest version of ASTM B746.

The aluminum structural plate shall meet the general requirements as specified in ASTM B746. Bolt holes shall be 25 millimetres in diameter using 19 millimetre diameter (M20) bolts.

Bolts and nuts for the structural plate connections shall be heavy hex.

Steel bolts shall meet the requirements of CSA G401. Anchor bolts shall meet CSA G401.

All fasteners and anchor bolts shall be coated in accordance with CSA G401.

Aluminum bolts shall meet the requirements of ASTM F468, made from Alloy 6061-T6.

Aluminum nuts shall meet the requirements of ASTM F467, made from alloy 6061-T6.

424.04.04 HANDLING, SHIPPING AND STORAGE

All components shall be handled, stored and shipped in such a manner as to eliminate the potential for damage as detailed in the manufacturer's installation guide. All damaged components shall be rejected by the Department and replaced at the Contractor's expense.

424.05 EXCAVATION

The Contractor shall excavate a foundation within the limits and to the grade as staked by the Owner's Representative. This excavation shall be carried out and paid for in accordance with Section 403.

424.06 EXTENSIONS TO EXISTING STRUCTURAL PLATE

Where in order to secure the extension to the existing pipe, cuts need to be made, or bolt holes need to be drilled in the existing pipe, then the Contractor shall make such cuts or holes as are necessary. Cuts and holes shall be made in such a manner so as to leave neat edges.

In the case of extensions or modifications to existing arches all cutting and drilling shall be reviewed and accepted by the supplier and the Owner's Representative. Cuts (if essential) shall be made with saws and holes (if essential) shall be drilled. Following such alteration, the Contractor shall clean, pre-treat if necessary and coat all damaged sections with cold-galvanizing compound as outlined. The cold-galvanizing compound shall be allowed to thoroughly dry before adding the extension.

Where corrugated steel pipe is cut, drilled, or welded the pipe shall be thoroughly cleaned with a wire brush to remove scale, rust, slag residue, weld splatter, and wiped clean. The clean surface shall receive at least one application of metal conditioner to de-oxidize, de-grease, and phosphatize the metal surface to be treated if the surface is oily. Pre-mixed, ready-to-apply, liquid-zinc compound should be applied to the prepared clean dry metal surface. The cold-galvanizing compound must be of a type that imparts cathodic action

against corrosion. The cold-galvanizing compound should have a minimum 50 millimetre overlap of the surrounding undamaged galvanized metal.

When applying a metal conditioner and a cold galvanizing compound near a watercourse or water body, the Contractor shall ensure that the application is carried out carefully as to prevent leakage or spillage.

All cut edges and any damage to aluminized or polymer laminated coatings shall be repaired in accordance with the latest version of CSA G401

All materials must be applied in accordance with the manufacturer's instructions.

424.07 ASSEMBLY

The Contractor shall load the plates, base channels, nuts, bolts, washers, ribs if required, and all necessary hardware at the point of supply and transport them to the installation site.

The Contractor shall allow the concrete footings to cure for at least three days before commencing the assembly of the structural plate and the bolting of the plates to the channel embedded in the footing.

The cutting of plate(s) or the drilling of holes in new structural plate pipe construction will not be permitted. Any defective plate(s) must be reported to the supplier and corrective action taken by the supplier or the manufacturer.

Plates shall be bolted at longitudinal and circumferential seams such that no more than 3 plates overlap at any bolt hole.

The Contractor shall assemble the structure using procedures as recommended by the supplier and in accordance with the instructions of the Owner’s Representative.

When extending an existing arch, the Contractor shall brush off all soil sticking to the outside of those parts of plates that are to be lapped when joined.

The structural plate arch shall be placed to the required alignment, and grade and be within the required limits, as specified by the Owner’s Representative.

After complete assembly all bolts shall be re-tightened with a torque wrench to not less than 200 N-m for plates of thickness up to and including 3.2 millimetres thick, and not less than 340 N-m for plate thicker than 3.2 millimetres or to the manufacturer’s specifications.

Any damage to metallic coatings shall be repaired in accordance with the latest version of CSA G401.

Uncoated areas wider than 50mm shall be replaced with new material or redipped in accordance with CSA G401.

Any damage to polymer coatings shall be promptly repaired in accordance with CSPI Technical Bulletin Number 2. The damaged area shall receive a zinc rich coating with a minimum dry thickness of 50µm, Denso Butyl Spray Primer and Denso Tape. For coating damage exceeding 50mm in width; the Contractor shall submit an engineered repair plan which ensures a 75 year design life and is manufacturer approved. The acceptance of the repair procedure shall be at the sole discretion of the Department. Should the Department find the repair procedure unacceptable then the structural plate will be rejected and replaced with new, undamaged structural plate. All costs associated with preparation of repair procedures and repairing or replacing the damaged structural plate arch shall be borne entirely by the Contractor.

424.08 BACKFILLING

424.08.01 SELECT BACKFILL AND MATERIAL TESTING

Backfill material in the engineered backfill zone shall be clean, well graded, granular material meeting the strength, gradation, compressibility and electrochemical requirements specified herein.

When the air temperature is below 0°C, no backfilling is allowed. Frozen granular backfill materials will not be permitted. No backfill material will be permitted to be placed directly on frozen substrate.

The engineered backfill envelop shall meet the requirements of the latest CAN/CSA-S6 design code.

All select backfill shall be provided from a single source.

It shall be the Contractor’s responsibility to carry-out all required testing. The Contractor shall use professional engineering services and a qualified testing firm licensed in Newfoundland and Labrador for all sampling and testing of the select backfill.

At least two weeks prior to start of construction the Contractor shall identify the source of materials to be used for the select backfill and provide initial testing for the select backfill.

This testing shall include both gradation and electrochemical testing as a minimum. A copy of these test results shall be provided to the Owner's Representative.

Select backfill material shall satisfy the following soil classification requirements:

1. ASTM D2487 - Group GW, SW, GP, GW-GM, or SW-SM
2. ASTM D6913 - Maximum 75mm particles size
   Less than 50% passing the 0.150mm sieve
   Less than 10% passing the 0.075mm sieve
3. ASTM D4318 - Plasticity index less than 6%

All select backfill material must conform to the following electro-chemical limits per AASHTO LRFD specifications as detailed in Table 4 of Corrugated Steel Pipe Institute's (CSPI) Technical Bulletin Thirteen.

As a minimum requirement, the select backfill material shall be tested in accordance with AASHTO or ASTM standard methods and meet the following criteria:

ELECTRO-CHEMICAL PARAMETER	ELECTRO-CHEMICAL REQUIREMENT	TEST METHOD	
		AASHTO	ASTM
Chlorides (Cl^-)	< 100 ppm	T291	D4327
Sulphates (SO_4^{2-})	< 200 ppm	T290	D4327
Resistivity	> 3000 ohm-cm	T288	G187
pH	5 – 10	T289	D4972
Max Organic Content	< 1%	T267	D2974

In addition to the initial gradation and electrochemical testing, the Contractor shall sample and test the backfill for conformance with the gradation requirements at least once for every 250 cubic metres of material placed.

The Contractor shall also provide a 20 kilogram representative sample of the backfill proposed for construction to the Owner's Representative for testing and approval two weeks prior to start of construction. The sample provided shall meet the geotechnical parameters as specified.

All sampling shall be carried out in the presence of the Owner's Representative.

Additional gradation testing at the Contractor's expense may be required if based upon visual inspection in the field it is evident to the Owner's Representative that the gradation of the select backfill material has changed.

Gradation requirements will be strictly enforced and variances to coarser or less well graded material will not be accepted.

The Contractor shall also be responsible for testing to establish the Standard Proctor Maximum Dry Density (ASTM 698) of the approved backfill and will be responsible for having the compaction of each lift of backfill tested for conformance with the compaction requirements specified in Section 424.08.02.

All results shall be provided to the Owner's Representative as the work progresses.

Where conventional material testing is not possible the Contractor shall use professional engineering services licensed to practice in Newfoundland and Labrador to provide a visual inspection of each lift, ensuring proper compaction. The Contractor shall provide a letter of conformance from the third party engineering firm stating that the select backfill meets the compaction requirements of this specification

There will be no payment for installation until all initial testing results have been submitted to the Owner's Representative and deemed acceptable.

Timely submission of all required gradation and compaction testing results shall be provided to the Owner's Representative as the work progresses. The Contractor is advised that failure to provide testing results, or failure to meet the specified requirements, may result in the rejection of the select backfill material. Select backfill rejected by the Department as a result of not meeting the material requirements of this specification, shall be carefully excavated and replaced in accordance with this specification, at the Contractor's expense.

The Contractor is advised that the Department may elect to carryout quality assurance work in relation to any aspect of this structure. No delay claims will be accepted as a result of this activity.

Where there are discrepancies between the Department's and manufacturer's specifications then the more stringent requirement shall govern.

424.08.02 Backfilling Operations

The Contractor shall notify the Owner's Representative a minimum of 7 days prior to the commencement of backfilling operations.

Backfilling shall not commence until any concrete footings, headwalls and wing walls have cured to at least 70% of the specified design strength at 28 days or cured for seven days, whichever comes first. This requirement may be increased by Engineer of Record for the reinforced concrete components.

Backfilling with select backfill material shall be continued until all parts of the arch have not less than 1 metre of backfill cover, or not less than the manufacturer's recommended minimum cover, whichever is less.

The backfill material shall be uniformly placed in compacted lifts on both sides of the structure. The backfill lifts shall not exceed 250 millimetres in depth (before compaction) and shall be compacted to a minimum of 98% Standard Proctor Dry Density (ASTM D698).

The difference in levels of the backfill on the two sides at any transverse section shall not exceed two compacted lift thickness and the maximum particle size of 75 millimetres within 300 millimetres of the structure.

The select backfill shall extend along the sides of the structure at least one span width away from the steel surfaces.

Backfilling with select backfill material shall be continued until all parts of the pipe have not less than 1 metre of backfill cover, or not less than the manufacturer's recommended minimum cover, whichever is less.

Heavy equipment cannot be operated within 1000 millimetres of the structure. Fill within 1000 millimetres of the structure must be placed and compacted using light equipment or by hand.

Loads that exceed design loading are not permitted on the structure. Live Load traffic is not permitted until the structure has been backfilled to the minimum design height of cover without prior approval from the Engineer of Record.

Backfill shall be carefully placed and compacted so that the correct shape of the structure is maintained. The Contractor shall monitor the shape of the structure during backfilling operations. Any deflection from the specified dimensions shall be within the tolerances noted on the manufacturer’s shop drawings. If deflections exceed the permitted tolerances, then backfilling operations shall be ceased until a suitable procedure is developed by the Contractor and accepted by the Department or the structural components are replaced at the Contractor’s expense. Any repair procedure by prepared

by the Contractor shall be stamped by a Professional Engineer and shall ensure a 75 year design life. The Manufacturer and Owner's Representative shall be notified of any deflections in writing immediately.

424.09 PROTECTION FROM TRAFFIC

Prior to allowing the movement of construction equipment or any vehicular traffic over the structure, the depth of cover over the structure shall not be less than the manufacturer's recommended minimum cover for the particular loading. Any construction equipment exceeding CL-625 loading conditions shall not be permitted over the structure.

424.10 MEASUREMENT FOR PAYMENT

Measurement for payment for the supply and installation of Structural Plate Arch shall be the actual length of the new structural plate part of the arch measured in metres, to one decimal place, along the bottom of one side of the new structural plate.

424.11 BASIS FOR PAYMENT

Payment at the contract price for the size, thickness, and type of structural plate arch specified shall be full compensation for all labour, materials, and equipment use required to: supply all plates, base channels, nuts, bolts, washers, ribs if required, together with all necessary hardware, load and haul the same from the supply point to the installation site, provide for temporary storage and all rehandling necessary, assemble the structure, and bolt base channels, locate to alignment, grade, and tolerance specified by the Owner's Representative, place, compact and test select backfill as specified herein, together with all labour, materials and equipment-use necessary to provide any required unwatering.

Where the work involves extending an existing structural plate arch the tendered price shall include full compensation for cleaning, pre-treating if necessary, including the supply and application of cold-galvanizing compound to all cuts, holes and damaged galvanizing.

Select backfill material shall be paid for in accordance with Section 206 or Section 207 or Section 310 as the case may be, but the additional requirements for bedding and backfilling as stipulated in this specification shall be considered compensated for in the contract price for the supply and installation of the structural plate arch.