PART 1 - GENERAL

1.1 RELATED WORK

.1 Section 02 41 16 - Demolition and Removal.

1.2 REFERENCES

.1 CAN/CSA-A23.1-09(R2014) - Concrete Materials and Methods of Concrete Construction.

1.3 ENVIRONMENTAL CONDITIONS

.1 Provide adequate nuisance dust protection masks and ear protection to operator.

.2 Wet cutting only will be permitted unless directed otherwise by Departmental Representative.

1.4 PROTECTION

.1 Protect surrounding surfaces from damage due to work of this section. Make good such damage to satisfaction of Departmental Representative and at no additional cost.

1.5 CONCRETE CUTTING

.1 Contractor to cut concrete as required.

1.6 CONTRACTOR'S RESPONSIBILITIES

.1 Furnish labour and facilities to:
.1 Provide access to work requiring cutting.
.2 Make good work disturbed by Cutting.
.3 Provide storage on site for cutting specialists equipment and tools.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Concrete cutting saw to CAN/CSA-C22.2 No 71.1-M89 - Portable Electric Tools.

PART 3 - EXECUTION

3.1 PREPARATION

.1 Define exactly, all lines to be cut or cored and mark with indelible lines. All quantities and thicknesses to be determined with Departmental Representative and provided to Departmental Representative in writing.

.2 Advise Departmental Representative prior to commencing cutting.

.3 Departmental Representative to approve areas, quantities, and thicknesses identified prior to any cutting

3.2 CUTTING, GENERAL

.1 Sawcut to depth required using a purpose made blade in a specialized concrete saw. Depth to be a minimum of 15 mm to avoid the necessity of feather edging.

.2 Sawed surfaces to be smooth, plane and parallel unless otherwise specified.

.3 Remove all debris and clean surfaces of loose material.

.4 Remove all concrete dust and debris resulting from work specified and dispose of off National Parks property at NSDEL approved dumpsite.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 74 21 - Construction/ Demolition Management and Disposal.

.2 Section 03 20 00 - Concrete Reinforcing.

.3 Section 03 30 00 - Cast-in-Place Concrete.

1.2 REFERENCES

.1 Canadian Standards Association (CSA)
.1 CSA-A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction.
.2 CSA-O86S1-05, Engineering Design in Wood (Limit States Design).
.3 CSA S269.1-1975(R2003), Falsework for Construction Purposes.
.4 CAN/CSA-S269.3-M92(R2008) Concrete Formwork.
.5 CSA 0121-08, Douglas Fir Plywood.

.2 Council of Forest Industries of British Columbia (COFI)
.1 COFI Exterior Plywood for Concrete Formwork.

1.3 SHOP DRAWINGS

.1 Submit shop drawings for formwork and falsework for suspended slab formwork and supports in accordance with Section 01 33 00 - Submittal Procedures.

.2 Indicate method and schedule of construction, shoring, stripping and re-shoring procedures, materials, arrangements of joints, special architectural exposed finishes, ties, liners, and locations of temporary embedded parts. Comply with CSA S269.1, for falsework drawings. Comply with CAN/CSA-S269.3 for formwork drawings.

.3 Indicate formwork design data, such as permissible rate of concrete placement, and temperature of concrete, in forms.

1.3 SHOP DRAWINGS (Cont'd)

.4 Indicate sequence of erection and removal of formwork/falsework as directed by Departmental Representative.

.5 Each shop drawing submission shall bear stamp and signature of qualified professional engineer registered or licensed in the Province of Nova Scotia.

1.4 RESPONSIBILITY

.1 Design for method and schedule of construction, shoring, stripping and re-shoring procedures, materials, arrangement of joints, ties, liners, and locations of temporary embedded parts. Comply with CAN/CSA-S269.3 for formwork drawings.

.2 Indicate formwork design data, such as permissible rate of concrete placement, and temperature of concrete, in forms upon request from Departmental Representative.

1.5 WASTE MANAGEMENT AND DISPOSAL

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

.2 Place materials defined as hazardous or toxic waste in designated containers.

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

.4 Use sealers, form release and stripping agents that are non-toxic, biodegradable and have zero or low VOC's.
.1 Use of sealers, form release and stripping agents within the inboard side of the weather barrier, including must comply with VOC limits as set by SCAQMD Rule 1113.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, handle and store formwork materials to prevent weathering, warping or damage detrimental to the strength of the materials or to the surface to be formed.

1.6 DELIVERY, STORAGE AND HANDLING (Cont'd)

.2 Ensure that formwork surfaces which will be in contact with concrete are not contaminated by foreign matter. Handle and erect the fabricated formwork so as to prevent damage.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Formwork materials:
.1 Use wood and wood product formwork materials to CSA-A23.1/A23.2 and CSA O121.
.2 Plywood and wood formwork materials to CSA-O121, CAN3-O86.1, CAN3-O86.1S1, CSA O153.
.3 Use new and undamaged forms only for exposed surfaces. Use formwork liners as required to achieve stringent specified finish tolerances.

.2 Falsework materials: to CSA S269.1.

.3 Form ties:
.1 Use removable or snap-off galvanized metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm dia. in concrete surface. Holes are to be filled with non-shrink grout.
.2 Adjustable in lengths to permit tightening and alignment of forms.

.4 Form release agent: non-toxic, biodegradable, low VOC, chemically active release agents containing compounds that react with free lime present in concrete to provide water insoluble soaps, preventing concrete from sticking to forms.

.5 Form stripping agent: colourless mineral oil, non-toxic, biodegradable, low VOC, free of kerosene, with viscosity between 15 to 24 mm^2 /sat 40°C, flashpoint minimum 150°C, open cup. Agent shall be compatible with bridge sealing and waterproofing systems where applicable.

PART 3 - EXECUTION

3.1 FABRICATION AND ERECTION

.1 Verify lines and levels before proceeding with formwork/falsework and ensure dimensions agree with drawings. Review all drawings and check dimensions prior to construction for proper fit and report any discrepancies before proceeding with the work.

.2 Obtain Departmental Representative's approval for use of earth forms.

.3 Obtain Departmental Representative's approval before framing openings not indicated on drawings.

.4 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.

.5 Assemble formwork so that concrete is not damaged during its removal.

.6 Fabricate and erect falsework in accordance with CSA S269.1 and COFI exterior plywood for concrete formwork.

.7 Provide form finishes as per CAN/CSA A23.1-09 and ACI 301 as follows:
.1 Top of footings: rough form finish to CSA A23.1.
.2 Abutment walls exposed to view plus 500mm below ground surface: Rubbed finish to ACI 301.
.3 Deck soffits, curb faces and all other formed concrete surfaces unless otherwise indicated: Rubbed Finish to ACI 301.
.4 Horizontal surface at top of Sidewalk: Broom Finish to CSA A23.1.
.5 Repair all deficient areas prior to proceeding with other finishes.

.8 Do not place shores and mud sills on frozen ground.

.9 Provide site drainage to prevent washout of soil supporting mud sills and shores.

3.1 FABRICATION AND ERECTION (Cont'd)

.10 Fabricate and erect formwork in accordance with CAN/CSA-S269.3 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA-A23.1/A23.2.

.11 Align form joints and make watertight. Keep form joints to minimum.

.12 Locate horizontal form joints for walls and pilasters below top of finished grade. Minimize vertical form joints for walls above top of finished grade. Align horizontal form joints with recesses, reveals and other features of the abutment and bridge structure. Use non-standard size panels and reduced maximum tie spacias required to achieve panel layout.

.13 Form slots, openings, drips, recesses, expansion and control joints as indicated.

.14 Prior to placing concrete, the elevations of forms shall be checked to verify drainage slopes.

.15 Provide 48 hours notice to Departmental Representative for inspection prior to concrete placement.

.16 Clean formwork as erection proceeds, to remove foreign matter. Remove cuttings, shavings and debris from within forms. Flush completely with water to remove remaining foreign matters. Ensure that water and debris drain to exterior through clean-out ports.

.17 During cold weather, remove ice and snow from within forms, do not use de-icing salts. Do not use water to clean out completed forms, unless formwork and concrete construction proceed within a heated enclosure.

.18 Patch all form tie holes and finish surface to remove all evidence of tie holes and/or patching.

.19 Construction Joints:
.1 Form construction joints where required and as approved.

3.1 FABRICATION AND ERECTION (Cont'd)

.19 (Cont'd)
.2 Build waterstops into forms, supported against displacement by pouring of concrete.
.3 Use preformed waterstop corners and intersections where they are available to suit conditions.
.4 Join waterstops to preformed corners and intersections, and between lengths with butted and welded connections in accordance with manufacturer's recommendations.

.20 Clean formwork in accordance with CSA A23.1/A23.2 before placing concrete.

.21 Apply form release agent to all formed surfaces prior to casting concrete.

3.2 REMOVAL AND RESHORING

.1 Notify Departmental Representative prior to form removal.

.2 Form removal times are dependent on proper curing as specified herein.

.3 Remove formwork progressively and in accordance with the reference code requirements, and so that no shock loads or imbalanced loads are imposed on the structure.

.4 Leave formwork in place for following minimum periods of time after placing concrete.
.1 3 days for footings, retaining walls and bridge abutment walls.

.5 Re-use formwork and falsework subject to requirements of CSA-A23.1/A23.2.

.6 Loosen forms carefully. Do not wedge pry bars, hammers or tools against concrete surfaces.

.7 Provide all necessary reshoring of members where early removal of forms may be required or where members may be subjected to additional loads during construction as required.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 01 74 21- Construction/Demolition Waste Management and Disposal

.2 Section 03 10 00 - Concrete Forming and Formwork Accessories.

.3 Section 03 30 00 – Cast-in-Place Concrete.

1.2 REFERENCES

.1 Canadian Standards Association (CSA)
.1 CSA-A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction.
.2 CSA-G30.3 - Cold Drawn Steel Wire for Concrete Reinforcement.
.3 CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
.4 CSA-A23.3-04 (R2010), Design of Concrete Structures for Buildings.
.5 CAN/CSA-G30.18-09, Billet-Steel Bars for Concrete Reinforcement.

.2 Reinforcing Steel Institute of Canada (RSIC)
.1 RSIC-2004, Reinforcing Steel Manual of Standard Practice.

.3 ASTM A108-13, Standard Specification for Steel Bar, Carbon and Alloy, Cold finished.

.4 ANSI/ACI 315, Manual of Engineering and Placing Drawings for Reinforced Concrete Structures.

1.3 SHOP DRAWINGS

.1 Submit reinforcing steel shop drawings for review by the Departmental Representative that are sealed and signed by a registered Engineer in the Province of Nova Scotia.

.2 Indicate on shop drawings, bar bending details, lists, quantities of reinforcement, sizes, spacings, splice lengths locations of reinforcement and mechanical splices if approved by Departmental Representative, with identifying code marks to permit correct placement without references to structural drawings. Indicate sizes, spacings and locations of chairs, spacers

and hangers.

.3 Prepare reinforcement drawings in accordance with Reinforcing Steel Manual of Standard practice - by Reinforcing Steel Institute of Canada and to ANSI/ACI 315.

.4 Detail splice lengths to CSA-A23.3 as follows:
.1 All splices to be tension lap splices, Class "B".
.2 No more than 50% of the reinforcing to be spliced at any given location.
.3 Do not splice near locations of maximum stress (for example, do not splice bottom deck longitudinal reinforcement at midspan).

1.4 WASTE MANAGEMENT AND DISPOSAL

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

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Substitute different size bars only if permitted in writing by Departmental Representative.

.2 Reinforcing steel: billet steel, grade 400, deformed bars to CAN/CSA-G30.18, unless indicated otherwise.

.3 Cold-drawn annealed steel wire ties: minimum 1.5 mm diameter to CAN/CSA G30.3.

.4 Chairs, bolsters, bar supports, spacers: to CSA-A23.1/A23.2, adequate for strength and support of reinforcing during construction conditions, all of which to be non-staining. Do not use metal chairs. Colour to be grey where all or portions of the chair may remain exposed.

.5 Mechanical splices: subject to approval of Departmental Representative.

2.2 FABRICATION

.1 Fabricate reinforcing steel in accordance with CSA-A23.1/A23.2, ANSI/ACI 315 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada. Shop

fabricate and bend all reinforcing steel.

.2 Fabricate to the following tolerances:
.1 Sheared length + 25 mm.
.2 Stirrups, items and spirals to + 10 mm.
.3 Other bends + 25 mm.

.3 Obtain Departmental Representative's approval for locations of reinforcement splices other than those shown on placing drawings.

.4 Welding of reinforcing steel must receive prior approval of the Departmental Representative.

.5 Upon approval of Departmental Representative, weld reinforcement in accordance with CSA W186.

.6 Have welding performed by workers qualified under CSA W47.1.

.7 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.

2.3 SOURCE QUALITY CONTROL

.1 Upon request, provide Departmental Representative with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis, minimum 2 weeks prior to beginning reinforcing work. Mill certificates shall be in accordance with CAN/CSA G30.18.

.2 Upon request inform Departmental Representative of proposed source of material to be supplied.

2.4 CLEANING

.1 Clean reinforcing to CSA-A23.1/A23.2. All reinforcing bars are to be free of scale rust and contamination at time of placing in forms.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Examine work related to this section and report discrepancies to Departmental Representative.

.2 Commencement of work shall imply acceptance of conditions.

3.2 FIELD BENDING

.1 Do not field bend or field weld reinforcement except where indicated or authorized by Departmental Representative.

.2 When field bending is authorized, bend without heat, applying slow and steady pressure.

.3 Replace bars, which develop cracks or splits.

3.3 PLACING REINFORCEMENT

.1 Place reinforcing steel as indicated on reviewed placing drawings and in accordance with CSA-A23.1/A23.2.

.2 Provide all chairs, braces, lateral support, headers, ties, etc. to secure reinforcing in place during construction.

.3 Prior to placing concrete, obtain Departmental Representative's approval of reinforcing material and placement.

.4 Ensure cover to reinforcement is maintained during concrete pour.

.5 Under no circumstances will concrete trucks or highway traffic be permitted to travel over the reinforcing during concrete placing operations.

.6 After reinforcing is placed and prior to closing of forms, notify the Departmental Representative for inspection of the Work.

.7 Reinforcement shall be adequately supported by chairs, spacers or hangers and secured against displacement within the tolerance permitted and in accordance with the latest ACI Standard 315.

3.4 STORAGE

.1 Store reinforcing steel to prevent deterioration, contamination or disfigurement.

.2 Store reinforcing steel off the ground.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 45 00 - Quality Control.

.3 Section 03 10 00 - Concrete Forming and Accessories.

.4 Section 03 30 00 - Cast-in-Place Concrete.

.5 Section 03 30 51 - Concrete for Bridge Decks.

1.2 REFERENCES

.1 American Concrete Institute (ACI)
.1 SP-66-04, ACI Detailing Manual 2004.
.1 ACI 315-99, Details and Detailing of Concrete Reinforcement.
.2 ACI 315R-04, Manual of Engineering and Placing Drawings for Reinforced Concrete Structures.
.2 ACI 440.1 R-06, Guide for the Design and Construction of Structural Concrete Reinforced with FRP Bars.
.3 ACI 440.5-08

.2 Canadian Standards Association (CSA International)
.1 CSA-A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/ Test Methods and Standard Practices for Concrete.
.2 CSA S6-14, Canadian Highway Bridge Design Code.
.3 CSA S807-10 (2010), Specification for Fibre-Reinforced Polymers.

.3 Reinforcing Steel Institute of Canada (RSIC)
.1 RSIC-2004, Reinforcing Steel Manual of Standard Practice.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Prepare reinforcement drawings in accordance with RSIC Manual of Standard Practice and ACI 315, except as noted herein. Submit shop drawings at least four 4) weeks prior to commencing fabrication for review and approval. The Contractor retains responsibility for correctly detailing reinforcement, but the shop drawings must be approved for conformity with the design. Fabrication shall not proceed until the final approval of shop drawings. Shop drawings shall be stamped by a Professional Engineer licensed to practice in the Province of Nova Scotia.

.3 Submit shop drawings including placing of reinforcement and indicate:
.1 Bar bending details.
.2 Lists.
.3 Bar identification numbers to correspond between the lists and the placement of drawings.
.4 Quantities of reinforcement.
.5 Sizes, spacings, covers, locations of reinforcement and splices as specified / if approved by Departmental Representative, with identifying code marks to permit correct placement without reference to structural drawings.
.6 Indicate sizes, spacings and locations of chairs, spacers and hangers.
.7 Product data including material and mechanical properties.

.4 Detail lap lengths and bar development lengths to CSA-S6-14, unless otherwise indicated.
.1 Provide lap splice lengths to CSA-S6-14, where required.

1.4 QUALITY ASSURANCE

.1 Submit in accordance with Section 01 45 00 - Quality Control and as described in PART 2.3 - SOURCE QUALITY CONTROL.

1.4 QUALITY ASSURANCE (Cont'd)

.1 (Cont'd)
.1 Test Reports: provide Departmental Representative with certified test report for source quality control testing for material and mechanical properties performed by an independent testing agency, minimum 4 weeks prior to beginning reinforcing work.
.2 Submit in writing to Departmental Representative proposed source of reinforcement material to be supplied.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
.1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
.2 Store materials under covers to avoid UV radiation and chemical substances.
.3 Use a spreader bar when hoisting bundles of GFRP bars.
.4 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Substitute different size bars only if permitted in writing by Departmental Representative.

.2 Nominal bar diameters and area shall be in accordance with the tables shown on the drawings.

2.1 MATERIALS (Cont'd)

.3 Minimum design tensile strength (FGFRP) and minimum modulus of elasticity (EGFRP) for GFRP straight and bent bars shall be in accordance with the tables shown on the drawings. The yield strength of bent GFRP reinforcing bars must be at least 400 MPa at the bend in accordance with test method B.12 (ACI 440.1R-06).

.4 The surface of the GFRP reinforcing bars shall be deformed and/or sand coated to achieve mechanical and chemical bond to the concrete as per CSA-S6-14.

.5 Binding material is composed of modified vinyl ester resin with a maximum volume fraction of 35 percent.

.6 Fibre reinforcement to consist of continuous E-glass fibres with a minimum volume fraction of 65 percent.

.7 GFRP reinforcing bars shall be fastened together at all joints and intersections using plastic or nylon ties.

.8 Bars shall be supported as per manufacturer's recommendations using non-corrosive chairs.

.9 All GFRP bars in the same structural component shall be supplied by the same manufacturer.

.10 Cross Sectional Area: to CAN/CSA S806, Annex A, Determination of Cross Sectional Area of FRP Reinforcement.

.11 Longitudinal Tensile strength for straight bars and straight portions of bent bars: to CAN/CSA S806, Annex C, or to ASTM C7205.

.12 Longitudinal tensile modulus and ultimate elongation (for straight bars and straight portions of bent bars): to CAN/CSA S806, Annex C, or to ASTM D7205.

.13 Transverse shear strength: to ACI 440.3R, Test Method B.4, or to CAN/CSA S806, Annex N.

2.1 MATERIALS (Cont'd)

.14 Longitudinal tensile strength and modulus of FRP bent bars at bend locations: to ACI 440.3R-04, Test Method B5; or to ACI 440.3R, Test Method B.12.

.15 Fibre Content: to ASTM D3171 (Method I of Procedure G); or to ASTM E1131 and ASTM D2584 as required.

.16 Void Content: to ASTM D2734 or to ASTM D5117.

.17 Water Absorption at 50 degrees Celsius for straight bars: to ASTM D570.

.18 Cure ratio for straight bars: to CAN/CSA S807, Appendix A.

2.2 FABRICATION

.1 Fabricate GFRP reinforcing in accordance with CSA S807-10, ACI 440 and Reinforcing Manual of Standard Practice by the Steel Reinforcing Steel Institute of Canada.

.2 Obtain Departmental Representative's approval for locations of reinforcement splices other than those shown on placing drawings.

.3 Shop bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.

2.3 SOURCE QUALITY CONTROL

.1 Upon request, provide Departmental Representative with certified copy of test report of GFRP reinforcing, showing physical and chemical analysis, minimum 4 weeks prior to beginning reinforcing work.

.2 Upon request, inform Departmental Representative of proposed source of material to be supplied.

PART 3 - EXECUTION

3.1 PREPARATION

.1 Examine areas to receive GFRP bars. Notify Departmental Representative is areas are not acceptable. Do not begin placing GFRP bars until unacceptable conditions have been corrected.

.2 All GFRP reinforcing bars shall have the necessary net sectional area, and shall be cut to the exact lengths, and shop-bent to the exact forms and dimensions, shown on the approved plans. All stirrups and hoops shall accurately fit the rods.

3.2 FIELD BENDING

.1 Do not field bend reinforcement.

3.3 PLACING REINFORCEMENT

.1 Place GFRP reinforcing as indicated on placing drawings.

.2 Obtain approval from Departmental Representative before field cutting GFRP reinforcing bars. Field cutting shall be to manufacturer's recommendations with high speed cutter or saw. Do not shear bars.

.3 Prior to placing concrete, obtain Departmental Representative's approval for reinforcing material and placement.

.4 Ensure cover to reinforcement is maintained during concrete placement.

3.3 PLACING REINFORCEMENT (Cont'd)

.5 All reinforcing bars shall be placed held rigidly in the exact same positions in the forms as shown on the approved plans, or otherwise required, and there shall be no displacement of the same by the placing and tamping of the concrete. Adjusting or moving the bars while the concrete is being placed shall not be permitted, unless specified on the plans. Concrete protection required for GFRP reinforcing shall be in accordance with the Contract Documents, or as directed by the Departmental Representative. All bars shall be tied and properly braced to prevent displacement. No concrete shall be placed until the reinforcement, after being cleaned and placed in position, has been examined and approved by the Departmental Representative.

.6 Place and support GFRP bars accurately using plastic or non-corrosive chairs before concrete placement has been started. GFRP bars should be supported at about 2/3 of the distance normally used for steel rebar, as the GFRP bar is more flexible.

.7 Fasten GFRP bars with coated tie wire, stainless steel tie wire or nylon ties.

.8 Use plastic of nylon form ties.

.9 Use lap splices, whenever continuity is required in the reinforcement. Do not use mechanical connections or welded splices.

.10 Remove form oil from GFRP bars by wiping bars with compatible solvents before placing concrete.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 Abbreviations and Acronyms:

.1 Cement: hydraulic cement or blended hydraulic cement (GUb - where b denotes blended).

.1 Type GU or GUb - General use cement.

.2 Reference Standards:

.1 ASTM International

.1 ASTM C 260-06, Standard Specification for Air-Entraining Admixtures for Concrete.

.2 ASTM C 309-07, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

.3 ASTM C 494/C 494M-08a, Standard Specification for Chemical Admixtures for Concrete.

.4 ASTM C 1017/C 1017M-07, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.

.5 ASTM A615/A615M-12, Standard Specification for Deformed and Plain Carbon-steel Bars for Concrete Reinforcement.

.2 CSA International

.1 CSA A23.1/A23.2-2004, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

.2 CSA A283-06, Qualification Code for Concrete Testing Laboratories.

.3 CSA A3000-08, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

.4 CSA G30.18-09, Carbon Steel Bars for Concrete Reinforcement.

1.2 ADMINISTRATIVE REQUIREMENTS

.1 Pre-installation Meetings: in accordance with Section 01 32 16.07 - Construction Progress Schedules - Bar (GANTT) Chart, convene pre-installation meeting one week prior to beginning concrete works.

1.2 ADMINISTRATIVE REQUIREMENTS (Cont'd)

.1 (Cont'd)

.1 Ensure key personnel, site supervisor, Departmental Representative speciality contractor - forming concrete producer, testing laboratories attend.

.1 Verify project requirements.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Provide testing inspection results and reports for review by Departmental Representative and do not proceed without written approval when deviations from mix design or parameters are found.

.3 Concrete pours: provide accurate records of poured concrete items indicating date and location of pour, quality, air temperature and test samples taken as described in PART 3 - FIELD QUALITY CONTROL.

.4 Concrete hauling time: provide for review by Departmental Representative deviations exceeding maximum allowable time of 120 minutes for concrete to be delivered to site of Work and discharged after batching.

.5 Provide two copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements 01 35 43 - Environmental Procedures.

1.4 QUALITY ASSURANCE

.1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.

.2 Provide Departmental Representative, minimum 4 weeks prior to starting concrete work, with valid and recognized certificate from plant delivering concrete.

.1 Provide test data and certification by qualified independent inspection and testing laboratory that materials and mix designs used in concrete mixture will meet specified requirements.

1.4 QUALITY ASSURANCE (Cont'd)

.3 Minimum 4 weeks prior to starting concrete work, provide proposed quality control procedures for review by Departmental Representative on following items:
.1 Falsework erection.
.2 Hot weather concrete.
.3 Cold weather concrete.
.4 Curing.
.5 Finishes.
.6 Formwork removal.
.7 Joints.
.8 Backfilling.

.4 Quality Control Plan: provide written report to Departmental Representative verifying compliance that concrete in place meets performance requirements of concrete as established in PART 2 - PRODUCTS.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Delivery and Acceptance Requirements:
.1 Concrete hauling time: deliver to site of Work and discharged within 120 minutes maximum after batching.
.1 Do not modify maximum time limit without receipt of prior written agreement from Departmental Representative, laboratory representative, and concrete producer as described in CSA A23.1/A23.2.
.2 Deviations to be submitted for review by Departmental Representative.
.2 Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.

PART 2 - PRODUCTS

2.1 CONCRETE DESIGN CRITERIA

.1 Performance: to CSA A23.1/A23.2, and as described in MIXES of PART 2 - PRODUCTS.

2.2 CONCRETE PERFORMANCE CRITERIA

.1 Quality Control Plan: ensure concrete supplier meets performance criteria of concrete as established by Departmental Representative and provide verification of compliance as described in PART 1 - QUALITY ASSURANCE.

2.2 CONCRETE PERFORMANCE CRITERIA

.1 Quality Control Plan: ensure concrete supplier meets performance criteria of concrete as established by Departmental Representative and provide verification of compliance as described in PART 1 - QUALITY ASSURANCE.

2.3 CONCRETE MATERIALS

.1 Cement: to CSA A3001, Type GU to CSA A23.1/A23.2 and CAN/CSA A5.

.2 Hydraulic cement: Type GUb to CSA A3001.

.3 Water: to CSA A23.1.

.4 Aggregates: to CSA A23.1/A23.2. Coarse aggregates to be normal density.

.5 Admixtures:
.1 Air entraining admixture: to CSA A23.1/A23.2 and CAN3-A266.1.
.2 Chemical admixture: to CSA A23.1/A23.2 and CAN3-A266.4. Departmental Representative to approve accelerating or set retarding admixtures during cold and hot weather placing.
.3 Obtain authorization from Departmental Representative for use of super plasticizing admixture, water reducer, and/or other admixtures as approved by Departmental Representative to achieve designed concrete properties.

.6 Concrete shall be normal and shall have a unit weight of 2350 kg/m3.

.7 Curing compound: to CSA A23.1/A23.2 white and ASTM C 309.

.8 Premoulded joint fillers:
.1 Bituminous impregnated fiber board: to ASTM D 1751.
.2 Sponge rubber: to ASTM D 1752, Type I, flexible firm grade.
.3 Self-expanding Standard cork: to ASTM D 1752, Type III.

.9 Weep hole tubes: plastic.

2.4 CONCRETE MIXES

.1 Performance Method for specifying concrete: to meet Departmental Representative performance criteria and to CSA A23.1/A23.2.

.2 Ensure concrete supplier meets performance criteria as established below and provide verification of compliance as in Quality Control Plan.

.1 Provide concrete mix to meet following plastic state requirements:

.1 Uniformity: to CSA A23.1

.2 Workability: free of loss of mortar, segregation.

.3 Finishability: amount of bleeding.

.4 Set time: 2 hours maximum.

.2 Mix 1: Non-bridge footings, retaining walls, baffle drain and reinforced concrete not on bridge:

.1 Exposure Classification: C-1.

.2 Compressive strength at 28 age: 35 MPa minimum.

.3 Aggregate size 20 mm maximum.

.3 Mix 2: Mud slabs and lean concrete:

.1 Compressive strength at 28 days: 10 MPa minimum.

.2 Exposure classification: N.

.4 Mix 3: Concrete for Bridge pile cap, abutments, bridge deck curbs, sidewalks, wingwalls, precast girders and other cast-in-place elements for bridge.

.1 Exposure Classification: C-1, except as modified below.

.2 Minimum comprehensive strength at 28 days: 45 MPa.

.3 Chemical admixtures: in accordance with ASTM C494; submit to Departmental Representative for approval.

.4 Nominal maximum aggregate size: 20mm.

.5 Maximum Water/Cement Ratio: 0.35

.6 Total cementitious materials content: minimum 415 kg/m3, maximum 480kg/m3.

.7 Air content: 5-8%

.8 Slump: design for 60mm before addition of superplasticizer/ Tolerances per CAN/CSA A23.1.

.9 Maximum spacing factor for hardened concrete: 0.2mm to ASTM C457M.

.10 Maximum chloride ion penetrability: 1000 coulombs within 56 days.

2.4 CONCRETE MIXES (Cont'd)

.2 (Cont'd)

.4 (Cont'd)

.5 Use superplasticizer in all concrete to achieve workability. Pay for all admixtures as required to achieve specified properties.

.6 Maximum concrete temperature delivered: 25 degrees Celsius, except 18 degrees Celsius where thickness of element exceeds 2 meters.

.7 Maximum concrete temperature in situ: 70 degrees Celsius.

.8 Maximum temperature gradient: 20 degrees Celsius per meter.

.3 Provide quality management plan to ensure verification of concrete quality to specified performance.

.4 Concrete supplier's certification: both batch plant and materials meet CSA A23.1 requirements.

PART 3 - EXECUTION

3.1 PREPARATION

.1 Obtain Departmental Representative's written approval before placing concrete.

.1 Provide 24 hours minimum notice prior to placing of concrete.

.2 Place concrete reinforcing in accordance with Section 03 20 00 - Concrete Reinforcing.

.3 During concreting operations:

.1 Development of cold joints not allowed.

.2 Ensure concrete delivery and handling facilitates placing with minimum of re-handling, and without damage to existing structure or Work.

.4 Pumping of concrete will be permitted only after approval of equipment and mix.

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

3.1 PREPARATION (Cont'd)

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

.7 Protect previous Work from staining.

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

.9 In locations where new concrete is dowelled to existing work, drill holes in existing concrete.
.1 Place steel dowels of deformed steel reinforcing bars and pack solidly with shrinkage compensating grout epoxy grout to anchor and hold dowels in positions as indicated.

.10 Do not place load upon new concrete until authorized by Departmental Representative. Backfilling of retaining walls is prohibited until authorized by Departmental Representative.

3.2 INSTALLATION/ APPLICATION

.1 Do cast-in-place concrete work to CSA A23.1/A23.2.

.2 Sleeves and inserts:
.1 Do not permit penetrations, sleeves, ducts, pipes or other openings to pass through walls except where indicated or approved by Departmental Representative.
.2 Where approved by Departmental Representative, set sleeves, ties, pipe hangers and other inserts and openings as indicated or specified elsewhere.
.3 Sleeves and openings greater than 100 x 100 mm not indicated, must be reviewed by Departmental Representative.
.4 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain written approval of modifications from Departmental Representative before placing of concrete.
.5 Confirm locations and sizes of sleeves and openings shown on drawings.

3.2 INSTALLATION/ APPLICATION (Cont'd)

.2 (Cont'd)

.5 Confirm locations and sizes of sleeves and openings shown on drawings.

.6 Set special inserts for strength testing as indicated and as required by non-destructive method of testing concrete.

.3 Drainage holes and weep holes:

.1 Form weep holes and drainage holes in accordance with Section 03 10 00 - Concrete Forming and Accessories. If wood forms are used, remove them after concrete has set.

.2 Install weep hole tubes and drains as indicated.

.4 Finishing and curing:

.1 Finish concrete to CSA A23.1/A23.2.

.2 Use procedures as reviewed by Departmental Representative or those noted in CSA A23.1/A23.2 to remove excess bleed water. Ensure surface is not damaged.

.3 Use curing compounds compatible with applied finish on concrete surfaces. Applied finish on concrete: brushed on exposed pad footings. Provide written declaration that compounds used are compatible.

.4 Refer to Section 03 10 00 - Concrete forming and formwork accessories for form finish tolerances.

.5 Horizontal surface at top of Sidewalk: Broom finish to CSA A23.1.

.6 Top surfaces of curbs, barriers, and approach slab: steel trowelled finish to finish classification D per CAN CSA A23.1.

.5 Waterstops:

.1 Install waterstops to provide continuous water seal.

.2 Do not distort or pierce waterstop in way as to hamper performance.

.3 Do not displace reinforcement when installing waterstops.

.4 Use equipment to manufacturer's requirements to field splice waterstops.

.5 Tie waterstops rigidly in place.

.6 Use only straight heat sealed butt joints in field.

.7 Use factory welded corners and intersections unless otherwise approved by Departmental Representative.

3.3 SURFACE TOLERANCE

.1 Concrete tolerance to CSA A23.1 Straightedge Method.

3.4 FIELD QUALITY CONTROL

.1 Site tests: conduct tests as follows in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
.1 Concrete pours.
.2 Slump.
.3 Air content.
.4 Compressive strength at 3 and 7 28 and 56 days.
.5 Air and concrete temperature.
.6 Weather.

.2 Inspection and testing of concrete and concrete materials will be carried out by testing laboratory designated by Departmental Representative for review to CSA A23.1/A23.2.
.1 Ensure testing laboratory is certified to CSA A283.

.3 Ensure test results are distributed for discussion at pre-pouring concrete meeting between testing laboratory and Departmental Representative.

.4 Departmental Representative will pay for costs of tests as specified in Section 01 29 83 - Payment Procedures for Testing Laboratory Services.

.5 Departmental Representative will take additional test cylinders during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they represent.

.6 For compressive strength testing, a minimum of 3 cylinders and 2 field cured cylinders are required for:
.1 Each day's pour
.2 Each type of grade of concrete
.3 Each change of supplier
.4 Each 40 cubic metre or fraction thereof for footings and foundation walls.

3.4 FIELD QUALITY CONTROL (Cont'd)

.6 (Cont'd)

.5 Additional test specimens shall be taken whenever requested by the Departmental Representative to verify the concrete quality.

.7 Non-Destructive Methods for Testing Concrete: to CSA A23.1/A23.2.

.8 Inspection or testing by Departmental Representative will not augment or replace Contractor quality control nor relieve Contractor of his contractual responsibility.

3.5 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

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

.1 Divert unused concrete materials from landfill to local quarry facility after receipt of written approval from Departmental Representative.

.2 Provide appropriate area on job site where concrete trucks and be safely washed.

.3 Divert unused admixtures and additive materials (pigments, fibres) from landfill to official hazardous material collections site as approved by Departmental Representative.

.4 Do not dispose of unused admixtures and additive materials into sewer systems, into lakes, streams, onto ground or in other location where it will pose health or environmental hazard.

.5 Prevent admixtures and additive materials from entering drinking water supplies or streams.

.6 Using appropriate safety precautions, collect liquid or solidify liquid with inert, noncombustible material and remove for disposal.

.7 Dispose of waste in accordance with applicable local, Provincial/Territorial and National regulations.

3.6 CURING

.1 Ensure that freshly placed concrete is protected from freezing, dehydration, mechanical shock and contact with injurious substances.

.2 Do not use curing compounds that would have a detrimental effect on bonding, adhesion, curing, appearance, or similar qualities of materials applied to concrete surfaces. Use only moisture curing.

.3 Protect the concrete from premature drying and extremes of temperature.

.4 Cure, protect and finish concrete to CAN/CSA A23.1-09, CSA S269.1 and S269.3. Curing type in accordance with specified exposure classification unless more stringent requirements are noted otherwise. Special curing and finishing requirements are as follows:
.1 Exterior concrete pads: curing "TYPE 2". Seven (7) days total at >10°C and for the time necessary to attain 70% of the specified concrete strength.
.2 Bride Deck: Curing "TYPE 3 - Extended wet curing". A wet curing period of 7 days at >10°C. The curing types allowed are ponding, continuous sprinkling, absorptive mat, or fabric kept continuously wet.

.5 Foot traffic shall be kept off curing concrete for 1 day.

.6 Vehicles shall be kept off concrete for 7 days.

3.7 DEFECTIVE WORK

.1 Repairs and classification of unacceptable concrete to be in accordance with CSA-A23.1/A23.2.

.2 Remove defective concrete and embedded debris and repair as directed by Departmental Representative.

.3 Excessive honeycomb or embedded debris in any concrete shall deem it defective. Remove and replace defective concrete.

3.7 DEFECTIVE WORK (Cont'd)

.4 Remove to bare concrete curing compounds detrimental to application of specified finishes.

.5 Concrete to be supplied at the minimum strength requirement at 28 days. Tests indicating strengths lower than specified will necessitate further testing as required by the Departmental Representative. Cost for such testing to be at the Contractor's expense. Should further tests confirm low values, the Departmental Representative has the right to require strengthening of the affected area or removal and replacing of the weak concrete all to the Contractor's expense.

.6 Repair all shrinkage cracks in the completed concrete work employing a suitable epoxy injection technique acceptable to Departmental Representative to completely seal all such cracks.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 35 29.06 - Health and Safety Requirements.

.3 Section 01 45 00 - Quality Control.

.4 Section 03 10 00 - Concrete Forming and Accessories.

.5 Section 03 20 00 - Concrete Reinforcing.

.6 Section 03 20 01 - GFRP Reinforcing.

.7 Section 03 30 00 - Cast-in-Place Concrete.

1.2 EXECUTION

.1 Except as noted herein, all work under this section shall be undertaken in accordance with Section 03 30 00 - Cast-in-Place Concrete.

1.3 PROTECTION OF STEEL GIRDERS

.1 Prevent marking or staining of girders.
.1 Seal joints between deck formwork and concrete girders to prevent leakage of cement paste or concrete.
.2 Use caulking, duct tape, polyethylene foam, or other suitable means or material, to achieve seal.

.2 If foreign material spills onto girders despite protection provided, clean off, wash and sandblast contaminated areas and repair any and all damaged coatings, as reviewed by Departmental Representative.

.3 If exterior surfaces of girders becomes stained or marked, sandblast lightly and repair girder as reviewed by Departmental Representative.

PART 2 - PRODUCTS

2.1 NOT USED .1 Not used.

PART 3 - EXECUTION

3.1 NOT USED .1 Not used.

END OF SECTION