

**Harbour Improvements****Shag Harbour, Shelburne County, NS****R.118063.001**

## Concrete Formwork and Falsework

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## PART 1 - GENERAL

- 1.1 Related Work .1 Refer to other Specification Sections for related information.
- .2 Refer to Section 01 33 00 for Shop Drawing/Submissions requirements.
- 1.2 Reference Standards .1 Do concrete formwork and falsework in accordance with CSA standard A23.1-14, Concrete Materials and Methods of Concrete Construction, except where stricter standards specify otherwise.
- .2 CSA S269.1-16, Falsework and Formwork.
- 1.3 Submissions .1 Shop Drawings:
- .1 Upon request, submit to *Departmental Representative* for review four (4) sets of formwork and falsework shop drawings, in accordance with Section 01 33 00, at least four (4) weeks prior to erection. All such drawings to be stamped and signed by a Professional Engineer registered in the Province of Work.
- .2 Clearly indicate method and schedule of construction, materials, arrangement of joints, ties, shores, liners, and locations of temporary embedded parts. Comply with CSA S269.1 for falsework drawings.
- .2 Product Data/Samples:
- .1 Provide product data and samples for form ties.
- .3 Provide submissions in accordance with Section 01 33 00.
- 1.4 Measurement for Payment .1 This item will not be measured separately.

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PART 2 - PRODUCTS

- 2.1 Materials
- .1 Formwork lumber: plywood and wood formwork materials to CSA A23.1
  - .2 Falsework materials: to CSA S269.1
  - .3 Form stripping agent: colourless mineral oil, free of kerosene, with viscosity between 70s and 110s Saybolt Universal, 15 to 14 mm<sup>2</sup>/s at 40 degrees celcius, flash-point minimum 150 degrees Celsius, open cup.
  - .4 Form ties: removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm diameter in concrete surface. When forms are removed, no metal will be less than 50 mm from the surface of the concrete.

## PART 3 - EXECUTION

- 3.1 Erection
- .1 Verify lines and levels before proceeding with formwork and ensure dimensions agree with drawings.
  - .2 Construct forms to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA A23.1
  - .3 Line forms with material only as approved by *Departmental Representative*.
  - .4 Construct falsework in accordance with CSA S269.1
  - .5 Align form joints and make watertight. Keep form joints to minimum.
  - .6 Use 25 mm chamfer strips on all external corners.
  - .7 Clean formwork in accordance with CSA A23.1, before placing concrete.
  - .8 Leave formwork in place for at least seven (7) days, exclusive for days when temperature falls below 5 degrees Celsius,

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unless otherwise directed by *Departmental Representative*.

.9 Re-use of formwork and falsework subject to requirements of CSA A23.1

.10 All holes from form ties and rods to be plugged with mortar to requirements of CSA A23.1. When forms are removed, no metal will be less than 50 mm from the surface of the concrete.

## 3.2 Falsework

.1 Contractor to design and construct formwork and falsework to resist severe exposed wave conditions.

.2 Submit formwork and falsework design to Departmental Representative for review prior to construction.

.3 Formwork and falsework design to be approved by an Engineer registered in the Province of Work.

END OF SECTION

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## Concrete Reinforcement

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## PART 1 - GENERAL

- 1.1 Related Work .1 Refer to other Specification Sections for related information.
- .2 Refer to Section 01 33 00 for Shop Drawing/Submission requirements.
- 1.2 Reference Standards .1 Do concrete reinforcement work in accordance with CSA standard A23.1-14, Concrete Materials and Methods of Concrete Construction, except where stricter standards specify otherwise.
- .2 Reinforcing Steel Manual of Standard Practice (latest edition) by Reinforcing Steel Institute of Ontario.
- .3 CSA G30.18-09 (R2014) (or latest edition), Billet-Steel Bars for Concrete Reinforcement.
- .4 ASTM A1064/A1064M-18, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
- 1.3 Source Sampling .1 Upon request, provide *Departmental Representative* with certified copy of mill test of steel supplied showing physical and chemical analysis not less than two (2) weeks prior to commencement of work.
- 1.4 Submissions .1 Shop Drawings:
- .1 Clearly indicate bar sizes, spacing, location and quantities of reinforcement, mesh, chairs, spacers and hangers with identifying code marks to permit correct placement without reference to structural drawings; to Reinforcing Steel Manual of Standard Practice.
- .2 Detail placement of reinforcing where special conditions occur.
- .3 Design and detail lap lengths and bar development lengths to CSA standard

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A23.1, unless otherwise specified on drawings.

.2 Product Data/Samples:

.1 Provide product data for supports and spacers.

.3 Test Results:

.1 Provide Mill Test Certificates cross referenced to the product supplied to the site.

.4 Provide submissions in accordance with Section 01 33 00.

1.5 Storage

.1 Store reinforcing steel on racks or sills that will permit easy access for identification and handling and prevent it from becoming coated with material which would adversely affect bond.

.2 Do not store reinforcing steel in direct contact with the ground.

1.6 Measurement for  
Payment

.1 This item will not be measured separately.

.2 Wire ties and spacers to be considered incidental to supply and placing of reinforcement.

PART 2 - PRODUCTS

2.1 Materials

.1 Reinforcing steel: to CSA G30.18; billet steel grade 400 deformed bars.

.2 Wire ties: to ASTM A1064 plain, cold drawn annealed steel wire.

.3 Spacers: purpose made PVC, fabricated to suit site dimensions and cover requirements. Supporting reinforcing steel on bricks, rock, or similar will not be accepted.

.4 Polypropylene fibre reinforcing to ASTM C1116/C1116M, non-reactive and compatible with all cement, supplementary cementing materials, aggregates and admixtures, and

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suited for marine application. Contractor to submit product specifications for approval by Departmental Representative with mix design.

**2.2 Reinforcing Steel  
Fabrication**

- .1 Fabricate reinforcing to CSA standard A23.1
- .2 Fabrication tolerances for reinforcing steel to Reinforcing Steel Manual of Standard Practice.
- .3 Obtain *Departmental Representative's* acceptance for locations of reinforcement splices other than shown on steel placing drawings.
- .4 Ship bundles of bar reinforcement, clearly identified in accordance with bar list.
- .5 Do not weld reinforcing steel.

**PART 3 - EXECUTION****3.1 Placing**

- .1 Accurately place reinforcing in positions indicated and hold firmly during placing, compacting and setting of concrete.
- .2 Tie reinforcement where spacing in each direction is:
  - .1 Less than 300 mm: - tie at alternate intersections.
  - .2 300 mm or more: - tie at each intersection.

**3.2 Field Bending**

- .1 Do not field bend reinforcement except where indicated or authorized by *Departmental Representative*.
- .2 When authorized, bend reinforcement without heat, by applying slow and steady pressure.
- .3 Replace bars which develop cracks or splits.

**3.3 Cleaning**

- .1 Clean reinforcing before placing concrete.

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|-----|--------------------|----|---|
| 3.4 | Inspection         | .1 | Do not place concrete until <i>Departmental Representative</i> has inspected and accepted reinforcement work in place.  |
| 3.5 | Surface Conditions | .1 | Reinforcement, at time concrete is placed, to be free from mud, oil or other non-metallic 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

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## Cast-in-Place Concrete

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## PART 1 - GENERAL

- 1.1 Related Work
- .1 Refer to other Specification Sections for related information on aggregates, form work and false work, concrete reinforcement, paint, miscellaneous items.
  - .2 Refer to Section 01 33 00 for Shop Drawing/Submissions requirements.
- 1.2 Reference Standards
- .1 CSA A23.1/A23.2-2019, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
  - .2 CAN/CSA A3000-18, Cementitious Materials Compendium.
  - .3 ASTM C494/C494M-19, Chemical Admixtures for Concrete.
  - .4 ASTM C1116/C1116M(R2015)- Standard Specification for Fibre-Reinforced Concrete.
  - .5 ASTM C881/C881M-2020, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
- 1.3 Submissions
- .1 Shop Drawings:
    - .1 Upon request, submit shop drawings and erection drawings for formwork and falsework. All such drawings to be stamped and signed by a Professional Engineer registered in the Province of Work.
    - .2 Submit placement drawings for reinforcing steel.
    - .3 Submit placement drawings for miscellaneous items, sleeves, inserts, and embedded parts.
  - .2 Product Data/Samples:
    - .1 Provide technical data and/or samples for curing compounds (winter/ summer /green /white /red), evaporation retardant and finishing aids, expansion joint materials/sealants, grouts.



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- .2 Submit concrete mix design for all concrete mixes to be used in the project, stamped by a Professional Engineer registered in the province of Work.
  - .3 Certificates:
    - .1 Minimum four weeks prior to starting concrete work submit to *Departmental Representative* 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 Admixtures.
    - .2 Provide certification that plant, equipment, and materials to be used in concrete work comply with requirements of CSA A23.1
    - .3 Provide certification that mix proportions selected will produce concrete of specified quality and yield and that strength will comply with CSA A23.1
    - .4 Minimum two (2) weeks prior to commencing concrete work, submit a concrete mix design stamped by an engineer licensed to practice in the Province of Work, to the Departmental Representative for review containing the following for each concrete mix:
      - .1 Cement type.
      - .2 Minimum compressive strength and age as per class of exposure.
      - .3 Class of exposure.
      - .4 Nominal size of coarse aggregate.
      - .5 Air content.
      - .6 Slump at time and point of discharge.
      - .7 Dosage rate of macro fibres for fibre reinforced concrete mix.

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- .4 Provide certification that only compatible components, non-reactive synthetic macro-fibres, and non-reactive aggregate will be used in the concrete mix designs. Use of admixtures to neutralize or mitigate potential alkali-aggregate reactivity (AAR) will not be accepted.
  - .4 Methodology and Quality Control:
    - .1 Submit for review methodology and quality control procedures for the following:
      - .1 Cold weather concreting, including protection and curing.
      - .2 Hot weather concreting, including protection and curing.
      - .3 Concrete placement operations. Provide details of placement sequence and proposed layout of construction joints. Unless otherwise approved, the spacing of control joints shall not exceed 13.5m.
    - .2 Supporting reinforcing steel.
    - .3 Submit methodology for curing and crack control. To be stamped and signed by a Professional Engineer registered to practice in the Province of Work.
  - .5 Test Results:
    - .1 Provide design mix laboratory test results. Test results to be within 6 months of the start of the project.
    - .2 Provide mill test certificates for reinforcing steel.
  - 1.4 Storage of Materials
    - .1 Store all materials to prevent contamination or deterioration, whether at the plant or at the job site.
    - .2 Store cement in watertight bins or silos that provide protection from dampness and easy access for inspection and identification of each shipment whether at the plant or at the job site.

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	.3	Prevent stored liquid admixtures and compounds from freezing and powdered admixtures and compounds from absorbing moisture.
1.5 Source Sampling	.1	At least four (4) weeks prior to commencing work, inform <i>Departmental Representative</i> of proposed source of aggregates and provide access for sampling.
1.6 Ready-Mix Concrete Supply	.1	Provide, with each load of concrete delivered to site, duplicate delivery slips containing following: 1. Name of ready-mix batch plant. 2. Serial number of ticket. 3. Date and truck number. 4. Project identification. 5. Class of concrete or mix. 6. Amount of concrete in cubic metres. 7. Time of loading or first mixing of aggregate, cement and water. 8. Time of discharge of concrete. 9. Admixtures added at plant. 10. Amount of water added at plant.
1.7 Measurement for Payment	.1	Heating of water and aggregates and providing cold weather protection will not be measured but considered incidental to work.
	.2	Cooling of concrete and providing hot weather protection will not be measured but considered incidental to work.
	.3	Supply of anchor bolts, washers and nuts will not be measured but considered incidental to work. Bolt grouting will be considered incidental to the work.
	.4	Supply and installation of rigid PVC sleeves, expansion joints/sealants and curing compounds, or other compounds will be considered incidental to the work.
	.5	Concrete work will be measured in accordance with Section 01 29 00.

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## PART 2 - PRODUCTS

## 2.1 Materials

- .1 Aggregates: to CSA A23.1.
- .2 Polypropylene fibre reinforcing to ASTM C1116/C1116M, non-reactive and compatible with all cement, supplementary cementing materials, aggregates and admixtures, and suited for marine application. Contractor to submit product specifications for approval by Departmental Representative with mix design.
- .3 Portland Cement: to CSA A3000.
- .4 Water: to CSA A23.1
- .5 Admixtures:
  - .1 Air entraining admixtures: to CSA A3000
  - .2 Chemical admixtures: to CSA A3000 and ASTM C494. Departmental Representative to approve use of accelerating and set retarding admixtures.
- .6 Non-shrink grout: premixed compound consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agents, of pouring consistency, capable of developing compressive strength of 50 MPa at 28 days.
- .7 Curing compound: To ASTM-C309 and CSA A23.1 type 1, 1D, or 2.
- .8 Pre-moulded joint fillers: Bituminous impregnated fibre board: to ASTM D1751 (latest edition), non-extruding resilient type.
- .9 Joint sealer: two component polysulphide sealant complete with compatible foam backer rod and primer.
- .10 Adhesive Anchors: Epoxy resin adhesive: high strength epoxy to ASTM C881/C881M, Type IV, Grade 3. Epoxy adhesive shall be an

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injectable two-component, hybrid adhesive. The two components are to be separated by means of a dual-cylinder foil pack attached to a manifold which keep component A and component B separate. Containers shall be designed to accept static mixing nozzle which thoroughly blends component A and component B and allows injection of the mixed adhesive directly into the drilled hole. Only injection tools and static mixing nozzles supplied by the manufacturer may be used. Injection adhesive shall be formulated to include the resin and hardener to provide optimal curing speed, high strength and stiffness. Injection adhesive anchor system technical data shall be submitted to the Department Representative for review, prior to installation.

.1 Acceptable material: Hilti HIT-RE 500V3, Set Epoxy by Simpson Strong Tie, Redhead A7, or approved equivalent.

.11 Bonding Agent: a three component bonding agent for use between new concrete and existing concrete (where specified on drawings) complete with anti-corrosion coating for exposed reinforcing steel.

## 2.2 Concrete Mixes

.1 Prior to starting concrete work, submit to the Departmental Representative the proposed mix design(s) for review, complete with batch test results for mix. Laboratory batch testing of the mix must be no older than 6 months, and show that the concrete meets the strength, workability, and durability requirements of the specified concrete. Mix design(s) to be in accordance with Alternative 1 of Table 11 in CSA A23.1. Departmental Representative review is for general conformance with project specifications and does not relieve contractor of their responsibility to supply and install concrete to the project specifications. Comply with additional requirements of CSA A23.1, clause 4.1.1.5 for concrete exposed to sea water or sea water spray.

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- .2 Unless otherwise noted, use concrete mix designed and proportioned to produce air entrained concrete meeting the following requirements:
- .1 Cement: to CSA A23.1 in accordance with designated class of exposure.
  - .2 Minimum compressive strength at 28 days: 35 MPa.
  - .3 Class of Exposure: C-1 and S-3.
  - .4 Nominal size of coarse aggregate: 20mm.
  - .5 Air content: 5 to 8%.
  - .6 Maximum water/cement ratio: 0.40.
  - .7 Slump at time and point of discharge  $80 \pm 20$  mm. Where the nature of the work requires larger slumps, they are to be obtained by the use of admixtures rather than increasing the water content. The use of such admixtures and the increase in slump to be approved by the *Departmental Representative* prior to implementation in the work.
  - .8 Chloride ion penetrability at 65 days: less than 1500 coulombs.
- .3 For Fibre-reinforced concrete pile jackets, use concrete mix designed and proportioned to produce air entrained shrinkage compensating concrete proportioned in accordance with CSA A23.1 and designed to meet the following requirements:
- .1 Cement: Type 50, and to CSA A23.1 in accordance with designated class of exposure.
  - .2 Minimum compressive strength at 28 days: 35 MPa.
  - .3 Class of Exposure: C-1 and S-3.
  - .4 Nominal size of coarse aggregate: 10mm.
  - .5 Air content: 6 to 9%.
  - .6 Maximum water/cement ratio: 0.40.
  - .7 Slump at time and point of discharge  $80 \pm 20$  mm. Where the nature of the work requires larger slumps, they are to be obtained by the use of admixtures rather than increasing the water content. The use of such admixtures and the increase in slump to be

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- approved by the *Departmental Representative* prior to implementation in the work.
- .8 Chloride ion penetrability at 65 days: less than 1500 coulombs.
- .9 Polypropylene Fibres: minimum dosage of 2kg/m<sup>3</sup>.
- .4 Modify concrete mix to the approval of the *Departmental Representative* to accommodate pumping.
- .5 Admixtures to the approval of the *Departmental Representative* and the recommendation of the manufacturer. Admixtures must be dispersed separately into mixing water.
- .6 Do not use calcium chloride or compounds containing calcium chloride.
- .7 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.
- .8 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 satisfaction of the *Departmental Representative*.
- .9 Provide certification that plant, equipment and all materials to be used in concrete comply with the requirements of CSA A23.1.
- .10 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.

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- .11 Add macro fibres to concrete according to the manufacturers' printed recommendations.
  - .12 Use of plasticizers to increase concrete workability is subject to approval of Departmental Representative.
  - .13 All mix designs and fibre mixing procedures to be reviewed by Departmental Representative prior to work.

## PART 3 - EXECUTION

## 3.1 General

- .1 Obtain *Departmental Representative's* approval before placing concrete. Provide 24 hours' notice of intended placement.
- .2 Place, consolidate, finish, cure and protect concrete to CSA A23.1 except where specified otherwise.
- .3 Prior to placing of concrete, obtain *Departmental Representative's* approval of proposed method for protection of concrete during placing and curing in adverse weather.
- .4 Comply with additional requirements of CSA A23.1 except where specified otherwise, for concrete exposed to seawater environment.
- .5 Do not commence placing concrete until *Departmental Representative* has inspected/reviewed forms, inserts, dowels, reinforcing steel, joints; conveying, spreading, consolidation, finishing, curing and protective methods.
- .6 Ensure that reinforcement and anchorage are not disturbed during placing.
- .7 Maintain accurate records of placed concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
- .8 Do not place load(s) upon new concrete until *Departmental Representative* is satisfied



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		that the Contractor has carried out all calculations and tests necessary to confirm that the load(s) will not cause damage or create a safety hazard. Calculations and tests to be stamped by a Professional Engineer registered in the Province of Work, and submitted to the Departmental Representative.
3.2 Reinforcing Steel	.1	Place new reinforcing steel according to Section 03 20 00.
	.2	Provide 75 mm minimum cover for all reinforcing steel unless indicated otherwise on drawings.
3.3 Formwork	.1	Verify field dimensions to determine applicable sizes of formwork.
	.2	Design and construct form work to allow adequately for proper placement and consolidation while conforming to shape and dimensions shown on plans.
	.3	Formwork design will include closures at both top and bottom of form, and all necessary hardware to support the forms.
	.4	Upon request, submit drawings for review by the <i>Departmental Representative</i> , at least 3 weeks before placement of concrete. Drawings will show formwork details and illustrate dimensions, method of placing of concrete, connections and support.
	.5	Strip formwork after minimum 7 days. This condition might be waived only if an alternative method to curing and preventing alternate wetting and drying is provided, to the satisfaction of the <i>Departmental Representative</i> . This condition will be waived if the forms are left permanently in place, where approved by the <i>Departmental Representative</i> .
3.4 Placement of Concrete	.1	Place and consolidate concrete to CSA A23.1.

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- .2 If allowed by *Departmental Representative*, pump concrete to following requirements:
    - .1 Arrange equipment so that no vibrations result which might damage freshly placed concrete.
    - .2 Where concrete is conveyed and placed by mechanically applied pressure, provide suitable equipment.
    - .3 Operate pump so that concrete, without air pockets, is produced.
    - .4 When pumping is discontinued and concrete remaining in pipe line is to be used, void pipe line in a manner that prevents contamination of concrete or separation of ingredients.
  - .3 Concrete will be deposited in all cases as neatly as practicable, directly in its final position, and will not be caused to flow in a manner to permit or cause segregation.
  - .4 Each layer of concrete will be vibrated and tamped with an appropriate vibrator as allowed by the *Departmental Representative*. The concrete must be compacted to the maximum practicable density, free of air pockets, and until it is in complete contact with the reinforcement and formwork.

3.5 Concrete Placement  
(Underwater Concrete  
Tremie Method)

- .1 Definitions:
  - .1 Tremie concrete is placed underwater through a tube called a tremie pipe. The tremie pipe has a hopper at upper end and may be open ended or may have a foot valve, plug or traveling plug to control flow of concrete. Concrete is placed in hopper and a sufficient head of concrete is maintained in tremie pipe to provide desired rate of flow.
  - .2 Pumped concrete method of placing concrete underwater uses a concrete pump with a discharge line used in a similar manner to a tremie pipe.

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- .2 Place and consolidate concrete to CSA A23.1.
  - .3 Provide tremie pipe which is watertight and sufficiently large to allow free flow of concrete. Diameter of tremie pipe to be not less than 200 mm or less than eight times maximum size of coarse aggregate.
  - .4 Provide hopper at top of tremie pipe and means to raise and lower tremie.
  - .5 Provide plug or foot valve at end of tremie pipe to permit filling pipe with concrete initially.
  - .6 Start pour with tremie pipe full of concrete and keep end of pipe buried in freshly placed concrete by at least 300 mm. Control rate of flow by increasing or decreasing depth of end in concrete.
  - .7 If seal is lost, allowing water to enter pipe, withdraw pipe immediately.
  - .8 If tremie operation is interrupted so that a horizontal construction joint has to be made, cut surface laitance by jetting, within 24 to 36h and remove loose material by pumping or air lifting before placing next lift.
  - .9 Do not place concrete in flowing water. Do not vibrate, disturb or puddle concrete after it has been placed.
  - .10 Placement by pumped concrete method to follow similar procedures as by tremie method, using the pump discharge line in place of the tremie pipe.

### 3.6 Fibre Reinforced Concrete Jackets

- .1 Clean entire surface of piles where fibre-reinforced concrete pile protection jackets are to be installed.
- .2 Clean surfaces of piles by wire brushing and high pressure jetting ensuring that all

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debris and marine growth are completely removed.

- .3 If more than 48 hours have elapsed between cleaning and installation of the jackets, clean surfaces again with high pressure jetting.
- .4 Any sagging or deformation of the pile jacket during installation will require replacement or repair at no additional cost to the Departmental Representative. The contractor shall consult with the Departmental Representative during this process.
- .5 Metallic formwork must be removed after installation of concrete jackets. Non-metallic formwork may be left in place for concrete protection jackets if it provides a smooth surface free of obstructions, will not degrade, become dislodged, or otherwise create a hazard to users or navigation for the life of the structure.

## 3.6 Inserts

- .1 Set galvanized sleeves and other inserts and openings as indicated or specified elsewhere. Sleeves and openings greater than 100 X 100 mm not indicated on drawings must be approved by *Departmental Representative*.
- .2 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval of all modifications from *Departmental Representative* before placing of concrete.
- .3 Galvanized items embedded in concrete will be completely separated from reinforcing steel.
- .4 Anchor bolts:
  - .1 Set anchor bolts to rigid templates under supervision of appropriate trade prior to placing concrete.

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- .2 With *Departmental Representative's* concurrence, grout anchor bolts in pre-formed holes or holes drilled after concrete has set. Formed holes to be at least 100 mm in diameter. Drilled holes to be minimum 25 mm larger in diameter than bolts used.
  - .3 Protect anchor bolt holes from water accumulations.
  - .4 Set bolts with specified adhesive anchor compound. Preparation, installation and curing must adhere to manufacturer printed instructions. Ensure installation sheds water.
  - .5 Anchor bolts for base plates and cleats will be set to allow at least 25 mm of grout under the base plates, unless noted otherwise.
- 3.7 Protection and Curing
- .1 Provide protection and curing in accordance with CSA A23.1.
  - .2 Protect concrete with windproof shelter to allow free circulation of inside air around fresh concrete. Do not let walls of shelter touch formwork and provide sufficient space for removal of formwork.
  - .3 Supply approved heating equipment to maintain inside air at following temperatures:
    - .1 For an initial three days, at not less than 10° C nor more than 25° C at surfaces.
    - .2 At not less than 10° C for an additional 4 consecutive days or for the time necessary to attain 70% of the specified 28-day compressive strength of the concrete.
    - .3 Reduce temperature near end of curing period at rate not exceeding 20° C per day.
    - .4 Do not overheat.
  - .4 Keep concrete surfaces continuously moist during protection stage and allow concrete to dry before removal of protection.

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- .5 Freshly deposited concrete will be protected from premature drying and excessively hot and cold temperatures, will be maintained without drying at a relatively constant temperature for the period of time necessary for hydration of the cement and proper hardening of the concrete. It will be protected from harmful effects of sunshine, drying winds, cold weather, running or surface water and mechanical shock.

## 3.8 Finishing

- .1 Finish concrete in accordance with CSA A23.1.
- .2 When concrete has hardened sufficiently, give deck surface a uniform finish free from porous spots, irregularities, depressions, small pockets or rough spots using a float. Following use of a float, provide coarse broom finish using stiff, coarse, fibre broom. Use broom to produce transverse ridges satisfactory to Departmental Representative. Brooming will be delayed until concrete is sufficiently hard to retain ridges.
- .3 Wood floating, broom finishing, placing of burlap and inspection of concrete to be done from transverse bridges of rigid construction free from wobbles and springing under use, unless other methods have been submitted and accepted.
- .4 Grind off fins, nibs and other raised protuberances with an approved hand stone.
- .5 Rub exposed sharp edges of concrete with carborundum to produce 3 mm radius edges unless otherwise detailed.

## 3.9 Joint Fillers

- .1 Furnish filler for each joint in single piece for depth and width required for joint, unless otherwise authorized by *Departmental Representative*. When more than one piece is required for a joint, fasten

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abutting ends and hold securely to shape by stapling or other positive fastening.

.2 Locate and form separation joint as indicated. Install joint filler.

.3 Unless indicated otherwise, use 13 mm thick joint filler to separate deck slabs and other components as noted on drawings. Extend joint filler from bottom of slab to within 13 mm of finished concrete surface.

## 3.10 Field

## Quality Control

.1 Quality Assurance (QA) inspection and testing of concrete and concrete materials will be carried out by Testing Laboratory designated by the *Departmental Representative* in accordance with CSA A23.1 and CSA A23.2.

.2 *Departmental Representative* will pay for costs of tests as specified in Section 01 45 00.

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

.4 If tests do not meet requirements of the *Departmental Representative*, take such measures as indicated in CSA A23.1 and CSA A23.2.

.5 Arrange and pay for inspection and testing when necessary for production control to meet requirements.

.6 Quality Assurance (QA) Inspection and testing by *Departmental Representative* will not augment Contractor's Quality Control (QC) program or relieve them of contractual responsibility.

## 3.11 Defective Work

.1 Concrete is defective when:  
.1 Failing to meet any requirement of this specification

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- .2 Concrete contains honeycombing or embedded debris
  - .3 28-day strength in any area is less than 95% of specified minimum.
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- .2 Repair or remove and replace defective work as directed by the Departmental Representative. Submit proposed remediation plan to Departmental Representative for preliminary review prior to auctioning.
  - .3 Any repair must be accompanied by a certification by a Professional Engineer Registered in the Province of Work that the repair will be equal to or better than the original specified product in all aspects including but not limited to loading, exposure resistance, life expectance and durability. Only complete submissions covering all aspects listed above will be considered.
  - .4 Take corrective measures as directed by the Departmental Representative to prevent occurrence of further defective concrete.

END OF SECTION