

PART 1 - GENERAL

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| <u>1.1 DESCRIPTION</u> | .1 | This section specifies requirements for supply, placing, finishing, protecting and curing cast-in-place concrete for mooring cleat blocks, wharf deck, retaining wall, slab on grade and foundation wall for electrical shed, concrete launchway, jib crane base, wet well and manhole. |
| <u>1.2 RELATED SECTIONS</u> | .1 | Section 03 10 00 - Concrete Forming and Accessories. |
| | .2 | Section 03 20 00 - Concrete Reinforcing. |
| | .3 | Section 35 59 29 - Mooring Devices. |
| <u>1.3 REFERENCES</u> | .1 | American Society for Testing and Materials (ASTM) |
| | .1 | ASTM C109/C109M-08, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 in. or 50 mm Cube Specimens). |
| | .2 | ASTM C260/260M-10a, Standard Specification for Air-Entraining Admixtures for Concrete. |
| | .3 | ASTM C494/C494M-10a, Standard Specification for Chemical Admixtures for Concrete. |
| | .2 | Canadian General Standards Board (CGSB) |
| | .1 | CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction. |
| | .3 | Canadian Standards Association (CSA) |
| | .1 | CAN/CSA-A23.1-09, Concrete Materials and Methods of Concrete Construction. |
| | .2 | CAN/CSA-A23.2-09, Methods of Test for Concrete. |

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

.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.

1.4 CERTIFICATES

- .1 Submit certificates in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Minimum 2 weeks 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 Grout.
 - .5 Admixtures.
 - .6 Aggregates.
 - .7 Water.
 - .8 Joint filler.
 - .9 Joint Sealant.
- .3 Provide certification that mix proportions selected will produce concrete of quality, yield and strength as specified in concrete mixes, and will comply with CAN/CSA-A23.1.
- .4 Provide certification that plant, equipment, and materials to be used in concrete comply with requirements of CAN/CSA-A23.1.

1.5 STORAGE OF MATERIALS

- .1 Store materials to prevent contamination or deterioration.

- .2 Provide adequate storage facilities for materials to ensure a continuous supply of these materials during batching operations.
- .3 Store cement in weathertight facility.

1.6 QUALITY ASSURANCE

- .1 Minimum 2 weeks prior to starting concrete work, submit proposed quality control procedures to Departmental Representative for the following items:
 - .1 Cold weather concrete.
 - .2 Curing.
 - .3 Finishes.
 - .4 Formwork removal.
 - .5 Joints.

1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 Use trigger operated spray nozzles for water hoses.
- .2 Designate a cleaning area for tools to limit water use and runoff.
- .3 Carefully coordinate the specified concrete work with weather conditions.
- .4 Ensure emptied containers are sealed and stored safely for disposal away from children.
- .5 Prevent plasticizers, water-reducing agents and air-entraining agents from entering drinking water supplies or streams. Using appropriate safety precautions, collect liquid or solidify liquid with an inert, noncombustible material and remove for disposal. Dispose of all waste in accordance with applicable local, provincial and national regulations.

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

1.8 MEASUREMENT FOR PAYMENT

- .1 Concrete Deck - marginal wharf: Supply and installation of reinforced concrete deck for the new marginal wharf to be measured in square metres (m²) calculated from actual field measurements, excluding area occupied by mooring cleat pedestals, jib crane base, poles and coping. Contractor to provide all plant, equipment, material, and labour including concrete, reinforcing steel, and control joints.
- .2 Concrete Launchway (200mm): Supply and installation of reinforced concrete launchway (atop cribs and slab on grade portion) to be measured in square metres (m²) calculated from actual field measurements. Contractor to provide all plant, equipment, material, and labour including concrete, reinforcing steel, and control joints.
- .3 Jib Crane Base: Supply and installation of reinforced concrete jib crane foundation, as shown on the drawings to be measured by the unit. Contractor to provide all plant, equipment, material, and labour including concrete, reinforcing steel and anchor bolts.
- .4 Wet Well: Supply and installation of reinforced concrete wet well, as shown on the drawings to be measured by the unit. Contractor to provide all plant, equipment, material, and labour.
- .5 Retaining Wall: Supply and installation of reinforced concrete retaining wall (complete with footing), as shown on the drawings to be measured by the linear

metre (LM). Contractor to provide all plant, equipment, material, and labour.

- .6 Manhole: Supply and installation of manhole, as shown on the drawings to be measured by the unit. Contractor to provide all plant, equipment, material, and labour. Note that a pre-cast manhole will be accepted, provided the material strength properties are in accordance with these specifications.
- .7 Concrete Topping on Existing Marginal: Supply and installation of reinforced concrete deck topping on existing marginal wharf to be measured in square metres (m²) calculated from actual field measurements. Contractor to provide all plant, equipment, material, and labour including concrete, reinforcing steel, leveling timbers, shims, and granulars between timbers.
- .8 Cleat Pedestals: No measurement for payment to be made under this section. Include costs incidental to unit price for Type "A" mooring cleats.
- .9 Electrical shed slab on grade and perimeter foundation wall/footing: No measurement for payment to be made under this section. Include costs incidental to unit price for Electrical Shed.
- .10 Drilling through existing concrete on back of existing marginal wharf, and supply/ installation of drains, as noted on the drawings, will not be measured separately for payment, and is to be included incidental to the project.
- .11 No separate payment will be made for any other ingredient or feature of concrete

work, and all factors, including cold weather placement, reinforcing steel, anchor bolts, joint filler for control joints, cement, concrete to fill bollards, plant and labour will be considered as being included in the unit price for item.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Cement to CAN/CSA-A3001, Type GU.
- .2 Supplementary cementing materials: to CAN/CSA-A3001.
- .3 Cementitious hydraulic slag: to CAN/CSA-A3001.
- .4 Water: to CAN/CSA-A23.1.
- .5 Aggregates: to CAN/CSA-A23.1. Coarse aggregates to be normal density.
- .6 Air entraining admixture: to ASTM C260.
- .7 Chemical admixtures: to ASTM C494/C494M. Departmental Representative to approve accelerating or set retarding admixtures during cold and hot weather placing.
- .8 Concrete retarders: to ASTM C494/C494M. Do not allow moisture of any kind to come in contact with the retarder film.
- .9 Curing compound: curing compounds are not to be used.
- .10 Premoulded joint fillers:
 - .1 Sponge rubber: to ASTM D1752, Type I, flexible grade.

2.2 MIXES

- .1 Proportion concrete in accordance with CAN/CSA-A23.1, Clause 4.3.
- .2 Proportion concrete to comply with Alternate 1, Table 2 in CAN/CSA-A23.1 and following requirements:
 - .1 Cement:
 - .1 Type GU Portland cement.
 - .2 Minimum compressive strength: 35 MPa at 28 days.
 - .3 Class of exposure: C1.
 - .4 Minimum cement content: 385 kg/m³ of concrete.
 - .5 20 mm nominal size coarse aggregate.
 - .6 Air content 5% to 8%.
 - .7 Density of air-dry concrete in range of 2240 kg/m³ to 2400 kg/m³.
 - .8 Slump at time and point of discharge 50 mm to 100 mm.
- .3 When the Contractor wishes to purchase concrete from a ready mix concrete supplier, submit a letter from the supplier certifying the following:
 - .1 That plant and equipment is certified and all materials to be used in the concrete comply with the requirements of CAN/CSA-A23.1.
 - .2 That the mix proportions selected will produce concrete of the specified quality and yield. Indicate mix proportions and sources of all materials.
 - .3 That the strengths will comply with the strengths specified herein.
- .4 When the Contractor wishes to mix concrete on site, identify the source of aggregates and submit samples of fine and coarse aggregates to a testing laboratory for testing and trial mixes in order to determine a suitable mix design. The testing laboratory, at Contractor's cost, will test the trial mix for slump, air

content, density and strength. The results of these tests will be submitted to the Departmental Representative to be reviewed for compliance with the specification. This review must be completed before permission to place concrete is given.

.1 The sand, gravel, water and air entraining agent should be mixed prior to the addition of cement and water reducer.

- .5 Weigh aggregates, cement, water and admixture when batching. No alternative methods of measuring will be permitted.
- .6 Do not use calcium chloride.
- .7 If the Contractor chooses not to do work in the dry, specifically related to concrete work associated with the concrete launchway, submit alternate mix design (meeting 35MPa compressive strength requirements), to include anti-washout agents, for approval by the Departmental Representative. Submit methodology for underwater concrete placing, including use of tremie pipes, for approval by the Departmental Representative.

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 Pumping of concrete is permitted only after approval of equipment and mix.
- .3 Ensure reinforcement and inserts are not disturbed during concrete placement.

- .4 Prior to placing of concrete obtain Departmental Representative's approval of proposed method for protection of concrete during placing and curing in adverse weather.
- .5 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
- .6 Do not place load upon new concrete until authorized by Departmental Representative.

3.2 CONSTRUCTION

- .1 Comply with additional requirements of CAN/CSA-A23.1, Clause 4.1.1.5, for concrete exposed to seawater environments.
- .2 Minimum concrete cover over reinforcing steel bars to be 75 mm.
- .3 Place concrete in hot weather to CAN/CSA-A23.1.
- .4 Place concrete in cold weather to CAN/CSA-A23.1.
- .5 Keep concrete surfaces moist continually during protection stage.
- .6 Place, consolidate, finish, cure and protect concrete to CAN/CSA-A23.1.
- .7 Do not commence placing concrete until Departmental Representative has inspected and approved forms, foundations, reinforcing steel, joints, conveying, spreading, consolidation and finishing equipment and curing and protective methods.

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| <u>3.3 FORMWORK</u> | .1 | Install and strip formwork to CAN/CSA-A23.1 and Section 03 10 00. |
| <u>3.4 INSERTS</u> | .1 | Position and secure anchor bolts in formwork to maintain line and grades. |
| <u>3.5 CONTROL JOINTS</u> | .1 | Construct control joints in locations shown on drawings or directed by Departmental Representative. |
| | .2 | All joints will be centred over a support. Joints will be made in a perfectly straight line. |
| | .3 | Cut control joint when concrete has hardened. |
| | .4 | Fill saw cut with joint sealer as specified. |
| <u>3.6 PLACING CONCRETE</u> | .1 | Place and consolidate concrete to CAN/CSA-A23.1. |
| | .2 | Do not place concrete on or against frozen material. |
| | .3 | Place concrete continuously from joint to joint. |
| | .4 | Place concrete in a uniform heading, normal to the centreline. Limit rate of placing to that which can be finished before beginning of initial set. |
| <u>3.7 STRIKE OFF AND CONSOLIDATION</u> | .1 | High speed internal poker vibrators shall be used to consolidate the concrete during placing. Final compaction of the surfaces |

shall be done by beam-type vibratory air screed as approved by Departmental Representative. A surcharge of approximately 65 mm of concrete will be maintained at the screed face during consolidation.

- .2 Strikeoff and consolidation must be completed before excess water bleeds to the surface.
- .3 Ensure that the concrete deck conforms to the elevations and slopes as shown on the drawings so that satisfactory drainage will result.

3.8 FINISHING

- .1 Only ACI certified or other pre-approved concrete finishers are to be utilized in finishing all concrete works. All work is to be finished to CAN/CSA-A23.1, and as specified below.
- .2 The surface will be brought to the specified level by means of darbying or bull floating which will be carried out immediately following screeding and must be completed before any bleed water is present on the surface. Surface tolerance to be 8 mm under a 3 metre straight edge.
- .3 Provide slope as shown on the drawings to permit proper drainage of the concrete deck.
- .4 Finish slabs to elevations indicated on drawings.
- .5 Strike off the surface with a straight edge.
- .6 Hand tamp low slump concrete with jitterbug.

- .7 Darby or bull float the surface to smooth and level the concrete.
- .8 Allow bleed water or sheen to disappear.
- .9 Float the surface by means of power and/or hand float where the concrete has hardened enough for a man to leave only slight footprints on the surface.
- .10 Do not bring water and fines to the surface by over floating. Where extra floating is required the floating operation shall be repeated after the time interval necessary for any sheen to disappear and for concrete to set further.
- .11 Steel trowel the concrete surfaces by means of power and/or hand trowel. Do not leave any hard, smooth, polished or burnished surface area.
- .12 Do not bring water and fines to the surface by over trowelling.
- .13 After slight interval necessary for concrete to further harden, repeat the trowelling operation.
- .14 Lightly broom surface with a soft bristle broom obtaining a fine and even textured finish with a non-slip finish. All brush strokes to be parallel across paving.
- .15 The surface shall be true and accurate to a maximum tolerance of 1 mm in 500 mm.

3.9 PROTECTION AND CURING

- .1 Cure to CAN/CSA-A23.1.
- .2 Cure concrete by protecting it against loss of moisture, rapid temperature change

and mechanical injury for at least 7 days after placement. After finishing operations have been completed, the entire surface of the newly placed concrete shall be covered by whatever curing medium is applicable to local conditions and approved by the Departmental Representative. The edges of concrete slabs exposed by removal of forms shall be protected with continuous curing treatment equal to the method selected for curing the slab and curb surfaces. Cure to CAN/CSA-A23.1. Have the equipment needed for adequate curing at hand and ready to install before actual concrete placement begins.

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

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

.1 For initial 3 days at a temperature of not less than 15°C nor more than 27°C at surface.

.2 Maintain concrete at 10°C for an extra 4 days plus the initial 3 days.

.3 In addition to the protective housing, the concrete must be cured as outlined in Clause 3.9.2 above.

3.10 TESTING

- .1 Departmental Representative will appoint a concrete testing company to test all work under this section of specification as per CAN/CSA-A23.1.
- .2 Cost of compressive strength tests shall be paid for by the Departmental Representative.
- .3 Testing company shall issue reports to Departmental Representative on quality of test cylinders.
- .4 Notify Departmental Representative at least 7 days prior to start of placing concrete. Provide for testing purposes an adequate quantity of approved test cylinders.
- .5 At least 1 set of 3 cylinders each shall be taken from 25 m³ or fraction thereof of each day's pour, whichever is less. 1 cylinder shall be tested at 7 days and other 2 tested at 28 days.
- .6 Crate cylinders and deliver to the testing laboratory within 48 hours after casting in accordance with CAN/CSA-A23.1. Contractor will pay for crating and delivery of cylinders to the laboratory.
- .7 If strength tests of test cylinder for any portion of the work falls below the specified compressive strength at 28 days, the Departmental Representative reserves the right to determine the acceptability of the concrete by performing additional field testing as outlined in CAN/CSA-A23.1.

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