

1 GENERAL

1.1 RELATED WORK

- .1 Section 02 41 13 - Selective Site Demolition.
- .2 Section 02 41 13.14 - Asphalt Pavement Removal.

1.2 REFERENCES

- .1 CAN/CSA-A23.1-M90 - 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.

2 PRODUCTS

2.1 MATERIALS

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

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 Parks Canada property at NSDEL approved dumpsite.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 03 20 00 - Concrete Reinforcing.
- .2 Section 03 30 00 - Cast-in-Place Concrete.

1.2 REFERENCES

- .1 American Concrete Institute (ACI)
 - .1 ACI 301-10, Specifications for Structural Concrete.
- .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 O86-14, Engineering Design in Wood.
 - .3 CSA O121-08(R2013), Douglas Fir Plywood.
 - .4 CSA O151-09(R2014), Canadian Softwood Plywood.
 - .5 CSA O153-13, Poplar Plywood.
 - .6 CSA O325-07(R2012), Construction Sheathing.
 - .7 CSA S269.1-1975 (R2003), Falsework for Construction Purposes.
 - .8 CAN/CSA-S269.3-M92(R2013), Concrete Formwork.

1.3 SUBMITTALS

- .1 Submit shop drawings for formwork and falsework.
- .2 Indicate method and schedule of construction, shoring, stripping and re-shoring procedures, materials, arrangements of joints, 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: permissible rate of concrete placement, and temperature of concrete, in forms.
- .4 Indicate sequence of erection and removal of formwork as directed by Departmental Representative.
- .5 Each shop drawing submitted to bear the stamp and signature of a qualified Professional Engineer registered or licensed to practice in the Province of Nova Scotia.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling.
 - .2 Place materials defined as hazardous or toxic in designated containers.

- .3 Divert wood materials from landfill to a recycling, reuse or composting facility as approved by Departmental Representative.
- .4 Divert plastic materials from landfill to a recycling, reuse or composting facility as approved by Departmental Representative.
- .5 Use sealers, form release and stripping agents that are non-toxic, biodegradable and have zero or low VOC's.
- .2 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.
- .3 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 high density overlaid plywood to CSA 0121.
 - .2 The form facing material shall be free from surface defects and meet deflection requirements in accordance with CAN/CSA S269.3.
- .2 Falsework materials: to CSA S269.1.
- .3 Form ties:
 - .1 Use removable or snap-off metal ties 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.
 - .3 Form tie colour shall be grey.
- .4 Form release agent: compatible with repair materials, 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 and 24 mm²/sat 40°C, flashpoint minimum 150°C, open cup.

PART 3 EXECUTION

3.1 FABRICATION AND ERECTION

- .1 Verify lines, levels and centres 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 Contractor solely responsible for design and construction of formwork and safety of structure before and after forms are removed.

- .3 Assemble formwork so that concrete is not damaged during its removal.
- .4 Fabricate and erect falsework in accordance with CSA S269.1.
- .5 Provide site drainage to prevent washout of soil supporting mud sills and shores.
- .6 Fabricate and erect formwork in accordance with CAN/CSA-S269.3 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within minimum tolerances required by CSA-A23.1/A23.2 and as noted in Section 3.2.
- .7 Formwork and all supporting or bracing members shall be designed such that they will not deflect noticeably under the weight or pressure of the concrete and other loadings incidental to construction. The maximum deflection of facing materials in concrete surfaces exposed to view shall be 1/360 of the span between supporting members.
- .8 When necessary to maintain specified tolerances, the formwork shall be cambered to compensate for anticipated deflections.
- .9 Align form joints and make watertight. Keep form joints to minimum.
- .10 Make the form mortar tight by sealing with building tape or sealants along all joints.
- .11 Use 25 mm chamfer strips on external corners unless specified otherwise.
- .12 Form chases, slots, recesses as indicated.
- .13 Build in inserts, anchors, and other embedments as required.
- .14 Provide 48 hour notice to Departmental Representative for inspection prior to concrete placement.
- .15 Clean formwork 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.
- .16 Prior to placing concrete, suitable means for checking alignment and elevations of forms during concrete placement operation shall be devised. Checks shall be made frequently during placement. Corrective wedging or shoring carried out both horizontally and vertically as required, until all concrete is in place.
- .17 Repair concrete will be placed within the working time of bonding coats.
- .18 Patch all form tie holes and finish surface to remove all evidence of tie holes and/or patching.
- .19 Properly clean formwork in accordance with CSA-A23.1/A23.2, before placing concrete. Provide temporary openings for clean-out purposes at bottom of all deep units.

3.2 TOLERANCES

- .1 Variations from plumb: in the lines and surfaces of wall: 6 mm per 3 m but not more than 20 mm.
- .2 Variations from the level or from the grades indicated on the drawings: in 3 mm - 6 mm, but not to exceed 10 mm.
- .3 Variation in the thickness of slabs and walls: minus 6 mm, plus 12 mm.
- .4 Footings: variations in dimensions in plan: minus 12 mm, plus 50 mm.
- .5 Misplacement or eccentricity: plus or minus 30 mm.

3.3 FORMWORK REMOVAL

- .1 Notify Departmental Representative prior to form removal.
- .2 Form removal times are dependent on proper curing in accordance with CAN/CSA-A23.1, CSA S269.1 and CAN/CSA-S269.3. Provide written evidence of concrete strength to the Departmental Representative 24 hours prior to form removal to show that suitable strength has been achieved. Contractor shall pay for the concrete cylinder strength tests to demonstrate concrete strength prior to form removal.
- .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 Unless otherwise approved, leave formwork in place for following minimum periods of time after placing concrete:
 - .1 3 days for footings.
 - .2 7 days for walls.
- .5 Remove formwork when concrete has reached 80% of its design strength or minimum period noted above, whichever comes later.
- .6 Loosen forms carefully. Do not wedge pry bars, hammers or tools against concrete surfaces.
- .7 Remove all forms. Do not leave any forms in place after completion of project.

3.4 FINISHES

- .1 Form finishes: to CSA A23.1 and ACI 301 as follows:
 - .1 Sides of footings, walls and formed surfaces buried below earth: Rough form finish.
 - .2 Surfaces of walls and formed surfaces exposed to view: Rubbed finish as per ACI 301.

END OF SECTION

2017-02-09

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 03 10 00 - Concrete Forming and Accessories.
- .3 Section 03 30 00 - Cast-in-Place Concrete.

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 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A1064/A1064M-15, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
- .3 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 A23.3-14, Design of Concrete Structures.
 - .3 CSA G30.18-09(R2014), Carbon Steel Bars for Concrete Reinforcement.
 - .4 CSA S6-14, Canadian Highway Bridge Design Code.
- .4 Reinforcing Steel Institute of Canada (RSIC)
 - .1 RSIC-2004, Reinforcing Steel Manual of Standard Practice.

1.3 SUBMITTALS

- .1 Submit shop drawings, including placing of reinforcement.
- .2 Submit shop drawings including placing of reinforcement and indicate:
 - .1 Bar bending details.
 - .2 Lists.
 - .3 Quantities of reinforcement.
 - .4 Sizes, spacings, locations of reinforcement and mechanical splices with identifying code marks to permit correct placement without reference to structural drawings.
 - .5 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.

2017-02-09

- .4 Detail lap lengths and bar development lengths to CSA A23.3, unless otherwise indicated. Provide Class B tension lap splices unless otherwise indicated.
- .5 Each shop drawing submitted to bear stamp and signature of a qualified Professional Engineer registered or licensed to practice in the Province of Nova Scotia.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Handle and store reinforcing steel in such a manner to keep it free of dirt, mud, ice and water.
- .2 Off-load reinforcing steel from the truck directly onto purpose-made storage racks and cover with tarps.
- .3 Clean reinforcing steel of excess rust and previously deposited concrete prior to placing concrete.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Substitute different size bars only if permitted in writing by Departmental Representative.
- .2 Reinforcing steel: carbon steel, grade 400, deformed bars to CAN/CSA-G30.18, unless indicated otherwise.
- .3 All bars shall be free from loose rust or scale, oil, structural defects, and shall be unpainted and uncoated. Bars shall be bent cold and accurately shaped as required.
- .4 Cold-drawn annealed steel wire ties: to ASTM A1064/A1064M.
- .5 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.

2.2 FABRICATION

- .1 Fabricate reinforcing steel in accordance with CSA-A23.1/A23.2, ACI 315 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.
- .2 Hooks are to be standard unless noted otherwise. All splices shall be Class "B" tension lap splices. No more than 50% of the reinforcing shall be spliced at any given location.
- .3 Obtain Departmental Representative's approval for locations of reinforcement splices other than those shown on placing drawings.

2017-02-09

- .4 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.
- .2 Upon request inform Departmental Representative of proposed source of material to be supplied.

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 STORAGE

- .1 Store reinforcing steel to prevent deterioration, contamination or disfigurement.
- .2 Store reinforcing steel off the ground.

3.3 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.

3.4 PLACING REINFORCEMENT

- .1 Place reinforcing steel as indicated on 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 Ensure cover to reinforcement is maintained during concrete pour.
- .4 Under no circumstances will concrete trucks or highway traffic be permitted to travel over the reinforcing during concrete placing operations.

- .5 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.
- .6 Remove and replace reinforcement which is visibly damaged or cracked.
- .7 Do not cut reinforcement, either before or after concrete is placed, to permit incorporation of other work.
- .8 Do not relocate reinforcement without approval.
- .9 Clean reinforcement before placing concrete.
- .10 The Contractor shall inform the Departmental Representative 48 hours before the concrete is to be poured. Prior to placing concrete, obtain Departmental Representative's approval of reinforcing material and placement.

3.5 CONCRETE PROTECTION FOR REINFORCEMENT

- .1 Unless otherwise indicated on plans, reinforcing steel shall be detailed so that distance from face of steel to nearest face of concrete is not less than one diameter, nor in any case less than the following:
 - .1 70 ± 20 mm for footings and walls.
 - .2 100 ± 25 mm for concrete surfaces cast against and permanently exposed to earth (bottom bars in footing.)

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 03 10 00 - Concrete Forming and Accessories.
- .2 Section 03 20 00 - Concrete Reinforcing.

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM C260/C260M-10a, Standard Specification for Air-Entraining Admixtures for Concrete.
 - .2 ASTM C309-11, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - .3 ASTM C330/C330M-14, Standard Specification for Lightweight Aggregates for Structural Concrete.
 - .4 ASTM C494/C494M-15a, Standard Specification for Chemical Admixtures for Concrete.
 - .5 ASTM C1017/C1017M-13e1, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
- .2 Canadian Standards Association (CSA International)
 - .1 CSA-A23.1/A23.2-14, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
 - .2 CSA A283-06(R2011), Qualification Code for Concrete Testing Laboratories.
 - .3 CAN/CSA-A3000-13, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - .1 CSA-A3001-13, Cementitious Materials for Use in Concrete.
- .3 Government of Nova Scotia, Department of Transportation and Public Works, Highway Construction and Maintenance, Standard Specification Book, 1997 edition (2011 revision).

1.3 SUBMITTALS

- .1 Minimum two (2) weeks prior to starting concrete work, submit proposed quality control procedures for Departmental Representative's approval for following items:
 - .1 Falsework erection.
 - .2 Cold and hot weather concreting.
 - .3 Temporary bracing.
 - .4 Chairs and spacers for support of reinforcing.
 - .5 Curing of concrete.
 - .6 Finishes.
 - .7 Formwork removal.

- .2 Provide certification indicating the concrete supplier is certified in accordance with the Atlantic Provinces Ready Mix Concrete Association Program or equivalent.
 - .1 Only concrete supplied from such certified plants shall be acceptable to the Departmental Representative.
 - .2 Plant certification shall be maintained for the duration of the fabrication and erection until the warranty period expires.
- .3 Provide certification that plant, equipment, and materials to be used in concrete comply with requirements of CSA-A23.1.
- .4 Provide mix design in compliance with CSA-A23.1 to provide concrete of quality, yield and strength as specified under 2.2 Mix Design. Mix design to be prepared by and stamped by an engineer licensed to practice in the Province of Nova Scotia.
- .5 Prior to starting concrete work, submit to Departmental Representative manufacturer's test data and certification by qualified independent inspection and testing laboratory that following materials will meet specified requirements:
 - .1 Portland cement.
 - .2 Blended hydraulic cement.
 - .3 Supplementary cementing materials.
 - .4 Admixtures.
 - .5 Aggregates.
 - .6 Water.

1.4 CONSTRUCTION QUALITY CONTROL

- .1 Inspection and testing of concrete and concrete materials will be carried out in accordance with CSA-A23.1.
- .2 Testing laboratory will take additional test cylinders during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they represent.
- .3 Non-destructive methods for testing concrete shall be in accordance with CSA-A23.2.
- .4 Inspection or testing by Departmental Representative, or Testing Agency designated by Departmental Representative, will not augment or replace the Contractor's quality control nor relieve him of his contractual responsibilities.

1.5 QUALITY ASSURANCE

- .1 At least fifteen (15) days prior to the start of the concrete construction schedule, a pre-concrete conference must be held. The mix designs shall be reviewed, and the required methods and procedures to achieve the required concrete shall be discussed. Send a pre-concrete conference agenda to all the attendees ten (10) days prior to the scheduled date of the conference.

- .2 Arrange for representatives of parties concerned with the concrete work to attend the conference, including but not limited to the following:
 - .1 The Contractor.
 - .2 The concrete subcontractor.
 - .3 The Departmental Representative.
 - .4 The Owner's Representative.
- .3 Record minutes of meeting and distribute to all parties concerned within five (5) days of meeting. Submit minutes to Departmental Representative.
- .4 Quality Control Plan: submit written report to Departmental Representative verifying compliance that concrete in place meets performance requirements of concrete as established in PART 2 - PRODUCTS.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Concrete hauling time: maximum allowable time for concrete to be delivered to site of Work and discharged not to exceed 120 minutes after batching.
 - .1 Modifications to maximum time limit must be agreed to Engineer 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.
- .3 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling.
 - .2 Divert unused concrete materials from landfill to local quarry facility approved by Departmental Representative.
 - .3 Provide an appropriate area on the job site where concrete trucks can be safely washed.
 - .4 Divert unused admixtures and additive materials (pigments, fibres) from landfill to official hazardous material collections site as approved by the Departmental Representative.
 - .5 Unused admixtures and additive materials must not be disposed of into sewer systems, into lakes, streams, onto ground or in other location where it will pose health or environmental hazard.
 - .6 Prevent admixtures and additive materials from entering drinking water supplies or streams. Using appropriate safety precautions, collect liquid or solidify liquid with inert, noncombustible material and remove for disposal. Dispose of waste in accordance with applicable local, Provincial and National regulations.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 All materials for concrete structure to be in accordance with the Nova Scotia Department of Transportation and Public Works Standard

Specification Book, 1997 edition (2011 revision), Division 5 - Structures, Section 7 - Cast-in-Place Concrete, article 4.0 - Materials.

- .2 Cementing materials for all components to be Type GU.
- .3 Joint Sealant: acceptable products include:
 - .1 For horizontal joint at edge of lean concrete behind retaining wall: two component polyurethane self-leveling elastomeric sealant.

2.2 MIXES

- .1 Provide the concrete mix designs for all concrete used in the work.
- .2 Ensure that the mixture proportions are properly batched, mixed, placed, and cured, such that the concrete conforms to the specification.
- .3 Mix designs to be in accordance with the Nova Scotia Department of Transportation and Public Works Standard Specification Book, 1997 edition (2011 revision). Mix designs to produce the specified properties and meet the parameters listed in the table 5.7.1 given in Division 5 - Structures, Section 7 - Cast-in-Place Concrete, article 4.3.2 - Mix Proportions as follows:
 - .1 For concrete in footings and walls: meet parameters listed for Non-HPC Construction, 45 MPa concrete in accordance with Part 2, Article 2.1.1 above.
 - .2 For lean concrete:
 - .1 Compressive strength at 28 days: 15 MPa.
 - .2 Slump: 75 mm.
 - .3 Nominal size of coarse aggregate: 20 mm.
- .4 Where admixtures are used, do not allow end-of-truck slump with admixtures to exceed 150mm.
- .5 In sufficient time before placement, submit all concrete mix designs to Departmental Representative for approval. No concrete shall be placed before mix designs are approved.
- .6 Obtain authorization from Departmental Representative for use of super plasticizing admixture, water reducer and all other admixtures. Add plasticizer, water reducer and/or other admixtures as approved by Departmental Representative to achieve desired concrete properties. Pay for all admixtures required.
- .7 Provide quality management plan to ensure verification of concrete quality to specified performance.
- .8 Use of Calcium Chloride not permitted.

PART 3 EXECUTION

3.1 PREPARATION

- .1 Obtain Departmental Representative's approval before placing concrete. Provide 24 hours' notice prior to placing of concrete.
- .2 Place, consolidate, finish, cure and protect concrete to CAN/CSA-A23.1 except where specified otherwise.
- .3 Pumping of concrete is permitted only after approval of equipment and mix.
- .4 Secure in position reinforcing steel, embedded parts, anchor bolts and dowels etc. prior to placing concrete and ensure these are not disturbed during concrete placement in accordance with CAN/CSA A23.1.
- .5 Prior to placing of concrete obtain Departmental Representative's approval of proposed method for protection of concrete during placing and curing in adverse weather.
- .6 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
- .7 Do not place load upon new concrete until authorized by Departmental Representative.
- .8 During concreting operations:
 - .1 Development of cold joints not allowed.
 - .2 Ensure concrete delivery and handling facilities placing with minimum of rehandling, and without damage to existing structure or work.
- .9 Ensure that reinforcement and formwork are thoroughly clean before placing.
- .10 Place concrete in dry conditions.
- .11 Preparation of bottom of excavation shall be in accordance with the Geotechnical Investigation Report. Rock surface shall be sound and rough as indicated on drawings. Geotechnical Engineer shall ensure compliance with the recommendations noted herein and in the geotechnical report.
- .12 Ensure that foundation bearing materials are free from water and frost. Remove previously frozen bearing materials.
- .13 Keep excavation dry while placing concrete.
- .14 All dowels shall be placed before concrete footings are poured.
- .15 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .16 Maintain adequate frost protection to rock surface under footing for entire duration of work.

- .17 Protect previous work from staining.
- .18 Bond fresh concrete to hardened concrete to CAN/CSA A23.1.
- .19 Do not permit vertical free fall of concrete mix to exceed 1500 mm.

3.2 CONSTRUCTION

- .1 Do cast-in-place concrete work in accordance with CSA-A23.1/A23.2.
- .2 Construction Joints
 - .1 Construction joint locations shall be approved by Departmental Representative wherever they are not specifically designated on drawings.
 - .2 Surface of concrete construction joints shall be cleaned and laitance removed.
 - .3 Locate construction joints in wall so as to least impair the strength of the structure and to Departmental Representative's approval.
 - .4 Immediately before concrete is placed, all construction joints shall be wetted and standing water removed.
- .3 Concrete shall not be placed on or against any surface (including rebar) that is at a temperature below 5°C (40°F).
- .4 Concrete at time of deposit shall be between 10°C (50°F) and 30°C (85°F).
- .5 Hot-weather and cold-weather concreting shall be carried out, protected, and cured in accordance with CSA-A23.1.
- .6 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .7 Cure all concrete for a minimum of 7 days after placing.
- .8 Finishing and curing:
 - .1 Finish concrete in accordance with CSA-A23.1/A23.2.
 - .2 Formed surfaces:
 - .1 Concrete wall surfaces to be left exposed in finished work - smooth form finish.
- .9 The Departmental Representative reserves the right to reduce the amount of payment for all concrete which fails to meet the requirements of the drawings and this specification, where the defect is such as to permit leaving the concrete in question in place.

3.3 SURFACE TOLERANCE

- .1 Concrete tolerance in accordance with CSA-A23.1/A23.2 and as otherwise indicated on the drawings.

3.4 FIELD QUALITY CONTROL

- .1 Quality Control Inspection and testing of concrete and concrete materials will be carried out by an independent testing agency in accordance with CAN/CSA A23.1/A23.2.
- .2 For compressive strength testing of concrete 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 meters or fraction thereof.
 - .5 Test cylinders are required for testing at 7, 14 and 28 days as per requirements of CAN/CSA A23.1.
 - .6 Test cylinders are required for testing at 56 days, in addition to requirements of CAN/CSA A23.1.
 - .7 Conduct at least one slump and one air entrainment test with each compressive strength test.
 - .8 In addition, each truck to be tested for air and slump.
 - .9 Additional test specimen shall be taken whenever requested by Departmental Representative to verify concrete quality.
 - .10 Additional test specimen shall be taken during cold weather concreting.
- .3 Cure cylinders on job site under same conditions as concrete which they represent.
- .4 Non-destructive Methods for Testing Concrete shall be in accordance with CSA-A23.1/A23.2.
- .5 Inspection and testing by testing laboratory will not augment or replace contractor quality assurance nor relieve contractor of contractor responsibility.

3.5 FINISHING

- .1 Only ACI (American Concrete Institute) certified or other pre-approved concrete finishers are to be utilized in finishing all concrete works.
- .2 Finish concrete in accordance with CSA-A23.1.
 - .1 Float horizontal surfaces with wood or metal floats and bring surfaces to true grade or dimensions.
 - .2 Use curing compounds compatible with applied finish on concrete surfaces. Provide written declaration that compounds used are compatible.

3.6 CURING

- .1 Cure concrete in accordance with CAN/CSA A23.1.
- .2 Ensure that freshly placed concrete is protected from freezing, dehydration, mechanical shock and contact with injurious substances.

- .3 Use curing compounds compatible with applied finish on concrete. 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 where finishes are incompatible with curing compound.
- .4 Concrete to be cured in accordance with the Nova Scotia Department of Transportation and Public Works Standard Specification Book, 1997 edition (2011 revision), Division 5 - Structures, Section 7 - Cast-in-Place Concrete, article 5.5 - Curing Concrete.
- .5 Protect the concrete from premature drying and extremes of temperature.
- .6 Do not remove forms or shoring during curing period.

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 A cold joint, honeycombing or embedded debris in any concrete shall deem it defective. Remove and replace defective concrete as directed by Departmental Representative.
- .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 Departmental Representative. Cost for such testing to be at the Contractor's expense. Should further tests confirm low values, Departmental Representative has the right to require strengthening of the affected area or removal and replacement of weak concrete all to the Contractor's expense.
- .6 Repair all shrinkage cracks in the completed concrete work minimum 28 days after casting employing an epoxy injection technique acceptable to Departmental Representative to completely seal all such cracks.

END OF SECTION

1 GENERAL

1.1 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A 185/A 185M-05a, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
 - .2 ASTM A 775/A 775M-04a, Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
 - .3 ASTM C 260-01, Standard Specification for Air-Entraining Admixtures for Concrete.
 - .4 ASTM D 412-98a(2002)e1, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension.
 - .5 ASTM D 2240-05, Standard Test Method for Rubber Property - Durometer Hardness.
 - .6 ASTM C 1433-10, Standard Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains and Sewers.
 - .7 ASTM C 877-10, External Sealing Bands for Concrete Pipe, Manholes and Precast Box Sections.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.40-97, Anticorrosive Structural Steel Alkyd Primer.
 - .2 CAN/CGSB-1.181-99, Ready Mixed Organic Zinc-Rich Coating.
- .3 Canadian Standards Association (CSA International)
 - .1 CSA-A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CSA-A23.3-(R2010), Design of Concrete Structures.
 - .3 CSA-A23.4-09, Precast Concrete - Materials and Construction.
 - .4 CAN/CSA-A3000-08, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - .1 CSA-A3001-08, Cementitious Materials for Use in Concrete.
 - .5 CAN/CSA-G30.18-09, Carbon-Steel Bars for Concrete Reinforcement.
 - .6 CAN/CSA-G40.20/G40.21-04 (R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .7 CAN/CSA-S6-06, Canadian Highway Bridge Design Code.
 - .8 CSA-W47.1-09, Certification of Companies for Fusion Welding for Steel.
 - .9 CAN/CSA W48-06(R2011), Filler Metals and Allied Materials for Metal Arc Welding (Developed in co-operation with the Canadian Welding Bureau).
 - .10 CSA-W59-03 (R2008), Welded Steel Construction (Metal Arc Welding) (Metric version).
 - .11 CSA-W186-M1990(R2007), Welding of Reinforcing Bars in Reinforced Concrete Construction.
- .4 The Master Painters Institute (MPI) - Architectural Painting Specification Manual (ASM) - February 2004
 - .1 MPI # 18, Organic Zinc Rich Primer.
 - .2 MPI # 23, Oil Alkyd Primer.
- .5 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S701-05, Standard for Thermal Insulation, Polystyrene, Boards

and Pipe Covering.

- .6 American Association of State Highway and Transportation Officials (AASHTO)
 - .1 LRFO Bridge Design Specifications.

1.2 DESIGN REQUIREMENTS

- .1 Design precast elements to CSA-A23.3 and CSA-A23.4 to carry handling stresses.
- .2 Design precast open span culverts and associated wingwalls to carry highway loads in accordance with Canadian Highway Bridge Design Code, CAN/CSA-S6.
- .3 Design connections/attachments of precast box culverts and associated wingwalls to load/forces specified by Canadian Highway Bridge Design Code, CAN/CSA-S6.
- .4 Provide detailed design drawings for typical precast elements and connections as described in PART 1 - SUBMITTALS.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit WHMIS MSDS - Material Safety Data Sheets.
- .3 Submit shop drawings in accordance with CSA-A23.3 and CSA-A23.4 and include following items:
 - .1 Details of prestressed and non-prestressed members, reinforcement and their connections.
 - .2 Camber.
 - .3 Gaskets.
 - .4 Finishing schedules.
 - .5 Methods of handling, erection and sealing.
 - .6 Openings, sleeves, inserts and related reinforcement.
- .4 Shop Drawings: submit drawings stamped and signed by qualified professional engineer registered or licensed in Province of Nova Scotia, Canada.

1.4 QUALITY ASSURANCE

- .1 Quality Control Plan: submit written report, as described in PART 3 - VERIFICATION, to Departmental Representative verifying compliance that concrete provided meets performance requirements of concrete as established in PART 2 - PRODUCTS.

1.5 QUALIFICATIONS

- .1 Fabricate and erect precast concrete elements by manufacturing plant certified in appropriate categories according to CSA-A23.4
- .2 Precast concrete manufacturer to be certified in accordance with CSA's certification procedures for precast concrete plants prior to submitting tender and to specifically verify as part of tender that plant is currently certified in appropriate categories, (Structural).

- .3 Only precast elements fabricated in such certified plants to be acceptable to Departmental Representative and plant certification to be maintained for duration of fabrication, erection until warranty expires.
- .4 Welding companies certified to CSA-W47.1.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, handle and store precast/prestressed units according to manufacturer's instructions.
- .2 Protect unit corners from contacting earth to prevent from staining.
- .3 Waste Management and Disposal:
 - .1 Separate waste materials for reuse in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

2 PRODUCTS

2.1 MANUFACTURED UNITS

- .1 Manufacture units in accordance with CSA-A23.4.
- .2 Mark each precast unit to correspond to identification mark on shop drawings for location with date cast on part of unit not be exposed.
- .3 Provide hardware suitable for handling elements.
- .4 Shop prime anchors and steel inserts after fabrication and touch up primer on anchors after welding. Do not apply primer to embedded portion of anchor or inserts.
- .5 Precast box culverts: size as indicated.
- .6 Precast headwalls: geometry as indicated.
 - .1 Only proprietary engineered concrete retaining wall systems are acceptable.
 - .2 Provide Departmental Representative with one set of complete working drawings, and one copy of detailed design calculations, for review at least 4 weeks prior to beginning construction. Drawings shall indicate dimensions of units, wall elevations, sections and grade profile. Drawings and design calculations to bear signature and stamp of qualified professional engineer registered or licensed in province of Nova Scotia in Canada.
 - .3 Verify existing site conditions and ground elevations before preparing working drawings.
 - .4 Use only one type of proprietary engineered retaining wall system for Project. Do not substitute for any component normally supplied by supplier of proprietary engineered retaining wall system.
 - .5 Wall unit texture and pattern shall be continuous at all exposed wall areas.

2.2 FINISHES

- .1 Finish units to standard grade to CSA-A23.4.

2.3 SOURCE QUALITY CONTROL

- .1 Provide Departmental Representative with certified copies of quality control tests related to this project as specified in CSA-A23.4 and CSA-G279.
- .2 Provide records from in-house quality control program based upon plant certification requirements to Departmental Representative for inspection and review.
- .3 Provide Departmental Representative with certified copy of mill test report of reinforcing steel supplied, showing physical and chemical analysis.
- .4 Precast plants should keep complete records of supply source of concrete material, steel reinforcement, prestressing steel and provide to Departmental Representative for review upon request.

3 EXECUTION

3.1 ERECTION

- .1 Erect, fasten and join precast elements in accordance with manufacturer's instruction, and as indicated on reviewed shop drawings.
- .2 Do precast concrete work in accordance with CSA-A23.4 CSA-A23.3 and CAN/CSA-S6.
- .3 Do welding in accordance with CSA-W59, for welding to steel structures and CSA-W186, for welding of reinforcement.
- .4 Non-cumulative erection tolerances in accordance with CSA-A23-4.
- .5 Set elevations and alignment between units to within allowable tolerances before connecting units.

3.2 VERIFICATION

- .1 Quality Control Plan: ensure concrete supplier meets performance criteria of concrete as established in Part 2 - Products, by Departmental Representative and provide verification of compliance as described in PART 1 - QUALITY ASSURANCE.

3.3 CLEANING

- .1 Use cleaning methods as reviewed by Departmental Representative before cleaning soiled precast concrete surfaces.

END OF SECTION