

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 33 00 – Submittal Procedures
- .2 Section 01 74 21 – Construction/Demolition Waste Management and Disposal
- .3 Section 03 20 00 – Concrete Reinforcing
- .4 Section 03 30 00 – Cast-in-Place Concrete

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA A23.1:19/A23.2:19, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CSA A23.4-16 (R2021), Precast Concrete – Materials and Construction
 - .3 CSA O86-19, Engineering Design in Wood.
 - .4 CSA O121-17, Douglas Fir Plywood.
 - .5 CSA O151-17, Canadian Softwood Plywood.
 - .6 CSA O153-19, Poplar Plywood.
 - .7 CSA O325-21, Construction Sheathing.
 - .8 CSA O437 Series-93(R2011), Standards for OSB and Waferboard.
 - .9 CSA S269.1-16 (R2021), Falsework and Formwork

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit shop drawings for formwork and falsework.
 - .1 Submit drawings and calculations stamped and signed by Professional Engineer registered or licensed in the Province of New Brunswick, Canada at least four (4) weeks before construction. The submission is intended for information purposes only and shall in no way relieve the Contractor of full responsibility to carry out work related in accordance with CSA S269.1 for Falsework and Formwork.
- .3 Indicate method and schedule of construction, shoring, stripping, and re-shoring procedures, and materials, arrangement of joints, special architectural exposed finishes, ties, liners, and locations of temporary embedded parts. Comply with CSA S269.1 for formwork drawings.
- .4 Indicate formwork design data: permissible rate of concrete placement, and temperature of concrete, in forms.
- .5 Indicate sequence of erection and removal of formwork/falsework as directed by formwork Engineer.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Store and manage hazardous materials in accordance with jurisdictional requirements.

- .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 material. Handle and erect the fabricated formwork so as to prevent damage.
- .4 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling 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 volatile organic compounds (VOC's).

1.5 MEASUREMENT FOR PAYMENT

- .1 Refer to Section 01 29 10– Measurement and Payment.

Part 2 Products

2.1 MATERIALS

- .1 Formwork materials:
 - .1 Use wood and wood product formwork materials to CSA O121, CSA O86.
 - .2 Formwork shall be constructed from lumber devoid of warped defects in order to achieve a face alignment free of distortion. This shall apply to all panel forms including prefabricated boards, plywood and steel panels.
 - .3 Formwork on exposed concrete surfaces shall be new or like new to achieve a quality aesthetically pleasing finish.
- .2 Form ties:
 - .1 Use removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm diameter in concrete surface. Holes to be filled with non-shrink grout.
 - .2 Form tie components which remain embedded in concrete are to be galvanized or non-metallic. Dissimilar metals which are in contact must be separated by denso tape barrier.
- .3 Form release agent: non-toxic, biodegradable, low VOC. Form release agents must be compatible with waterproofing systems where applicable.
- .4 Falsework materials: to CSA S269.1.

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.
 - .1 The deck/curb cannot extend beyond the face of the wall more than 40mm in any location.
- .2 Fabricate and erect falsework in accordance with CSA S269.1.
- .3 Do not place shores and mud sills on frozen ground.
- .4 Provide site drainage to prevent washout of soil supporting mud sills and shores.
- .5 Fabricate and erect formwork in accordance with CSA S269.1 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA A23.1/A23.2.
- .6 Align form joints and make watertight.
 - .1 Keep form joints to minimum.
- .7 Use 25 mm chamfer strips on external corners and/or 25 mm fillets at interior corners, joints, unless specified otherwise.
- .8 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.
- .9 Construct forms for architectural concrete as indicated.
 - .1 Joint pattern not necessarily based on using standard size panels or maximum permissible spacing of ties.
- .10 Built in anchors, sleeves, and other inserts required to accommodate Work specified in other sections.
 - .1 Ensure that anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including concrete texturing.
 - .2 Anchors and inserts cast into the concrete shall be non-metallic or galvanized metal and either be isolated from dissimilar metals by either a 30 mm clear spacing or 'Denso' tape barrier on the formwork anchors / inserts.
- .11 Clean formwork in accordance with CSA-A23.1/A23.2, before placing concrete.

3.2 REMOVAL AND RESHORING

- .1 Notify Departmental Representative prior to form removal.
- .2 Form removal times are dependent on proper curing in accordance with CSA A23.1 and CSA-S269.1. Provide written evidence of concrete strength to the Departmental Representative 24 hours prior to form removal to show the 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 when concrete has reached 70% of its design strength and replace immediately with adequate reshoring (if required). No vehicle loading or backfilling shall take place until concrete reaches design strength, unless otherwise approved in writing by Departmental Representative.

- .4 If formwork is used to aid curing, it shall not be removed until seven days after the concrete placement.
- .5 Re-use formwork and falsework subject to requirements of CSA-A23.1/A23.2.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .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

1.2 REFERENCES

- .1 American Concrete Institute (ACI)
 - .1 SP-66-04, ACI Detailing Manual 2004.
 - .1 ACI 315R-18, Guide to Presenting Reinforcing Steel Design Details.
 - .2 ACI 302.1R-15, Guide to Concrete Floor and Slab Construction.
 - .3 ACI 360R-10, Guide to Design of Slabs-on-Ground.
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A36/A36M-19, Standard Specification for Carbon Structural Steel.
 - .2 ASTM A108-18, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
 - .3 ASTM A143/A143M-07 (2020), Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
 - .4 ASTM A780 / A780M-20, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
- .3 Canadian Standards Association (CSA International)
 - .1 CSA A23.1:19/A23.2:19, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
 - .2 CSA A23.3-19, Design of Concrete Structures.
 - .3 CSA A23.4-16 (R2021), Precast Concrete – Materials and Construction.
 - .4 CSA G30.18:21, Carbon Steel Bars for Concrete Reinforcement.
 - .5 CSA G40.20-13/G40.21-13 (R2018), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .6 CSA G164-18, Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .7 CSA W186-21, Welding of Reinforcing Bars in Reinforced Concrete Construction.
 - .8 CSA S6-19, Canadian Highway Bridge Design Code.
- .4 Reinforcing Steel Institute of Canada (RSIC)
 - .1 RSIC-2020, 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 315R, except as noted herein. Shop drawings are to be submitted 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 New Brunswick, Canada.
- .3 Submit shop drawings including placing of reinforcement and indicate:
 - .1 Bar bending details as per RSIC-2020, Reinforcing Steel Manual of Standard Practice.
 - .2 Lists.
 - .3 Quantities of reinforcement.
 - .4 Sizes, spacings, locations of reinforcement and mechanical splices as specified / if approved by Departmental Representative, with identifying code marks to permit correct placement without reference to structural drawings.
 - .5 Indicate sizes, spacings and locations of chairs, spacers and hangers.
 - .6 Indicate dimensions and spacings of prefabricated dowel basket assembly.
 - .1 Comply with ACI SP-66-04, ACI 302.1R-15, ACI 360R-10 and manufacturer installation guides indicating arrangement of alternating tapered plate dowel basket assembly.
- .4 Detail lap lengths and bar development lengths to CSA A23.3, unless otherwise indicated.
 - .1 Provide Class B tension lap splices unless otherwise indicated.

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 of this specification section.
 - .1 Mill Test Report: provide Departmental Representative with certified copy of mill test report of reinforcing steel, 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 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 and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Replace defective or damaged materials with new.
- .3 Do not cut the shipping wires on the prefabricated dowel baskets.

1.6 MEASUREMENT FOR PAYMENT

- .1 Refer to Section 01 29 10– Measurement and Payment.

Part 2 Products

2.1 MATERIALS

- .1 Substitute different size bars only if permitted in writing by Departmental Representative.
- .2 Reinforcing steel: billet steel, quality 400W (weldable), deformed bars to CSA G30.18, unless indicated otherwise.
- .3 Chairs, bolsters, bar supports, spacers: to CSA A23.1/A23.2.
- .4 Mechanical splices:
 - .1 The use of mechanical rebar splices shall be subject to approval of Departmental Representative.
- .5 Wire ties: to CSA G30.3 plain, cold drawn annealed steel wire.
- .6 Prefabricated dowel basket assembly:
 - .1 Alternating tapered plate dowels: plasma cut from hot rolled steel bar certified to meet ASTM A36 standards to within 4.8 mm of specified dowel length with a 4° taper from the widest end to narrow end.
 - .2 Side frame supports fabricated from 6.35 mm diameter cold drawn wire certified to meet ASTM A108 grade 1010-1020 standards.
 - .3 De-bonding agent: Tectyl® 506.

2.2 FABRICATION

- .1 Fabricate reinforcing steel in accordance with CSA A23.1/A23.2, ACI 315R and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.
- .2 Obtain Departmental Representative's approval for locations of reinforcement splices other than those shown on placing drawings.
- .3 Upon approval of Departmental Representative, weld reinforcement in accordance with CSA W186.
- .4 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.
- .5 Do not weld reinforcing steel.
- .6 Prefabricated dowel basket assembly:

- .1 Weld plate dowels (on widest end only) into side frames, with welded ends alternating along length of assembly.
- .2 Weld eight-gauge wires across side frames at no more than 914 mm o/c to keep assembly stable during shipping and installation.
- .3 Factory applied de-bonding agent – thinly and evenly coat plate dowels without excessive drips or thickness.
- .4 Finished assembly shall hold alternating tapered plate dowels to within +/- 3.2 mm of half the slab depth.
- .5 Basket dimensions:
 - .1 Dowel cross-sectional area of steel required at the saw-cut joint: 19 mm x 63.5 mm.
 - .2 Dowel length: 305 mm.
 - .3 Slab depth: 300 mm.
 - .4 Dowel spacing: 450 mm.

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 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 All steel reinforcing bars shall have the necessary net sectional area, and shall be cut to the exact lengths, and bent cold to the exact forms and dimensions, shown on the approved plans, or otherwise required, before being placed in position. Bending shall be accurately done in a bending machine and no welding or heating of any bars shall be allowed, except with written approval from the Departmental Representative. All stirrups and hoops shall accurately fit the rods, and all bends shall be taken out of bars to be used as straight members.

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 CLEANING

- .1 Clean reinforcing before placement.

3.4 PLACING REINFORCEMENT

- .1 Place reinforcing steel as indicated on placing drawings.
- .2 Prior to placing concrete, obtain Departmental Representative's approval of reinforcing material and placement.
- .3 Ensure cover to reinforcement is maintained during concrete placement.
- .4 All reinforcing bars shall be placed and held rigidly in the exact 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.
- .5 Concrete protection required for reinforcing steel 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 Install prefabricated dowel baskets as per manufacturer recommendations.

3.5 SURFACE CONDITION

- .1 Reinforcement (at time concrete is placed) to be free from mud, oil or other nonmetallic coatings that adversely affect bonding capacity.
- .2 Reinforcement with rust, mill scale, or combination of both to be considered as satisfactory provided minimum dimensions, including height of deformations, and mass of hand wire brushed test specimen are not less than specified requirements in applicable CSA Standards.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 33 00 – Submittal Procedures
- .2 Section 01 35 29– Health and Safety Requirements
- .3 Section 01 45 00 – Quality Control
- .4 Section 01 74 21 – Construction/Demolition Waste Management and Disposal
- .5 Section 03 10 00 – Concrete Forming and Accessories
- .6 Section 03 20 00 – Concrete Reinforcing

1.2 REFERENCES

- .1 ACI 117-10/117R-10, Specifications for Tolerances for Concrete Construction and Materials and Commentary.
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM C260/C260M-10a, Standard Specification for Air-Entraining Admixtures for Concrete.
 - .2 ASTM C309-19, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - .3 ASTM C457/C457M-16, Standard Test Method for Microscopical Determination of Parameters of the Air-Void System in Hardened Concrete.
 - .4 ASTM C494/C 494M-19, Standard Specification for Chemical Admixtures for Concrete.
 - .5 ASTM C1017/C 1017M-13, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
 - .6 ASTM C1202-19, Standard Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration.
- .3 Canadian Standards Association (CSA International)
 - .1 CSA A23.1:19/A23.2:19, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CSA A23.5, Supplementary Cementing Materials
 - .3 CSA A283-19, Qualification Code for Concrete Testing Laboratories.
 - .4 CSA S269.1-16 (R2021), Concrete Falsework and Formwork.
 - .5 CSA A3000-18, Cementitious Materials Compendium.
 - .1 CSA A3001-18, Cementitious Materials for Use in Concrete.
 - .6 CSA S6-19, Canadian Highway Bridge Design Code

1.3 DESIGN REQUIREMENTS

- .1 Table 5-Alternative 1 – Performance: in accordance with CSA A23.1/A23.2, and as described in Mixes of Part 2 – Products.

- .1 Concrete mixture designs shall be proportioned as normal density concrete in accordance with CSA A23.1 latest edition, Table 5-Alternative #1. Concrete shall be proportioned using Portland cement, Type SF silica fume, fly ash, fine and coarse aggregates, air entraining, water reducing, and superplasticisers and / or set retarding admixtures. Other supplementary cementing materials may include Class F fly ash. Set retarding admixtures may be used as ambient and site conditions warrant upon approval from a Departmental Representative.

1.4 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit the following at least four (4) weeks prior to the commencing concrete work:
 - .1 Certification from the qualified independent inspection and testing company that plant, equipment and materials to be used in the concrete comply with requirements of CSA A23.1/A23.2.
 - .2 Manufacturer's test data and certification by qualified independent inspection and testing laboratory that the following materials will meet specified requirements:
 - .1 Portland cement
 - .2 Blended hydraulic cement
 - .3 Supplementary cementing materials
 - .4 Admixtures
 - .5 Water
 - .6 Aggregates
 - .3 Mix designs for concrete, mix proportions and aggregate sources, which will produce concrete of quality, yield and strength as specified in concrete mixes, and will comply with CSA A23.1/A23.2, and that mix design is adjusted to prevent alkali aggregate reactivity problems.
 - .4 Certification for the concrete supplier from the Atlantic Provinces Ready Mixed Concrete Association – APRMCA Concrete Production Facilities Certification Program.
- .3 Include in the submission of the mix designs, test results for each mix containing the following information:
 - .1 Plastic Concrete Tests
 - .2 Slump (CSA A23.2-5C)
 - .3 Air Content of Plastic Concrete by Pressure Method (CSA A23.2-4C)
 - .4 Mass Density and Yield (CSA A23.2-6C)
 - .5 Compressive Strength Testing (CSA A23.2-9C)
 - .6 2 cylinders to be tested at 28 days
 - .7 Air Void Analysis on Hardened Concrete (ASTM C457) tested at 7 days
 - .8 Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration (ASTM C1202) tested at 56 days
 - .9 Alkali Reactivity Test Results

- .4 Submit four (4) weeks in advance of concrete placement, relevant test data for all aggregate materials indicating conformance to the requirements of CSA A23.1 and this specification. The test results required, but not be limited to, shall include:
 - .1 Sieve Analysis of Fine and Coarse aggregate
 - .2 Amount of Material Finer than 80 µm in Aggregate
 - .3 Bulk Relative Density and Absorption of Fine and Coarse Aggregate (SSD basis)
 - .4 Fineness Modulus of Fine Aggregate
 - .5 Clay Lumps and Light Weight Pieces
 - .6 Test for Organic Impurities in Fine Aggregate
 - .7 Flat and Elongated Particles in Coarse Aggregates
 - .8 Petrographic Analysis of Coarse Aggregate (PN-NSTIR Test Method-2)
 - .9 Resistance to Degradation of Coarse Aggregate by Abrasion and Impact in the Los Angeles machine
 - .10 Micro-Deval test for Coarse and Fine Aggregate
 - .11 Soundness of Coarse and Fine Aggregate by Use of Magnesium Sulphate
 - .12 Test for Detection of Alkali-Aggregate Reactivity (AAR) on Coarse and Fine Aggregate
 - .13 Unconfined Freeze and Thaw test
- .5 Submit two (2) weeks prior to commencement of the project adequate details of all equipment to be used. Equipment shall include that required for transporting, handling, placement and curing of all concrete.
- .6 Concrete pours: submit 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.

1.5 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Submit to Departmental Representative, minimum of four weeks prior to starting concrete work, valid and recognized certificate from plant delivering concrete.
 - .1 When the plant does not hold valid certification, provide test data and certification by qualified independent inspection and testing laboratory that materials used in concrete mixture will meet specified requirements.
- .3 Minimum four weeks prior to starting concrete work, submit proposed quality assurance procedures for review by the Departmental Representative on the following items:
 - .1 Falsework erection
 - .2 Hot weather concrete
 - .3 Cold weather concrete
 - .1 Departmental Representative can provide expected provisions for cold weather concreting prior to submitting a procedure.
 - .4 Placement method(s)
 - .5 Curing

- .6 Finishes
- .7 Formwork Removal
- .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.
- .5 Health and Safety Requirements: undertake occupational health and safety in accordance with Section 01 35 29– Health and Safety Requirements.

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 by Departmental Representative and concrete producer as described in CSA A23.1/A23.2.
 - .2 Deviations to be submitted for review by Departmental Representative.
- .2 The concrete materials shall be mixed and transported in a manner which will not segregate or damage the mix in any fashion. Concrete shall be mixed using stationary or truck mixers. The mixer shall carry the Manufacturer's rating plate in a prominent position that indicates the following:
 - .1 The gross volume of the mixer
 - .2 The rated maximum mixing capacity
 - .3 The minimum and maximum speeds for mixing and agitating of the mixer
- .3 The mixer shall be capable of combining the concrete ingredients into a thoroughly mixed and uniform mass and shall not exceed the capabilities of the mixer.
- .4 Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.
- .5 Where ready mix trucks are used to transport the concrete, the Departmental Representative reserves the right to subject any truck suspected of poor mixing to a uniformity test as outlined in CSA A23. If the truck fails the test, then the concrete and the truck shall be rejected at the sole cost of the Contractor unless otherwise directed by the Departmental Representative.
- .6 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
 - .2 Use trigger operated spray nozzles for water hoses.
 - .3 Carefully coordinate the specified concrete work with weather conditions.
 - .4 Divert unused concrete materials from landfill to local facility approved by Departmental Representative.
 - .5 Refer to Section 01 35 44 for requirements associated with the cleaning of concrete trucks and tools.
 - .6 Prevent admixtures and additive materials from entering drinking water supplies or streams. Using appropriate safety precautions collect liquid or solidify liquid

with inert, non-combustible material and remove for disposal. Dispose of waste in accordance with applicable local, provincial and national regulations.

- .7 Choose least harmful, appropriate cleaning method which will perform adequately.

1.7 MEASUREMENT FOR PAYMENT

- .1 Refer to Section 01 29 10– Measurement and Payment.
- .2 Costs associated with cold and/or hot weather concreting shall be considered incidental to the work.

Part 2 Products

2.1 MATERIALS

- .1 All cementing materials to CSA A3001.
- .2 Portland Cement: to CSA A5, normal type 10.
- .3 Water: to CSA A23.1 and to be free from injurious amounts of oil, acid, alkali soluble chloride, organic matter, sedimentation and other deleterious substances.
- .4 Aggregates: to CSA A23.1/A23.2 for Class C-1 exposure, with a minimum 28-day compressive strength of 35 MPa.
- .5 Coarse aggregates shall consist of washed crushed stone having a nominal size of 20 mm.
- .6 Fine aggregate shall be washed and classified for conform to the gradation limits specified in CSA A23.1.
- .7 The use of Alkali-Silica Reactive Aggregates shall not be permitted.
- .8 Curing compound: to ASTM C309, Type 2.
- .9 Joint sealer: self-leveling, two component sealant capable of remaining resilient over temperatures ranging from - 25° C to 35° C. Material will be capable of an elongation of 300%, have tensile recovery of 90% ASTM D412-75 (or latest edition), hardness of 25-35 Shore A and have a high bond strength to the concrete faces.
- .10 Silane Sealer: self-penetrating, 100% silane, clear, breathable. Hydrozo 100 or equal.
- .11 Silicone Sealant: Dow Corning 888 Silicone Joint Sealant or approved alternate. The color shall be gray.
- .12 All timber to be used for the curb at the end of the concrete deck is to be S.P.F Grade 2 or better.

2.2 MIXES

- .1 Concrete Mixes:
- .1 Prior to starting concrete work, submit to the Departmental Representative the proposed mix designs for approval. Mix designs to be in accordance with Alternative 1 of Table 5 in CSA A23.1-latest edition. Comply with additional requirements of CSA A23.1-latest edition, Section 15 for concrete placed near sea water.

- .2 Use concrete mix (for both precast and cast-in-place) that meet the following parameters:
 - .1 Cement to be normal Portland Cement, Type GU.
 - .2 Minimum compressive strength of 35 MPa at 28 days.
 - .3 Exposure Class C-1.
 - .4 Maximum aggregate size: 20 mm.
 - .5 Air Content: 5-8%.
 - .6 Maximum water to cement ratio of 0.4.
 - .7 Slump at time and point of discharge of 20-80mm. Where the nature of the work requires larger slumps, they must be obtained using admixtures rather than increasing the water content. The use of such admixtures and the increase in slump to be approved by a Departmental Representative prior to implementation in the work.
 - .8 Admixtures to the approval of the Consultant and the recommendation of the manufacturer. Admixtures must be dispersed separately into mixing water.
 - .9 The contractor shall submit a modified concrete mix to the Departmental Representative for review to accommodate pumping and tremie concrete operations.
- .2 Tremie Concrete Mixes:
 - .1 Tremie concrete placed in the pile casing shall meet the same requirements as 2.2.1 – Concrete Mixes with the following exceptions:
 - .1 Maximum Nominal Aggregate Size: 10mm.
 - .2 Slump: 170 ± 30 .
 - .3 Do not use calcium chloride or compounds containing calcium chloride.
 - .4 Weigh aggregates, cement, water and admixtures separately when batching. Inspect and test scales for accuracy as directed. Accuracy to be such that successive quantities can be measured to within one percent of desired amounts. Test certificates to be submitted to Departmental Representative upon request.
 - .5 Where seven-day strength is less than 70% of specified 28 day strength; provide additional protection curing and make changes to mix proportions to the satisfactions of the Departmental Representative.
 - .6 Provide certification that plant, equipment, and all materials to be used in concrete comply with the requirements of CSA A23.1-latest edition.
 - .7 Provide certification from independent testing and inspection company that mix proportions selected will produce concrete of specified quality and can be effectively placed and finished for all work under this contract.

2.3 FINISHES

- .1 Finish concrete components per the below requirements:
 - .1 Provide a uniform broom finish on top surface of concrete deck parallel with the slope.

- .2 Provide a uniform broom finish on top surface of concrete curb parallel with its length.
- .3 Provide a smooth formed surface on exposed face of all precast panels.
- .4 Unless noted otherwise, provide a smooth troweled surface on all concrete surfaces.

Part 3 Execution

3.1 PREPARATION

- .1 Obtain Departmental Representative's written approval before placing concrete. Provide 24 hours minimum notice prior to placing concrete.
- .2 Place concrete reinforcing in accordance with Section 03 20 00 - Concrete Reinforcing.
- .3 During concreting operations:
 - .1 All construction joint locations shall be approved by a Departmental Representative.
 - .2 Control joints shall be saw cut at locations identified on the plans or at 4-meter center to center spacing if no joint spacing is provided.
 - .3 Ensure concrete delivery and handling facilitates placing with minimum of re-handling, and without damage to existing structure or Work.
- .4 Pumping of concrete is permitted only after review of equipment and mix by Departmental Representative.
- .5 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .6 Prior to placing of concrete obtain Departmental Representative's approval of proposed method for protection of concrete during placing and curing.
- .7 Protect previous Work from staining.
- .8 Clean and remove stains prior to application of concrete finishes.
- .9 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
- .10 Remove all debris including sawdust, chips, and any other deleterious materials from the interior of the forms.
- .11 Do not place load upon new concrete until authorized by Departmental Representative.

3.2 CONSTRUCTION

- .1 Perform cast-in-place concrete work to CSA A23.1/A23.2.
- .2 Comply with additional requirements of CAN/CSA A23.1 for concrete exposed to a seawater environment except where specified otherwise.
- .3 All reinforcing steel shall have 75 mm cover unless noted otherwise.
- .4 Sleeves, ducts, and inserts:
 - .1 Do not permit penetrations, sleeves, ducts, pipes or other openings to pass through structural members, except where indicated or approved by Departmental Representative.

- .2 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 Anchor bolts:
 - .1 Set anchor bolts to templates under supervision of appropriate trade prior to placing concrete.
 - .2 When setting anchor bolts, care shall be taken to not only ensure that the anchor bolts are set in the correct position and orientation, but also that sufficient thread extension is provided to facilitate bolting the assembly to the concrete, complete with compatible nuts and washers (plate washers where specified), as per the detailed on the Contract Drawings.
- .6 Placing of concrete:
 - .1 Contractor is responsible for the placing method used.
 - .2 Concrete shall be delivered to the point of final deposit in a manner satisfactory to the Departmental Representative using means and equipment which will prevent segregation or loss of materials.
 - .3 The size of section to be placed in one continuous operation shall be as detailed on the drawings or as directed by the Departmental Representative.
 - .4 Unless otherwise authorized by the Departmental Representative, forms shall be kept dry during the placing of the concrete until the concrete has reached initial set.
 - .5 Concrete shall be deposited in the forms in maximum lifts of 500 mm and in layers that are approximately horizontal and as close as practicable to its final position.
 - .6 Concrete shall not be moved horizontally with vibrators or by other methods which could cause segregation.
 - .7 Under adverse weather conditions the Contractor shall be prepared to provide suitable protection to prevent damage to concrete.
 - .8 Consolidation:
 - .1 All methods of consolidation shall be subject to the approval of the Departmental Representative.
 - .2 Concrete shall be consolidated thoroughly and uniformly by means of hand tamping, vibrators or finishing machines to obtain a dense, homogeneous structure, free from cold joints, voids and honeycomb.
 - .3 Enough vibrators shall be employed to adequately handle the anticipated rate of placement. The size and frequency of vibrators shall be as specified in CSA A23.1. A stand-by vibrator shall be always available on the site.
 - .4 Internal vibrators shall be used wherever practicable. External type vibrators may be used where surfaces cannot be properly consolidated with the internal type alone.
 - .5 Insertion of internal vibrators shall be made systematically at intervals such that the zones of influence of the vibrator overlap.
 - .6 Extreme care shall be taken to ensure that the internal type vibrators do not displace the reinforcing steel or the forms. Vibrators shall have rubber or non-metallic vibrating heads.

.7 Curing concrete:

- .1 Wet curing shall be completed to Curing Type 2 per Table 19 as indicated in CSA A23.1 to protected from freezing, premature drying, high temperature and moisture loss.
 - .1 Curing of plant production of precast concrete shall be as set out in CSA A23.4.
- .2 Curing shall be applied to concrete as soon as possible without damaging or marring the surface.
- .3 Provide protection for cold and hot weather concrete work per the requirements of CAN/CSA A23.1 and A23.2. See below maximum and minimum temperatures that prompt the requirements for cold and hot weather protection.
 - .1 Cold Weather Concreting: If the air temperature is forecasted to fall below 10 °C within 24 hours of placement (as forecast by the nearest official meteorological office), then cold weather protection is required.
 - .2 Hot Weather Concreting: If the air temperature is forecasted to be 27 °C or higher within 24 hours of placement (as forecast by the nearest official meteorological office), then hot weather protection is required.
- .4 Curing compounds cannot be used as a curing method due to the use of penetrating sealers.
- .5 Apply two coats of penetrating silane sealers on all exposed concrete surfaces.
 - .1 Surfaces include, as minimum, the exposed edges/faces of the deck, curb, and precast panels.

.8 Finishing of Concrete:

- .1 Finish concrete in accordance with CAN/CSA A23.1.
- .2 Concrete tolerance in accordance with CSA-A23.1/A23.2.
- .3 Float surfaces with wood or metal floats or power finishing machines to bring surfaces to true grades and dimensions.
- .4 Finish concrete components per the below requirements:
 - .1 Provide a uniform broom finish on top surface of concrete deck parallel with the slope.
 - .2 Provide a uniform broom finish on top surface of concrete curb parallel with its length.
 - .3 Provide a smooth formed surface on exposed face of all precast panels.
 - .4 Unless noted otherwise, provide a smooth troweled surface on all concrete surfaces.

.9 Precast Panels:

- .1 All panels shall have timber shims installed on a minimum of all four corners of the panel prior to installation.
- .2 The shims must keep the panels tight to the flange of the pile after installation.
- .3 The shims shall be anchored on the back of the panel (i.e., backfill side).
- .4 Lifting devices are not permitted in the top of the panel.
- .5 Lifting cables or inserts shall only be installed in the back of the panel.

- .6 The proposed lifting cables or inserts and rigging shall be designed and stamped by an Engineer in the Province New Brunswick.
- .10 Tremie Concrete:
 - .1 Placement of concrete in the casings may require placing concrete under water (tremie method) for which the following shall apply.
 - .1 Concrete to be placed by tremie method requires a submission of the proposed mix design stamped by a Professional Engineer registered in the Province of New Brunswick.
 - .2 The mix design and supporting documentation shall be in accordance with CSA A23.1 and A23.2.
 - .3 The Contractor shall provide written documentation as to the construction procedure to be used to place concrete by tremie method which shall include methods, equipment, and materials.
 - .4 Construction procedures require approval by a Departmental Representative before work is started; however, such approval shall not in any way relieve the Contractor of liability in connection with the Work.

3.3 CRACKS

- .1 Repair all cracks greater than 0.2mm in width with an epoxy injection grout. Repair methods and materials to be submitted to a Departmental Representative for approval.

3.4 FIELD QUALITY CONTROL

- .1 Site tests: conduct tests as follows in accordance with Section 01 45 00 - Quality Control and Section 1.6, Quality Assurance, of this Section and submit report as described in Part 1 - Submittals.
 - .1 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.
 - .2 Carry out tests for slump, air content, compressive strength and temperature in conformance with CSA A23.1 and CSA A23.2
 - .3 Frequency of testing as follows:
 - .1 Air, Slump and Temperature: one test for each load of concrete until satisfactory control is established daily and rate of placement > 35 m³ per hour; then one (1) test for each three (3) loads of concrete. Satisfactory control is considered to have been established when tests on five consecutive loads or batches of concrete are within specification requirements.
 - .2 Concrete shall be tested for slump, air content and temperature prior to and after the addition of superplasticizer (if added on site). Testing shall be carried out at the point of discharge from the truck and as close as possible to the final deposit into the forms. Sufficient superplasticizer shall be added to produce the desired consistency and if added on site, the superplasticizer shall be mixed into the load a minimum of five minutes prior to retesting.

- .3 A set of three regular compressive strength cylinders shall be made for every 50 m³ of concrete placed, or fraction thereof, or as directed by the Departmental Representative. In addition, for every regular set of three cylinders, two additional cylinders will be cast to be tested only if requested by the Departmental Representative for appeal purposes.
- .4 The responsibility for casting any additional cylinders required for interim testing lies with the Contractor.
- .5 Ensure there is no accelerated curing of concrete cylinders
- .2 The Departmental Representative shall have the right to sample and test all materials used in the mixture design and given access to the production facilities of the ready-mix supplier. Materials failing to meet requirements to be immediately rejected.
- .3 Ensure test results are distributed to all parties.
- .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 may take additional test cylinders as required. Cure cylinders on job site under same conditions as concrete which they represent.
- .6 Non-Destructive Methods for Testing Concrete: to CSA A23.1/A23.2.
- .7 Inspection or testing by Departmental Representative will not relieve Contractor of their contractual responsibility.

END OF SECTION