

**Part 1            General**

**1.1            RELATED WORK**

- |    |  |                  |
|----|--|------------------|
| .1 | Excavating, trenching and backfilling: | Section 31 23 10 |
| .2 | Concrete reinforcing:                  | Section 03 20 00 |
| .3 | Cast-in-place concrete:                | Section 03 30 00 |

**1.2            REFERENCE STANDARDS**

- .1 Do concrete formwork to CSA A23.1, except where specified otherwise.
- .2 Do concrete falsework to CSA S269.1, except where specified otherwise.

**1.3            SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with Division 1.
- .2 Clearly indicate method and schedule of construction, materials, arrangement of joints, ties, shores, liners and locations of temporary embedded parts. Shop drawings shall clearly indicate shoring left in place under deck as construction proceeds. Comply with Clause 3 of CSA S269.1 for falsework drawings.
- .3 Each shop drawing submitted shall bear the stamp of a qualified professional Engineer registered in the Province of New Brunswick.
- .4 All shop drawings and material lists are to contain a blank area measuring 70 mm high by 100 mm long located near the bottom right hand corner of the drawing or page. This area is to be reserved for the Departmental Representative review stamp.

**1.4            QUALITY ASSURANCE**

- .1 The Contractor shall be responsible for the structural design of formwork and falsework and its construction, including shoring and bracing, to ensure its stability, and to support safely and resist loads imposed by weight of forms and wet concrete, wind, fluid pressure of concrete, equipment and workers.
- .2 Design of formwork to be performed by a structural Engineer licensed to practice lawfully in New Brunswick and who is experienced in design of formwork.
- .3 The Contractor shall be responsible for the safety of the structure, both before and after removal of the forms, until the concrete has reached the specified 28 day strength.
- .4 The Formwork Contractor shall have a minimum of 3 years documented experience in similar work to that required for this project. The Formwork Contractor shall submit

documentation describing previously completed projects similar in scope, including project location.

## **1.5 REQUIREMENTS OF REGULATORY AGENCIES**

- .1 Construction shall conform to requirements of jurisdictional authorities; and New Brunswick Occupational Health and Safety Act and Regulations.

## **1.6 PRODUCT DELIVERY, STORAGE AND HANDLING**

- .1 Handle and store formwork to prevent damage affecting function or appearance of concrete surfaces exposed to view.

## **1.7 MEASUREMENT PROCEDURES**

- .1 No measurement will be made under this Section. Include costs in items of work for which concrete formwork and accessories is required.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Formwork lumber:
  - .1 Plywood and wood formwork materials to CSA A23.1.
  - .2 Use only new materials.
  - .3 Plywood form panels. Douglas fir, minimum thickness 19 mm, to meet specified requirements of CSA O121, finished one side, fabricated specially for use as concrete form panels, with sealed edges.
  - .4 Exposed concrete. For concrete surfaces exposed to view, use panels that are smooth and free of defects which would be reproduced as concrete blemishes.
- .2 Falsework materials: to CSA S269.1, Table 1. Materials shall bear grade marks, to be accompanied with certificates, test reports or other proof of conformity.
- .3 Form release agent: chemically active release agents containing compounds that react with free lime present in concrete to provide water insoluble soaps, preventing set of film of concrete in contact with form.
- .4 Form ties: removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes no larger than 25 mm dia.
- .5 Chamfers: Wood, 45° cut from 25 mm x 25 mm nominal material, or plastic type, unless specified differently on Contract Drawings.
- .6 Joint Tape: Non-staining, water impermeable, self-release.

.7 Approach Slab Dowels:

.1 Dowels at Bulkheads:

- .1 Diamond shaped load plate: 19 mm x 110 mm x 110 mm saw cut from cold rolled steel plate for acceptable tolerances meeting ASTM 108-03, grade 1018.
- .2 Pocket former: High density plastic with internal collapsible fins and spacer that hold diamond shaped load plate in correct position and creates a void to its vertical faces.
- .3 Acceptable product: PNA Diamond Dowel® System.

.2 Dowels at Sawn Control Joints:

.1 Material:

- .1 Alternating tapered plate dowels: Plasma cut from hot rolled steel bar certified to meet ASTM A36 standards to within 5 mm of specified dowel length with a 100 mm taper from the widest end to the narrow end.
- .2 Tapered plates to be 12 x 60 min x 300 mm spaced at 700 mm c/c.
- .3 Side frame supports: Fabricated from 6.4 mm diameter cold drawn wire certified to meet ASTM A108, Grade 1010-1020 standards.
- .4 De-bonding agent: Tectyl® 506.

.2 Fabrication:

- .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 900" 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 mm of ½ slab depth.

.3 Acceptable product: PNA PD<sup>3</sup> Basket® assembly.

.3 All steel components to be hot dip galvanized to CSA G164 (610 g/m<sup>2</sup>) after fabrications.

.8 Premoulded joint fillers:

- .1 Bituminous impregnated fiberboard: to ASTM D1751.
- .2 Backer Rod: Polyethylene or urethane, extruded closed cell foam 16 mm and 8 mm diameter, as necessary.

- .3 Joint Sealant: polyurethane base, multi-component, self-leveling, elastomeric polyurethane sealant that is mixed and poured in place, ASTM C920 Type M, Grade P, class 25, Use T, M, Canadian Specifications CAN/CGSB 19.24-M90, Classification MCG-1-40-B-L, No. 81031.

- .1 Acceptable Product: Sonolastic® SL 2 by BASF Building Systems.

.9 All Thread Rebar:

- .1 Hot rolled threaded bar, 517 MPa minimum yield as manufactured by Williams Form Engineering Corp or approved equal complete with connectors and nuts by same manufacturer.
  - .2 Anti-corrosive Paste: Denso past as supplied by Williams Form Engineering Corp or approved equal.
  - .3 Exposed steel plate washers, jam nuts and paste caps to be hot dip galvanized to CSA G164.

**Part 3 Execution**

**3.1 ERECTION**

- .1 Verify lines, levels and column centers before proceeding with formwork and ensure dimensions agree with drawings.
- .2 Construct and remove formwork to produce finished concrete conforming to shape, dimensions, locations and levels shown on the drawings within the tolerances required by CSA A23.1.
- .3 On completion of forms for each contemplated pour, notify Departmental Representative that he may review them in advance of placing of concrete. Do not place concrete in forms until review has been completed.
- .4 Construct falsework to CSA S269.1.
- .5 Camber slabs and beams 6 mm per 3000 mm of span unless shown otherwise. Maintain beam depth and slab thickness from cambered surface.
- .6 Construct concrete formwork and provide sufficient ties and bracing to safely resist concrete pressures and other construction loadings without excessive bulging, distortion or displacement.
- .7 Construction of formwork shall permit easy dismantling and stripping in order to avoid damage to concrete during formwork removal.
- .8 Obtain Departmental Representative's permission before framing openings in concrete unless shown on drawings.

- .9 Align form joints and make watertight. Keep form joints to minimum.
- .10 Locate vertical wall control joints mid-distance between columns unless noted otherwise on the drawings. Maximum distance between joints to be 10 m. Use 25 mm V-joint on exposed faces unless noted otherwise.
- .11 Use 19 mm chamfer strips on external corners of beams, columns, piers, slabs, curbs, and walls unless noted otherwise. Coordinate with Departmental Representative where chamfers are not shown on drawings..
- .12 Construction joints:
  - .1 In general incorporate either horizontal or vertical construction joints in accordance with CSA A23.1.
  - .2 Provide construction joints in concrete where work is left off at days end. Run reinforcement continuous through joint.
  - .3 Provide proper key, reinforcement and V-joint on exposed faces. In beams, provide inclined shear bars as required.
  - .4 Immediately before next pour, clean construction joint and brush with grout of neat cement.
- .13 Form chases, slots, openings, drips, recesses, expansion and control joints as detailed.
- .14 Coat formwork with form release agent before reinforcement, anchors or other accessories are placed. Do not coat plywood forms precoated with a chemical release agent.
- .15 Set all required bolts, anchor rods, inserts, angles, plates, decking and other embedded items. Anchor securely to formwork before placing concrete.
- .16 Leave formwork in place for following minimum periods of time after placing concrete:
  - .1 Three days for walls and sides of beams and pile caps.
  - .2 Twenty eight days for slabs or 7 days if all shoring removed to allow stripping of forms has been reinstalled and left in place for the remaining 21 days of the 28 day period. The 7 day time period may be waved provided that tests not harmful to the concrete cast in the formwork show that the concrete has reached 80% of its specified strength. The tests shall be done by an independent testing laboratory approved by the Departmental Representative and the cost of these tests shall be paid by the Contractor.
- .17 Take care in removing plywood forms. Use wood wedges and gradual force to pry the formwork loose from the concrete. Do not beat, jar or shake the formwork or pry with metal bars. Leave plywood forms in place as long as possible and until other adjacent formwork is stripped to permit maximum shrinkage away from concrete and to protect concrete surfaces. Take particular care to prevent damage to external corners and top edges of walls.

- .18 Re-use of formwork subject to requirements of CSA A23.1.

**END OF SECTION**

**Part 1        General**

**1.1        RELATED WORK**

- .1       Concrete forming and accessories:       Section 03 10 00
- .2       Cast-in-place concrete:       Section 03 30 00

**1.2        REFERENCE STANDARDS**

- .1       Do reinforcing work in accordance with CSA A23.1 and welding of reinforcing with CSA W186 except where indicated otherwise.

**1.3        TEST REPORTS**

- .1       Provide Departmental Representative with certified copy of mill test report of steel supplied, showing physical and chemical analysis a minimum of 4 weeks prior to commencing fabrication of reinforcing.

**1.4        SHOP DRAWINGS**

- .1       Submit shop drawings in accordance with Division 1.
- .2       Clearly indicate bar sizes, spacings, location and quantities of reinforcement, mesh, chairs, spacers and hangers with identifying code marks to permit correct placement without reference to structural drawings; to CSA A23.3, to Reinforcing Steel Manual of Standard Practice – 2004 by Reinforcing Steel Institute of Canada.
- .3       Detail placement of reinforcing where special conditions occur.
- .4       Use minimum lap lengths indicated on drawings.
- .5       Each drawing shall bear the stamp and signature of a qualified professional Departmental Representative registered in New Brunswick.
- .6       All shop drawings and material lists are to contain a blank area measuring 70 mm high by 100 mm long located near the bottom right hand corner of the drawing or page. This area is to be reserved for the Departmental Representative's review stamp.

**1.5        SUBSTITUTES**

- .1       Substitution of different size bars permitted only upon written approval of Departmental Representative.

**1.6        MEASUREMENT PROCEDURES**

- .1       No measurement to be made under this Section. Include costs in items of work for which concrete reinforcing is required.

**Part 2 Products**

**2.1 MATERIALS**

- .1 Reinforcing bars: billet steel, grade 400 deformed bars to CAN/CSA-G30.18 unless indicated otherwise.
- .2 Welded steel wire fabric: to ASTM A185. Provide in flat sheets only.
- .3 Chairs, bolsters, bar supports, spacers: adequate for strength and support of reinforcing and construction conditions.
- .4 Tie Wires: Cold-drawn annealed steel wire ties: to ASTM A82.
- .5 Architectural concrete surfaces: special chairs, bolsters, bar supports and spacers to be plastic coated, stainless steel or as indicated. Note that all exposed concrete requires an architectural surface.
- .6 Mechanical splices to be proportioned to develop full capacity of reinforcing bar and is subject to approval of the Departmental Representative.

**2.2 FABRICATION**

- .1 Fabricate reinforcing to CSA A23.1.
- .2 Fabrication tolerances for reinforcing steel to Reinforcing Steel Manual of Standard Practice-2004, by Reinforcing Steel Institute of Canada.
- .3 Obtain Departmental Representative's approval for locations of reinforcement splices other than shown on drawings.
- .4 Fabricate reinforcing steel within following tolerances:
  - .1 Sheared length: plus or minus 25 mm.
  - .2 Depth of truss bar: plus 0, minus 12 mm.
  - .3 Stirrups, ties and spirals: plus or minus 12 mm.
  - .4 Other bends: plus or minus 25 mm.
- .5 Ship bundles of bar reinforcement, clearly identified in accordance with bar list.

**Part 3 Execution**

**3.1 FIELD BENDING**

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



- .2 When field bending is authorized, bend without heat, applying a slow and steady pressure.
- .3 Replace bars which develop cracks or splits.

### **3.2 PLACING REINFORCEMENT**

- .1 Place reinforcing steel to CSA A23.1 and as indicated on reviewed shop drawings.
- .2 Place, support, and space reinforcing in alignment to position indicated and as follows:
  - .1 Exposed concrete: consider as architectural concrete and use non-staining supports and spacers.
  - .2 Walls and beams: provide spacers each face at 1200 mm maximum centres in each direction. Provide 10M spreader bars between mats and in line with concrete spacers.
  - .3 Pilasters and piers: laterally support along height. Place and support in pairs on opposite faces.
  - .4 Slabs: support all reinforcement in all layers on chairs or concrete spacer blocks at 1200 mm maximum centres or closer as required to accurately maintain position and concrete cover over reinforcement.
- .3 Do not cut reinforcement, either before or after concrete is placed, to permit incorporation of other work.
- .4 Do not relocate bars without approval from Departmental Representative.
- .5 Remove and replace reinforcement which is visibly damaged or cracked.
- .6 Clean reinforcing before placing concrete.
- .7 Obtain Departmental Representative's approval of reinforcing steel and placing before placing concrete.
- .8 Obtain Departmental Representative's approval before welding reinforcing bars. Weld to CSA W186.
- .9 Place footing reinforcing steel only after bearing surface has been inspected and approved.
- .10 Reinforce slabs as detailed on the drawings.
- .11 Adjust reinforcement immediately before concrete is placed to ensure that bars are in correct position and are securely tied to maintain position.
- .12 Ensure that reinforcing steel foreman is present at all times concrete is being placed to ensure that reinforcing remains in place as tied, and to take necessary remedial action.

**3.3 ON-SITE STORAGE AND HANDLING**

- .1 Reinforcing steel shall be handled and stored in such a manner to keep it free of dirt, mud and water.
- .2 Reinforcing steel shall be off loaded from the truck directly onto purpose made storage racks and covered with tarps.
- .3 Any reinforcing steel which is dirty, muddy and/or rusty shall be cleaned with wire brushes and/or shot blasted to the satisfaction of the Departmental Representative.

**END OF SECTION**

**Part 1 General**

**1.1 DESCRIPTION**

- .1 This section specifies requirements for supplying, placing, finishing, protecting and curing concrete for the following items:

- .1 Pipe pile and rock socket concrete fill.
- .2 Concrete wharf pile caps and beams.
- .3 Concrete wharf deck including curb and piers for electrical.
- .4 Concrete approach slab, including power centre and protection bollards.
- .5 Concrete encased duct.
- .6 All other concrete.

**1.2 Related Work Specified Elsewhere**

- |    |                                       |                  |
|----|---------------------------------------|------------------|
| .1 | Concrete Formwork and Accessories:    | Section 03 10 00 |
| .2 | Concrete Reinforcement:               | Section 03 20 00 |
| .3 | Metal Fabrications:                   | Section 05 50 00 |
| .4 | Pile Foundation General Requirements: | Section 31 61 13 |
| .5 | Steel Pipe Piles:                     | Section 31 62 17 |
| .6 | Concrete Encased Ducts:               | Section 33 65 73 |

**1.3 REFERENCE STANDARDS**

- .1 Do structural concrete work in accordance with CSA-A23.1-04 except where specified otherwise.

**1.4 MEASUREMENT FOR PAYMENT**

- .1 Cast-in-Place Concrete: With the exception of Item 1.4.2, 1.4.6 and 1.4.8, all structural concrete, as specified, will be measured by the cubic metre (m<sup>3</sup>) in place from the neat dimensions as formwork, cement, aggregates, admixtures, embedded parts, steel angle inserts, curing and reinforcing as specified herein for all cast-in-place concrete.
- .2 Concrete anchor blocks as specified will be measured by the number of units. Unit price to include all formwork, concrete, reinforcing steel, embedments, tie rods, placement and all excavation and backfill.
- .3 No deductions to be made for volume of concrete displaced by reinforcing steel, anchors, dowels or embedded parts, nor for any openings less than 0.10 m<sup>3</sup>.
- .4 Heating of concrete and its components, and providing cold weather protection, will not be measured for payment, but shall be considered part of the work.

- .5 Cooling of concrete and providing hot weather protection will not be measured but considered part of the work.
- .6 Concrete in steel pipe piles to be paid for under Section 31 62 17.
- .7 Installation of inserts, anchor bolts and edge protection angle supported under other sections will not be measured for payment.
- .8 Concrete in concrete encased ducts to be paid for under Division 26.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Aggregates: to CSA A23.1.
  - .1 Fine Aggregate: table 10, FA1.
  - .2 Coarse Aggregate: table 11, Group 1, nominal size 20-5.
  - .3 Alkali-aggregate Reactivity: to meet requirements of clause 4.2.3.6.
- .2 Cement and supplementary cementing materials.
  - .1 Cement: General Use (GU) Portland Cement (formerly Type 10) meeting the requirements of CSA A3001.
  - .2 Fly ash meeting the requirements of CSA A3001 may be used in concrete, however, the Departmental Representative reserves the right to limit its proportion to 20% of the cementing materials content in the mix.
- .3 Machine bolts, hold fasts, ladder rungs, anchor bolts, nuts, washers: to ASTM F1554 Grade 36.
- .4 Admixtures:
  - .1 Air entraining admixtures: to ASTM C260-01.
  - .2 Chemical admixtures: to ASTM C494/C494M-04.
  - .3 Pozzolanic mineral admixtures: CSA A23.1.
  - .4 A written statement from the manufacturer stating that the admixture contains no purposefully added calcium chloride shall be provided to the Departmental Representative.
- .5 Curing Materials:
  - .1 Burlap or non-woven geotextile shall be used for curing horizontal surfaces.
  - .2 For vertical surfaces, curing shall be carried out by placing plastic over the burlap and securing the burlap and plastic in place against the vertical surface.
  - .3 Curing materials shall, at any time of use, be in good condition free from holes, dirt, clay or other substance which would have a deleterious effect upon concrete.

- .4 Burlap shall be of a quality which will absorb water readily when dipped or sprayed and shall have a mass of not less than  $237 \text{ g/m}^2$  when clean and dry.
- .6 Grout:
  - .1 Ready to use, non-shrink, high-strength grout containing natural aggregates with a 28 day compressive strength of 60 MPa and be of pourable consistency.
  - .2 Standard of Quality: Masterflow 928 by BASF.

## **2.2 CONCRETE MIXES**

- .1 Concrete for encasement of conduits, Class C-1 in Table 2, CSA A23.1.
- .2 Concrete for tremie concrete in pipe piles, Class C-1 in Table 2, CSA A23.1 with additional restrictions of a minimum cementing material content of  $430 \text{ kg/m}^3$  and ASTM C494 Type D water reducer as required to develop a slump at placement of  $180 \text{ mm} \pm 25 \text{ mm}$ .
- .3 All other concrete shall follow a mix design as follows:
  - .1 Cement: General Use Portland Cement (formerly Type 10).
  - .2 Minimum compressive strength at 28 days: 35 MPa.
  - .3 Class of exposure: C-1 exposure from Table 2, CSA A23.1.
  - .4 Maximum water cement ratio by mass: 0.40.
  - .5 Minimum cement content:  $420 \text{ kg/m}^3$ .
  - .6 Curing Type: 3 from Table 19, CSA A23.1.
  - .7 Comply with additional requirements of CSA A23.1, Clause 4.1.1.5, for concrete exposed to seawater environments (S-3).
- .4 Weigh aggregates, cement, water and admixture separately when batching. No alternative methods of measuring will be permitted.
- .5 Do not use calcium chloride or compounds containing calcium chloride.

## **Part 3 Execution**

### **3.1 GENERAL**

- .1 Obtain Departmental Representative's approval before placing concrete. Provide 24 hours notice prior to placing of concrete.
- .2 Place concrete in accordance with CSA A23.1. All concrete to be vibrated using high frequency vibrators.
- .3 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .4 Preparation prior to placing of concrete shall include:
  - .1 Formwork completed.
  - .2 Ice and excess water removed.

- .3 Reinforcement secured in place.
- .4 All anchors and other embedded items accurately located and held in position.
- .5 Maintain accurate records of all concrete placed to indicate date, location of pour, quantity placed, concrete temperature and test samples taken.
- .6 Contractor shall submit a plan for curing to the Departmental Representative, for review and approval together with other construction documents. The curing plan shall be prepared in strict accordance with Clause 8.7.5.2 of CSA A23.1, as applicable, including:
  - .1 Method of protecting the concrete from evaporation of surface moisture from the fresh concrete.
  - .2 Type of curing material to be used.
  - .3 How the surface will be kept moist and the quality control requirements for keeping the surface moist.
  - .4 Time of initiation and duration of curing.
  - .5 Provisions to address potential problems such as high winds, and hot and cold weather.
  - .6 Limitations of access, if any, to the surfaces being cured.
- .7 All concrete shall be placed in a space free of standing water, unless otherwise specified in the Contract Documents.
  - .1 New concrete shall be defined as concrete that has not attained its minimum specified compressive strength.
  - .2 All loads to be applied on new concrete shall be subject to the approval of the Departmental Representative.
- .8 Bonding of new concrete to hardened concrete shall be carried out as follows:
  - .1 Before depositing new concrete on or against concrete that has set, the forms shall be re-tightened and the surface of the hardened concrete shall have all foreign matter and laitance removed.
  - .2 Hardened concrete surfaces shall be thoroughly saturated with water, without ponding, in advance of placing concrete.
  - .3 Methods of obtaining an adequate bond between the hardened and fresh concrete shall be subject of the approval of the Departmental Representative.
- .9 Concrete temperatures from the time of batching until final placing shall be maintained between 10°C and 25°C, unless otherwise authorized in writing.
- .10 Concrete shall be placed while still plastic and workable.
  - .1 Concrete at the advancing face of the concrete placement must be plastic and cold joints within a concrete placing operation shall not be permitted.
  - .2 Retempering any partially hardened concrete with additional water will not be permitted.

### **3.2 TREMIE CONCRETE IN PIPE PILES**

- .1 All concrete fill in pipe piles is to be considered tremie concrete irregardless of whether the piles are driven open or close ended.

- .2 Extend concrete pump hose or tremie pipe to the bottom of the pile or rock socket, as applicable.
- .3 Place concrete in the pile beginning at the bottom of the rock socket or pile, as applicable.
- .4 Withdraw the hose or tremie pile as the concrete fills the pile, always bearing the end of the hose or pipe at least a metre below the top of the concrete.
- .5 When the pile is full, displace the top metre of the concrete out the top of the pile to remove all seawater contaminated concrete.
- .6 If the tremie plug is broken, remove the filling pipe or hose, allow the top of the concrete to harden, remove the laitance by water blast or other approved method and place the remainder of the concrete in the same method.

### **3.3 INSERTS**

- .1 All embedded items and anchor bolts shall be supplied under Section 05 50 00 or Division 26 to the site unless noted otherwise on the drawings. Placing of embedded steel and anchor bolts shall be done by the concrete contractor.
- .2 All anchor bolts and embedded items shall be carefully set to conform to the dimensions shown on the drawings and shall be rigidly held in place during placing of the concrete.
- .3 No sleeves, ducts, pipes or other openings shall pass through beams, pile caps or piers except where expressly detailed on the drawings or approved by the Departmental Representative.
- .4 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.
- .5 Check locations and sizes of sleeves, openings, etc., shown on drawings with Departmental Representative prior to placing concrete. Sleeves, openings, etc., greater than 100 mm square not indicated on structural drawings must be approved by the Departmental Representative.

### **3.4 PLACING CONCRETE**

- .1 Place and consolidate concrete to CSA A23.1, and the following:
  - .1 Do not place concrete against frozen material.
  - .2 Place concrete continuously from joint to joint. Unless otherwise specified, vibrate plastic concrete mechanically.
- .2 If authorized 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 such that a continuous stream of 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 such a manner that prevents contamination of concrete or separation of ingredients.

### **3.5 WHARF DECK AND APPROACH SLAB**

- .1 Provide a smooth riding surface of uniform texture, true to required grade and cross section.
- .2 Do not place concrete until Departmental Representative is satisfied that rate of placing is sufficient to complete proposed placing, finishing and curing operations within scheduled time; that experienced finishing machine operators and concrete finishers are provided to finish deck, that curing equipment and finishing tools and equipment are at site of work and in satisfactory condition for use.
- .3 Immediately prior to placing, check falsework and wedges and make necessary adjustments. Exercise care to ensure that settlement and deflection due to added weight of concrete will be minimum. Provide suitable means, such as telltales, to readily permit measurement of settlement and deflection as it occurs.
- .4 Should events occur which would prevent a deck conforming to specified requirements, discontinue placing of concrete until corrective measures satisfactory to Departmental Representative are provided. In event satisfactory measures are not provided prior to initial set of concrete in affected area, discontinue placing concrete and install a bulkhead at a location approved by Departmental Representative. Remove concrete in place beyond bulkhead.
- .5 Place concrete in a uniform heading approximately normal to structure centreline, or in case of screed supported on transverse headers, parallel to centreline. Limit rate of placing to that which can be finished before beginning of initial set.
- .6 Immediately after concrete has been placed and consolidated, strike-off surface. Strike-off method and equipment are subject to approval by Departmental Representative. Approval to be withdrawn if performance is not satisfactory. Equipment to be capable of finishing decks within specified surface tolerances. Correct immediately any improper adjustment and operation which results in unsatisfactory consolidation and smoothness. Unsatisfactory performance may be cause for rejection of equipment and removal of concrete in place.

### **3.6 FINISHING**

- .1 Finish unformed surfaces true to grade and free of surface irregularities exceeding 3 mm under a 3 m straightedge placed in any direction.
- .2 Wharf Deck and Approach Slab: when concrete has hardened sufficiently, give surface a uniform stiff broom finish free from porous spots, irregularities, depressions, small pockets or rough spots. Broom finish to be in direction transverse to traffic flow.

### **3.7 CONSTRUCTION JOINTS**



- .1 Limitation in Use of construction Joints
  - .1 Construction joints will not be permitted except those shown in the Contract Documents or as approved in writing by the Departmental Representative, unless occasioned by the breakdown of the Equipment, or other unforeseen reasons, in which case the Contractor shall provide bulkheads parallel to the principal lines of stress.
  - .2 Vertical construction joints in deck slabs will not be allowed parallel to the centreline of the wharf.
- .2 Use of Keys:
  - .1 Suitable keys shall be formed at the top of the upper layer where Work is interrupted.
  - .2 Keys or construction joints shall be of the type and detail as shown in the Contract Documents, unless otherwise permitted by the Departmental Representative.

### **3.8 CONTROL JOINTS IN APPROACH SLAB**

- .1 Locate controls joints as shown on plan.
- .2 Use a bulkhead type joint complete with diamond shaped load plates at the end of each concrete placement operation.
- .3 Use sawn control joints at all other locations.
- .4 Bulkhead Type Control Joints
  - .1 See Section 03 10 00 for load plates, pockets etc.
  - .2 Install pocket formers at 500 mm max c/c in bulkhead with a minimum clearance of 100 mm from top and bottom of slab.
  - .3 Place Concrete.
  - .4 Remove bulkhead and install diamond shaped load plates.
  - .5 Install joint filler to manufacturer's instructions.
  - .6 Unless otherwise indicated, use 12 mm thick joint filler to separate slabs as shown.
  - .7 Install 16 mm foam filler to separate joint filler and sealer.
- .5 Sawn Control Joints:
  - .1 See Section 03 10 00 for baskets, tapered dowels, etc.
  - .2 Do not cut shipping wires.

- .3 Measure and mark (notch or nail) saw-cut joint location on forms.
- .4 Pull string lines. Spray paint saw-cut locations on subgrade.
- .5 Lay-out one row of baskets over painted marks on subgrade. Dowel spacing = 500 mm c/c.
- .6 Place concrete. Maintain alignment of baskets over paint marks (staking the 200 mm plate dowel basket is recommended to ensure it remains within the allowable 100 mm saw-cut installation tolerance).
- .7 Screed and finish concrete, using internal vibration as recommended in industry guidelines.
- .8 Use markings or nails on forms to snap chalk-lines and saw-cut joints as normal, to specified depth.
- .9 Saw cut control joints within 12 hours after finishing. Use 5 mm thick blade, cutting to depth as shown.
- .10 Install 8 mm foam filler 8 mm below finished slab surface and fill saw cut with joint sealer to manufacturer's instructions.

### **3.9 CURING AND PROTECTION**

- .1 The Contractor shall submit to the Departmental Representative for approval, 14 Days prior to any concrete placement, the proposed method and sequence to be employed in the Work for the curing and protection of the concrete.
- .2 Concrete shall be protected against plastic or dry shrinkage cracking by strict adherence to ACI 302 and ACI 308.
- .3 All exposed concrete surfaces, mortar and grout shall be continuously moist cured.
  - .1 The curing period for concrete shall be for a minimum of 7 Days from the completion of concrete placement.
  - .2 The curing period for mortar or grout shall be 3 Days from the completion of mortar or grout placement or as recommended by the manufacturer.
  - .3 A burlap or non-woven geotextile fabric shall be applied immediately after finishing of the concrete surface.
  - .4 A fog mist system shall be applied continuously the deck and approach slab from the time of screeding until concrete is covered with burlap or non-woven geotextile fabric, in such a way as to maintain high relative humidity above the concrete and prevent drying of the concrete surface.
    - .1 Water shall not be allowed to drip, flow or puddle on the concrete surface during fog misting, when placing the burlap or non-woven fabric or at any time before the concrete has achieved final set.

- .4 Equipment and materials necessary for curing and protection of concrete shall be available and ready for use before actual placing is started.
- .5 Freshly finished concrete shall be protected from the elements and from defacement due to construction operations.
  - .1 The Contractor shall repair or replace, subject to the approval of the Departmental Representative, any concrete damaged by the elements or defacement.
- .6 It shall be the responsibility of the Contractor to ensure that the system of curing and protection is properly constructed and maintained for the period of time required.
- .7 Material or Equipment, other than that required for actual curing operations, shall not be placed on the concrete deck or approach slab being cured, without the approval of the Departmental Representative.
- .8 Formwork shall not be removed before 7 Days without the approval of the Departmental Representative.
  - .1 When formwork is removed prior to the completion of curing, the newly exposed concrete surfaces shall be kept moist until the curing period is completed.

### **3.10 COLD WEATHER REQUIREMENTS**

- .1 As a minimum, the requirements of Clause 7.1.2 of CSA A23.1 shall be followed for cold weather protection.
- .2 All materials and equipment needed for the protection and curing of the concrete in cold weather, as defined by CSA A23.1 shall be available on site before the concrete placement begins.
- .3 Cold weather protection and curing shall be applied in order to maintain the concrete temperature at or above 10°C for the time of the curing periods specified in Table 19 of CSA A23.1. Measures shall be taken to prevent subsequent frost penetration to the subgrade.

### **3.11 HOT WEATHER REQUIREMENTS**

- .1 Hot weather curing and protection shall conform to the requirements of Clause 7.1.1 of CSA A23.1..

### **3.12 FINISHING HARDENED CONCRETE**

- .1 General
  - .1 The following concrete surfaces shall receive a "High Quality Surface Finish":
    - .1 Outside edges of the deck.

- .2 Cap beams.
    - .3 Wheel guards, and piers for electrical services.
  - .2 All other concrete surfaces shall receive an "Ordinary Surface Finish" unless otherwise directed by the Departmental Representative.
- .2 Defects
  - .1 Immediately after the removal of forms any part of the Work which displays defects shall be clearly marked and the Contractor shall notify the Departmental Representative of the location and extent of the defect for his review.
    - .1 The Contractor shall submit a repair procedure for approval.
      - .1 Cement washes of any kind shall not be used.
      - .2 All defects shall be finished smooth, uniformly colour matched and flush with the adjacent surface.
- .3 Ordinary Surface Finish
  - .1 All surface voids larger than 12 mm in diameter and cavities or holes visible upon the removal of the formwork, shall be filled to their entire depth, with an approved cement grout mix of cement and fine sand from the same source as used in the concrete and incorporate a latex bonding agent.
  - .2 All objectionable fins, projections, offsets, streaks or other surface imperfections shall be totally removed to the Departmental Representative's satisfaction.
  - .3 If the concrete surface does not adequately fulfil the requirements for Ordinary Surface Finish, the Contractor shall, as directed by the Departmental Representative, entirely remove certain designated portions, or all of the concrete, and replace with new concrete.
- .4 High Quality Surface Finish
  - .1 Prior to finishing, and without defacing the surface, the Contractor shall pressure wash the surface to identify all air voids.
  - .2 The surface shall first be given an Ordinary Surface Finish as specified in 3.12.3.
  - .3 Small surface voids due to entrapped air shall be cleaned to remove surface laitance and filled, to their entire depth, with an approved cement grout mix of cement and fine sand from the same source as used in the concrete incorporating a latex bonding agent.
  - .4 The entire surface shall be finished to produce a smooth dense surface of uniform colour without pits or irregularities.

### 3.13 GROUTING OF BEARING PLATES

- .1 Grout underside of bearing plates with a minimum of 40 mm on non-shrinking grout to manufacturer's instructions to ensure a smooth level surface at the elevation indicated. Grout shall be poured. Dry pack of grout is not acceptable.
- .2 Provide 24 hours notice prior to grouting base plates.

### **3.14 INSPECTION AND TESTING**

- .1 Inspection, sampling, testing and reporting of concrete and concrete materials will be carried out by a testing agency selected by the Departmental Representative as specified in Division 1. All test methods shall be in accordance with CSA A23.2.
- .2 Testing laboratory will cast three test specimens for each 75 m<sup>3</sup> of concrete placed, for every placement, or when required by the Departmental Representative. Cylindrical specimens shall be tested in compression at 7 and 28 days (2 specimens) unless directed otherwise by the Departmental Representative.
- .3 Testing laboratory will make at least one slump test and one air content test for each set of test specimens cast.
- .4 Alkali-aggregate reaction tests are to be performed by the concrete supplier, or certification reports supplied verifying the quality of the aggregates to be used.
- .5 Copies of all test reports to be submitted to the Departmental Representative, General Contractor and Ready Mixed Concrete Producer.
- .6 Cost of all testing to be borne by the Departmental Representative as specified in Division 1.
- .7 CSA A23.1 shall form the basis for acceptance, strengthening or replacement of concrete not meeting specified quality.
- .8 The Contractor shall cooperate with and assist the testing company by providing access to all parts of the work as required.
- .9 Inspection or testing by Departmental Representative will not augment or replace Contractor's quality control or relieve him of his contractual responsibility.
- .10 If tests do not meet specified requirements, take such measures as indicated in CSA A23.1. If concrete coring is required and results in unacceptable concrete strength, the Contractor will be responsible for the cost of the tests.

**END OF SECTION**