PART 1 - GENERAL

1.1 Description

.1 This section specifies requirements for supplying, placing, finishing, protecting and curing concrete for fishway reconstruction.

1.2 Reference Standards

.1 Do structural concrete work to CSA-A23.1 and CSA A23.3.

1.3 Submittals

.1 Qualifications of personnel performing the work.

.2 Mix designs including compressive test data used to establish proportions. Material certificates for materials, including cements, aggregates and admixtures.

1.4 Source Sampling

.1 At least two (2) weeks prior to commencing work inform Departmental Representative of proposed source of following material to be supplied and forward samples to testing laboratory to be designated by the Departmental Representative.

.1 Coarse and fine aggregate
.2 Portland cement
.3 Admixtures
.4 Joint filler
.5 Joint sealant
.6 Curing compound
.7 Blended hydraulic cement
.8 Supplementary cementing materials

.2 Provide certification that mix proportions selected will produce concrete of quality, yield and strength as specified in concrete mixes and will comply with CAN/CSA-A23.1.

.3 Provide certification that plant, equipment, and materials to be used in concrete comply with requirements of CAN/CSA-A23.1.

1.5 Storage of Materials

.1 Store materials to prevent contamination or deterioration.

.2 Provide adequate storage facilities for materials to ensure a continuous supply of these materials during batching operations.

.3 Store cement in weathertight facility.

.4 Stockpile aggregates in accordance with good standard practice.

1.6 Quality Assurance

.1 Minimum two (2) weeks prior to starting concrete work, submit proposed quality control procedures to Departmental Representative for the

following items:
.1 Cold weather concrete;
.2 Curing;
.3 Finishes;
.4 Formwork removal;
.5 Joints.

1.7 Waste Management & Disposal

.1 Use trigger operated spray nozzles for water hoses.

.2 Designate a cleaning area for tools to limit water use and runoff.

.3 Carefully coordinate the specified concrete work with weather conditions.

.4 Ensure emptied containers are sealed and stored safely for disposal away from children.

.5 Prevent plasticizers, water-reducing agents and air-entraining agents from entering water supplies or streams. Using appropriate safety precautions, collect liquid or solidify liquid with an inert, non-combustible material and remove for disposal. Dispose of all waste in accordance with applicable local, provincial and national regulations.

.6 Choose least harmful appropriate cleaning method which will perform adequately.

1.8 Measurement for Payment

.1 Concrete Diversion Walls:

.1 As specified including all plant, material, labour, and equipment will be measured in cubic metre (m^3) of concrete supplied and placed in the work. The wall quantity volume shall be calculated based on the elevations, dimensions and slopes indicated on the drawings, in conjunction with actual field measurements when required and as approved by the Departmental Representative. The shear key quantity volume shall be calculated based on the minimum dimensions indicated on the drawings, within the tolerances indicated in part 3.13 of this section. Additional concrete required due to over excavation will not be measured for payment. The unit price shall also include the supply and placement of reinforcing steel, drilling and installation of rock anchors, dowels, formwork, grout, bonding agent, and all other related accessories.

.2 Concrete Pipe Footing Base:

.1 As specified including all plant, material, labour and equipment will be measured in cubic metre (m^3) of concrete supplied and placed in the work calculated from elevations

and dimensions indicated on the drawings, in conjunction with actual field measurements and as approved by the Departmental Representative. The unit price shall also include the supply and placement of reinforcing steel, drilling and installation of dowels, formwork, grout, bonding agent and all other related accessories.

.3 Concrete Pipe Encasement:

.1 As specified including all plant, material, labour and equipment will be measured in cubic metre (m^3) of concrete supplied and placed in the work calculated from elevations and dimensions indicated on the drawings, in conjunction with actual field measurements and as approved by the Departmental Representative. The unit price shall also include the supply and placement of reinforcing steel, drilling and installation of dowels, formwork, grout, bonding agent and all other related accessories.

.4 Existing Concrete Wall Seal:

.1 No separate measurement for payment shall be made for this item. Include all costs for sealing the gap between the existing diversion wall and pier in the lump sum portion of the work on the Bid and Acceptance Form.

.5 Concrete shall be placed on a competent rock surface as approved by the Departmental Representative. Include incidental to the payment all surface preparation including the removal of all loose rock, and fragmented rock and intentional surface roughening, as approved by Departmental Representative.

.6 No separate measurement will be made for any other ingredient or feature of the concrete work including scheduling, cold weather placement, additives, cement, aggregates, finishing, plant or labour. All such items will be considered incidental to the work, and costs included in the unit price bid for structural concrete.

.7 No separate measurement will be made for preparation of rock to receive concrete.

PART 2 - PRODUCTS

2.1 Materials

.1 Cement to CAN/CSA-A3001, Type GU.

.2 Supplementary cementing materials: to CAN/CSA-A3001.

.3 Cementitious hydraulic slag: to CAN/CSA-A3001.

.4 Water: to CAN/CSA-A23.1.

.5 Aggregates: to CAN/CSA-A23.1. Coarse aggregates to be normal density.

.6 Air entraining admixture: to ASTM C260.

.7 Chemical admixtures: to ASTM C494/C494M. Departmental Representative to approve accelerating or set retarding admixtures during cold and hot weather placing.

.8 Concrete retarders: to ASTM C494M. Do not allow moisture of any kind to come in contact with the retarder film.

.9 Curing compound: curing compounds are not to be used.

.10 Pre-moulded joint fillers:
- .1 Sponge rubber: to ASTM D1752, Type 1, flexible grade.
- .2 Joint sealer: to CGSB 19-GP-24M and CSA A23.1, chemical curing, multi-component, Class 'B', Type 1 for horizontal joints.

.11 Bonding Agent
- .1 Bonding agent to be weld-crete or approved equal.

.12 Water Stops
- .1 Flexile butyl rubber and swellable clay waterproofing compound that swells upon contact with water to form a compression seal.
  - .1 Swellstop Waterstop by Greenstreak or approved equal.

.13 Tinting Mixture
- .1 Interstar pigments or approved equal.
- .2 All new placed concrete to be tinted to match the existing terrain and to look as natural as possible. Contractor shall provide samples and coordinate in the field with the Departmental Representative prior to pouring.

2.2 Concrete Mixes

.1 Concrete shall be mixed and proportioned in accordance to CSA A23.1, Clause 4.3.

.2 Concrete shall be proportioned to comply with Alternative 1, Table 2 in CSA A23.1 and following requirements:
- .1 Cement: Type GUb, Blended Cement (as required to meet type C1 exposure).
- .2 Minimum compressive strength of all concrete to be 35 MPa at 28 days.
- .3 Class "C1" exposure.
- .4 Nominal size of course aggregate 20

mm.

.5 Slump range at point of discharge 50 mm to 100 mm.

.6 Air Content 5 - 8 percent.

.7 Density of air-dry concrete will be in range of 2240 to 2400 kg/m^3.

.8 Minimum cement content: 385 kg/m^3.

.9 Maximum w/c ratio : 0.40

.10 High range water reducing agents (superplasticizers) may be used at the Contractor's request, if so indicated when the mix design is submitted. The Contractor must demonstrate competence and experience in their use and specific approval must be obtained. The Contractor shall state his method of concrete placement when submitting his concrete mix design.

.11 If superplasticizers are used, the maximum concrete slump in a superplasticized condition shall be limited to 230 mm. The mix design shall state the design slump before and after the addition of superplasticizers along with the appropriate tolerances. Note that the slump in the above may not be applicable when using superplasticizers.

.3 Submit from the ready mix concrete supplier, a letter certifying the following:

.1 That his plant and equipment is certified and all materials to be used in the concrete comply with the requirements of CSA Standard CSA A23.1.

.2 That the mix proportions selected will produce concrete of the specified quality and yield. Indicate mix proportions and sources of all materials.

.3 That the strengths will comply with the strengths specified herein.

.4 Weigh aggregates, cement, water and admixture when batching. No alternative methods of measuring will be permitted.

.5 Do not use calcium chloride.

PART 3 - EXECUTION

3.1 General

.1 Comply with additional requirements of CSA A23.1, Clause 15, for concrete exposed to seawater environments.

.2 Place concrete in hot weather to CSA A23.1.

.3 Place concrete in cold weather to CSA A23.1.

.4 Keep concrete surfaces moist continually during protection stage.

.5 Place, consolidate, finish, cure and protect concrete to CSA A23.1.

.6 Do not commence placing concrete until Departmental Representative has inspected and approved forms, foundations, reinforcing steel, joints, conveying, spreading, consolidation and finishing equipment and curing and protective methods.

3.2 Scheduling and Work Methology

.1 Prior to commencing any work, obtain all requirements and approvals of fish habitat and related regulatory authorities for carrying out the work.

.2 Develop a detailed work schedule and methodology for all excavation and construction work and submit to Departmental Representative and applicable regulatory authorities for review and approval. Contractor's schedule and methodology shall address all restrictions placed on work by regulatory authorities and indicate how the work plan will address such issues.

.3 All work must be carried out in the dry, unless otherwise approved by the Departmental Representative. Where berms are required to accomplish this, the design of such berms is to be carried out by a professional Engineer licensed to practice in Newfoundland. Drawings of the berm design, stamped by the Engineer, are to be submitted to and approved by the Departmental Representative before any work starts.

3.3 Preparation

.1 Prior to installing rock anchors or concrete formwork, remove all loose and fractured rock located underneath new concrete to sound competent material to satisfaction of Departmental Representative. This will provide for a clean and competent rock surface for dowelling and concrete placement. Roughen rock surface to approval of Departmental Representative to placement of bonding agent and fresh concrete.

.2 Hardened concrete which shall receive new concrete shall be roughened to a full amplitude of no less than 5 mm.

.3 Drill rock anchors into exposed solid rock and pressure grout full depth into the rock as defined in Section 03 36 60 and 03 20 50.

.4 Over excavation for rock removal will not be accepted. Additional work to correct over excavation, to the approval of the Departmental Representative, will be at the contractors expense.

.5 Obtain Departmental Representative's approval before placing concrete. Provide 24 hours notice

prior to placing concrete.

.6 Pumping of concrete is permitted only after approval of equipment and mix.

.7 Ensure reinforcement and inserts are not disturbed during concrete placement.

.8 Prior to placing of concrete obtain Departmental Representative's approval of proposed method for protection of concrete during placing and curing in adverse weather.

.9 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.

.10 Do not place load upon new concrete until authorized by Departmental Representative.

.11 Apply approved bonding agent on all concrete to rock interfaces and all concrete to concrete interfaces prior to pouring fresh concrete.

3.4 Formwork

.1 Install and strip formwork to CSA A23.1 and Section 03 10 00.

3.5 Inserts

.1 Position and secure anchor bolts in formwork to maintain line and grades.

3.6 Concrete Tinting

.1 All new placed concrete to be tinted to match the existing terrain and to look as natural as possible. Contractor shall provide samples and coordinate in the field with the Departmental Representative prior to pouring.

3.7 Placing Concrete

.1 Place and consolidate concrete to CSA - A23.1.

.2 Do not place concrete on or against frozen material.

.3 Place concrete continuously from joint to joint. Unless otherwise specified, consolidate concrete with high speed internal vibrators.

.4 Place concrete in a uniform heading, normal to the centreline. Limit rate of placing to that which can be finished before beginning of initial set.

.5 If proposed by the Contractor, alternate placement methods to those described herein (which yield, the desired results), can be reviewed by the Departmental Representative with necessary submittals from the Contractor.

3.8 Bonding Agent

.1 Apply bonding agent to all concrete/ rock interfaces and hardened concrete to fresh concrete interfaces, in accordance with manufacturer's instruction prior to pouring concrete. Bonding agent to be weldcrete or approved equal. Rock surfaces to be roughened to approval of the Departmental Representative before placement of fresh concrete. Hardened concrete surfaces to be roughened to a full amplitude of at least 5 mm prior to placement of fresh concrete.

3.9 Strike Off and Consolidation

.1 Internal poker vibrators shall be used to consolidate the concrete during placing.

.2 Strikeoff and consolidation must be completed before excess water bleeds to the surface.

.3 Ensure that the concrete conforms to the elevations and slopes as shown on the drawings.

3.10 Finishing

.1 Refer to Section 03 35 00: Concrete Finish.

3.11 Protection and Curing

.1 Cure to CSA-A23.1.

.2 Concrete shall be cured by protecting it against loss of moisture, rapid temperature change and mechanical injury for at least seven days after placement. After finishing operations have been completed, the entire surface of the newly placed concrete shall be covered by whatever curing medium is applicable to local conditions and approved by the Departmental Representative.

The Contractor shall have the equipment needed for adequate curing at hand and ready to install before actual concrete placement begins.

.3 When air temperature is at or below 5° C or when there is a probability of its falling to that limit within 24 hours of placing (as forecast by the nearest official meteorological office) cold weather protection as per CSA A23.1 will be provided and the following:

.1 Housing - Protect concrete by a windproof shelter of canvas or other material to allow free circulation of inside air around fresh touch formwork and provide sufficient space for removal of formwork for finishing. Supply approved heating equipment capable of keeping inside air at a constant temperature sufficiently height to maintain concrete at following curing temperatures.

.2 For initial three (3) days at a temperature of not less than 15 degrees C nor more than 27 degrees C at surface.

.3 Maintain concrete at 10 degrees C for an extra four (4) days plus the initial three (3) days.

.4 In addition to the protective housing, the concrete must be cured as outlined in Clause 3.10.2 above.

3.12 Testing

.1 Contractor will appoint a concrete testing company approved by the Departmental Representative to test all work under this section of specification as per CSA A23.1.

.2 Cost of comprehensive strength tests shall be paid for by the Contractor.

.3 Testing company shall issue reports to Departmental Representative on quality of test cylinders.

.4 Contractor shall notify Departmental Representative at least seven (7) days prior to start of placing concrete. He shall provide for testing purposes an adequate quantity of approved test cylinders.

.5 At least one (1) set of three (3) cylinders each shall be taken from 25 m^3 or fraction thereof of each day's pour, whichever is less. One (1) cylinder shall be tested at seven (7) days and other two (2) tested at twenty-eight (28) days.

.6 Cylinders will be crated and delivered to the testing laboratory within forty-eight (48) hours after casting in accordance with CSA A23.1. Contractor will pay for crating and delivery of cylinders to the laboratory.

.7 If strength tests of test cylinder for any portion of the work falls below the specified compressive strength at 28 days, the Departmental Representative reserves the right to determine the acceptability of the concrete by performing additional field testing as outlined in CSA-A23.1.

.8 If concrete does not conform to drawings or specifications, the Contractor will take measures as directed to correct the deficiency. All costs of correctional measures will be at the expense of the Contractor.

.9 Inspection or testing enforced by the Departmental Representative will not replace Contractor quality control or relieve him of his contractual responsibility.

3.13 Placement Tolerance

.1 All concrete work shall be within $\pm$ 12 mm of the dimensions and elevations indicated on the drawings. Failure to meet this condition may result in rejection of the work and replacement at the Contractor's expense.