

PART 1      GENERAL

1.1      WORK INCLUDED

- .1      This section specifies the requirements for supplying, transporting and installing concrete formwork and falsework.

1.2      RELATED SECTIONS

- .1      Concrete Reinforcement: Section 03 20 00
- .2      Cast-In-Place Concrete: Section 03 30 00
- .3      Excavating, Trenching and Backfilling: Section 31 23 10

1.3      REFERENCES

- .1      CAN/CSA-S269.3-M92(R2013), Concrete Formwork.
- .2      CSA-A23.1/A23.2-14, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
- .3      CSA 086-14, Consolidation, Engineering Design in Wood.
- .4      CSA 0121-17, Douglas Fir Plywood.
- .5      CSA 0151-17, Canadian Softwood Plywood.
- .6      CSA 0153-13, Poplar Plywood.
- .7      CSA S269.1-16, Falsework and Formwork.

1.4      WASTE MANAGEMENT AND DISPOSAL

- .1      Collect, separate and recycle all site generated waste materials in accordance with Section 01 00 00.
- .2      Place materials defined as hazardous or toxic waste in designated containers.
- .3      Seal and store emptied containers safely for disposal.
- .4      Use sealers, form release and stripping agents that are non-toxic, biodegradable and have zero or low VOC's.

PART 2      PRODUCTS

2.1      MATERIALS

- .1      Formwork lumber:
  - .1      Plywood and wood formwork materials to CSA 0121, CSA 086, and CSA 0153.

- .2 Use formwork materials in accordance to CAN/CSA A23.1.
- .2 Falsework materials: to CSA S269.1.
- .3 Form ties: use removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25mm diameter in concrete surface.
- .4 Form release agent: chemically active release agents containing compounds that react with free lime present in concrete to provide water insoluble soaps, preventing concrete from sticking to forms; having no adverse effect on paint, adhesives, waterproofing, or other treatments which are specified for application to concrete and containing no non-drying ingredients such as mineral oil. Use biodegradable form release agent with low VOC content.

PART 3      EXECUTION

3.1      ERECTION

- .1 Verify lines, levels and column centres before proceeding with formwork/falsework and ensure dimensions agree with drawings.
- .2 Obtain the Departmental Representative's approval for use of earth forms.
- .3 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.
- .4 Fabricate and erect falsework in accordance with CSA S269.1.
- .5 Do not place shores and mud sills on frozen ground.
- .6 Provide site drainage to prevent washout of soil supporting mud sills and shores.
- .7 Fabricate and erect formwork in accordance with CSA-S269.3 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CAN/CSA-A23.1.
- .8 Do not locate any services under foundations or their associate zone of influence without written approval from the Departmental Representative.
- .9 Review all of the foundations and building services and submit to the Departmental Representative the proposed footing locations and elevations to allow all of the services to be sleeved through the foundation wall and/or provide the required frost cover.
- .10 Construction Joints:
  - .1 In general incorporate either horizontal or vertical construction joints in accordance with CAN/CSA-A23.1 and to the Departmental Representative's approval. Submit proposed joint locations for review

prior to start of formwork erection.

.2 Provide construction joints in concrete where work is left off at day's end. Run reinforcement continuously through joints and shear key unless indicated otherwise.

.3 Immediately before next pour, clean construction joint and brush with grout of neat cement.

- .11 Coat formwork with form release agent before reinforcement, anchors or other accessories are placed, unless soaking with water during hot weather is acceptable. Do not coat plywood forms pre-coated with a chemical release agent.
- .12 Prior to the concrete pour, review and correct as necessary formwork tolerances and alignment.
- .13 Align form joints and make watertight. Keep form joints to minimum.
- .14 Use 25mm chamfer strips or as indicated on external corners.
- .15 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.
- .16 Build in anchors, sleeves, and other inserts required to accommodate work specified in other sections. Confirm all anchors and inserts do not protrude beyond surfaces designated to receive applied finishes, including painting.
- .17 Clean formwork in accordance with CAN/CSA-A23.1, before placing concrete.

### 3.2 REMOVAL AND RESHORING

- .1 Leave formwork in place until the concrete element has achieved at least 70% of the specified 28-day compressive strength for that element and a minimum of three (3) days. Additional cylinders to be cast for the purpose of early testing to verify 70% of compressive strength has been achieved.
- .2 Safely maintain structure, both before and after removal of the forms, until concrete has reached its specified 28 day strength.
- .3 Provide all necessary reshoring of members where early removals of forms may be required or where members may be subjected to additional loads during construction as required.
- .4 Space reshoring in each principal direction at not more than 3m apart.
- .5 Check all concrete formwork for alignment and levels prior to the placing of concrete in these forms. Again check the formwork for alignment and levels during and immediately after each concrete pour.
- .6 Provide and maintain during the total duration on site, properly



PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This section specifies the requirements for supplying, fabricating, shipping and placing the reinforcing as detailed on the drawings and as noted in these specifications.

1.2 RELATED SECTIONS

- .1 Concrete Forms and Accessories: Section 03 10 00
- .2 Cast-in-Place Concrete: Section 03 30 00
- .3 Excavating, Trenching and Backfilling: Section 31 23 10

1.3 REFERENCES

- .1 AASHTO M32-09(R2013), Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
- .2 ACI SP-66, ACI Detailing Manual, 2004.
- .3 ASTM A1064/A1064-17, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed for Concrete.
- .4 CSA A23.1/A23.2-14, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
- .5 CSA A23.3-14, Design of Concrete Structures.
- .6 CSA G30.18-09(R2014), Carbon Steel Bars for Concrete Reinforcement.
- .7 CSA G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .8 CSA W186-M1990(R2016), Welding of Reinforcing Bars in Reinforced Concrete Construction.
- .9 Reinforcing Steel-Manual of Standard Practice, 4th Canadian Edition by the Reinforcing Steel Institute of Canada.

1.4 SOURCE QUALITY CONTROL

- .1 Upon request, provide the Departmental Representative with:
  - .1 Steel reinforcement - certified copy of mill test report of reinforcing steel, showing physical and chemical analysis, minimum four (4) weeks prior to commencing reinforcing work. Mill test reports to include certification that reinforcing steel recycled steel content rating meets or exceeds 90%. Certification to also include a breakdown of the pre-consumer, post-industrial

and post-consumer content percentages of recycled content.

- .2 Supply test reports at no additional cost to the Contract.
- .3 Upon request inform the Departmental Representative of proposed source of material to be supplied.

#### 1.5 SHOP DRAWINGS

- .1 Submit shop drawings, including reinforcement placing in accordance with Section 01 33 00.
- .2 Indicate on shop drawing bar bending details, lists, quantities of reinforcement, sizes, spacings, locations of reinforcement and mechanical splices (if approved by Departmental Representative) with identifying code marks to permit correct placement without reference to structural drawings. Indicate sizes, spacings and locations of chairs, spacers and hangers. Prepare reinforcement drawings in accordance with Reinforcing Steel Manual of Standard Practice - by Reinforcing Steel Institute of Canada.
- .3 Detail lap lengths and bar development lengths to CAN/CSA-A23.3, unless otherwise indicated. Provide Class B tension lap to CAN/CSA-A23.3 unless otherwise indicated.
- .4 Reinforcement shop drawings must indicate the location of all concrete pour joints. Obtain the Departmental Representative approval for location of joints prior to cutting and bending of reinforcement.

#### 1.6 SUBSTITUTES

- .1 Substitute different size bars only if permitted in writing by the Departmental Representative.

#### 1.7 HANDLING

- .1 Deliver, store and handle reinforcing in accordance with manufacturer's recommendation.

#### 1.8 WASTE MANAGEMENT AND DISPOSAL

- .1 Collect, separate and recycle all site generated waste materials in accordance with Section 01 00 00.

### PART 2 PRODUCTS

#### 2.1 MATERIALS

- .1 Reinforcing steel: billet steel, Grade 400W (weldable), deformed bars to CSA G30.18, unless indicated otherwise.

- .2 Cold-drawn annealed steel wire ties: to AASHTO M32.
- .3 Chairs, bolsters, bar supports, spacers: to CSA A23.1/A23.2.
- .4 Mechanical splices: subject to approval of the Departmental Representative.
- .5 Plain round bars: to CSA G40.21.
- .6 Welded wire fabric: to ASTM A1064

## 2.2 FABRICATION

- .1 Fabricate reinforcing steel in accordance with CSA A23.1/A23.2, ACI SP-66 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.
- .2 Obtain Departmental Representative's approval for locations of reinforcement splices other than those shown on placing drawings.
- .3 Upon approval of Departmental Representative, weld reinforcement in accordance with CSA W186.
- .4 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.

## PART 3 EXECUTION

### 3.1 PREPARATION

- .1 All steel reinforcing bars to have the necessary net sectional area and will be cut to the exact lengths, bent cold to the exact forms and dimensions, shown on the approved plans, or otherwise required, before being placed in position. Bending must be accurately done, in a bending machine and no welding or heating of any bars will be allowed, except with written approval from the Departmental Representative.

### 3.2 FIELD BENDING

- .1 Do not field bend or field weld reinforcement except where indicated or authorized by Departmental Representative.
- .2 When field bending is authorized, bend without heat, applying a slow and steady pressure (for steel reinforcement only).
- .3 Replace bars which develop cracks or splits.

### 3.3 PLACING REINFORCEMENT

- .1 Examine formwork to ensure that it has been completed and adequately braced in place before starting reinforcement

placing.

- .2 Place reinforcing steel as indicated on drawings and in accordance with CSA A23.1 and as follows:
  - .1 Clean all reinforcing of millscale, oil grease, or other deleterious material before and after erection.
  - .2 Secure reinforcing steel rigidly in position with annealed wire or use approved clips at intersections supported on reinforcing chairs.
  - .3 Do not allow the position of the bars to alter during concreting and maintain the correct cover at all times.
- .3 Prior to placing concrete, obtain the Departmental Representative's approval of reinforcing material and placement. Provide the Departmental Representative with a minimum of 48 hours' notice when reinforcing material will be installed and ready for inspection.
- .4 Maintain cover to reinforcement during concrete pour. Cover to be as noted on Drawings.
- .5 Use plain round bars as slip dowels in concrete. Paint portion of dowel intended to move within hardened concrete with one (1) coat of lead or asphalt paint. When paint is dry, apply a thick even film of mineral lubricating grease.
- .6 Place all reinforcing bars and hold rigidly in the exact positions in the forms as shown on the approved plans, or otherwise required, and there must be no displacement of the same by the placing and tamping of the concrete. Adjusting or moving the bars while the concrete is being placed will not be permitted unless specified on the plans. Protect concrete required for reinforcing steel in accordance with CSA A23.3. Tie all bars properly, brace to prevent displacement. Do not place concrete until the steel reinforcement, after being cleaned and placed in position, has been examined by the Departmental Representative.

#### 3.4 STORAGE OF REINFORCEMENT ON SITE

- .1 Store reinforcing steel on site on blocks so that it is not in direct contact with the ground. Cover reinforcing steel stored on site with tarpaulins to protect it from rain and snow.

**END OF SECTION**

PART 1      GENERAL

1.1      WORK INCLUDED

- .1 This section specifies the requirements for providing all labour, tools, materials and equipment to perform all cast-in-place concrete work.

1.2      RELATED SECTIONS

- .1 Concrete Forms and Accessories: Section 03 10 00
- .2 Concrete Reinforcing: Section 03 20 00
- .3 Air/Vapour Barrier: Section 07 28 00
- .4 Site Grading: Section 31 22 13
- .5 Excavating, Trenching and Backfilling: Section 31 23 10

1.3      REFERENCES

- .1 ACI 302.1R-15, Guide for Concrete Floor and Slab Construction.
- .2 ASTM C109/C109M-16a, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (using 2 in. or 50 mm Cube Specimens).
- .3 ASTM C260/C260M-10a(2016), Standard Specification for Air-Entraining Admixtures for Concrete.
- .4 ASTM C309-11, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
- .5 ASTM C494/C494M-16, Standard Specification for Chemical Admixtures for Concrete.
- .6 ASTM C827/C827M-16, Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures.
- .7 ASTM C939/C939M-16a, Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method).
- .8 ASTM D412-16, Standard Test Method for Vulcanized Rubber and Thermoplastic Elastomers - Tension.
- .9 ASTM D624-00(R2012), Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
- .10 ASTM D1653-13, Standard Test Methods for Water Vapour Transmission of Organic Coating Films.
- .11 ASTM D1709-16a, Standard Test Method for Impact Resistance of Plastic Film by the Free-Falling Dart Method.

- .12 ASTM D1751-04(R2013)e1, Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
- .13 ASTM D2240-15, Standard Test Method for Rubber Property-Durometer Hardness.
- .14 ASTM E1155-14, Standard Test Method for Determining FF Floor Flatness and Floor Levelness Numbers.
- .15 ASTM E1745-11, Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.
- .16 ASTM F1249-13, Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor.
- .17 CAN/CGSB 37.2-M88, Emulsified Asphalt, Mineral Colloid- Type, Unfilled, for Dampproofing and Waterproofing and for Roof Coatings.
- .18 CSA A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
- .19 CSA A23.3-14, Design of Concrete Structures.
- .20 CSA A3000-13, Consolidation - Cementitious Materials Compendium.

#### 1.4 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Minimum of four (4) weeks prior to commencing concrete work, submit shop drawings to Departmental Representative for review containing the following for each concrete mix:
  - .1 Cement type.
  - .2 Minimum compressive strength at 28 days.
  - .3 Class of exposure.
  - .4 Nominal size of coarse aggregate.
  - .5 Air content.
  - .6 Slump at time and point of discharge.
  - .7 Admixtures.
  - .8 Engineer's stamp.
- .3 Provide two (2) copies of WHMIS MSDS.
- .4 Concrete pours: submit accurate records of poured concrete items indicating date and location of pour, quality, air temperature and test samples taken as described in PART 3 - FIELD QUALITY CONTROL.
- .5 Submit proposed isolation board material and joint sealer/filler

products to the Departmental Representative for review.

1.5 CERTIFICATES

- .1 Minimum of four (4) weeks prior to starting concrete Work, submit to the Departmental Representative the 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 Supplementary cementing materials:
    - .1 For fly ash, provide details of supply, supplier's quality control program, test data for at least three (3) samples from the previous month's supply and details of proposed quality control tests to be made between shipment to concrete supplier and use in the concrete.
  - .3 Grout.
  - .4 Admixtures.
  - .5 Aggregates.
  - .6 Water.
- .2 Provide certification that plant, equipment and materials to be used in concrete comply with requirements of CSA A23.1.
- .3 Provide certification that mix proportions selected will produce concrete of specified quality, yield and strength which will comply with CSA A23.1 and that mix design is adjusted to prevent alkali aggregate reactivity problems.
- .4 Provide written confirmation from concrete supplier the percent replacement of mass of Portland cement for fly ash/supplementary cementing materials for all concrete mix designs.

1.6 QUALITY ASSURANCE

- .1 Minimum of four (4) weeks prior to starting concrete work, submit proposed quality control procedures for review by the Departmental Representative on following items:
  - .1 Falsework erection.
  - .2 Hot weather concrete.
  - .3 Cold weather concrete.
  - .4 Curing.
  - .5 Finishes.
  - .6 Formwork removal.
  - .7 Joints.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Concrete hauling time: deliver to site of Work and discharge within 120 minutes maximum after batching.
  - .1 Do not modify maximum time limit without receipt of prior written agreement from Consultant and concrete producer as described in CSA A23.1/A23.2.

.2 Submit deviations for review by Departmental Representative.

.2 Prepare to implement alternative concrete supply and placement contingency plans in the event of concrete material supply issues, batch plant malfunction and/or transport and placement equipment malfunction.

1.8 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycle in accordance with Section 01 00 00.

.2 Use trigger operated spray nozzles for water hoses.

.3 Designate a cleaning area for tools to limit water use and runoff.

.4 Carefully coordinate the specified concrete work with weather conditions.

.5 Seal and store emptied containers safely for disposal.

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

.7 Prevent plasticizers, water-reducing agents, air-entraining/curing compounds from entering drinking water supplies or streams. Using appropriate safety precautions, collect liquid or solidify liquid with an inert, non-combustible material and remove for disposal. Dispose of all waste in accordance with applicable local, provincial and national regulations.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Portland cement and supplementary cementing materials: to CSA A3000.

.2 Water: to CSA A23.1.

.3 Aggregates: to CSA A23.1. Coarse aggregates to be normal density.

.4 Air entraining admixture: to ASTM C260.

.5 Chemical admixtures: to ASTM C494. Departmental Representative to approve accelerating or set retarding admixtures during cold and hot weather placing.

.6 Shrinkage compensating grout: premixed compound consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agents.

.1 Compressive strength: 50 MPa at 28 days.

- .2 Consistency:
  - .1 Fluid: to ASTM C827. Time of efflux through flow cone (ASTM C939), under 30 s.
  - .2 Flowable: to ASTM C827. Flow table, 5 drops in 3 s, (ASTM C109, applicable portion) 125 to 145%.
  - .3 Plastic: to ASTM C827. Flow table, 5 drops in 3 s, (ASTM C109, applicable portions) 100 to 125%.
  - .4 Dry pack to manufacturer's requirements.
- .7 Vapour Retarder Membrane: to be a 10mil (0.25mm) thick, polyolefin resin sheet in accordance with ASTM E1745 such as Perminator 10mil by W.R. Meadows Inc., or approved equivalent. Seal seams with a 100mm wide high density polyethylene tape with pressure sensitive adhesive to suit a 150mm wide sheet overlap in accordance with the manufacturer's written recommendations.
- .8 Curing compounds: to CSA A23.1 and to ASTM C309, Type 1-D with fugitive dye for hidden or exterior use and Type 1 for exposed concrete. Confirm compatibility with finish floor adhesives.
- .9 Isolation board between concrete surfaces to be 13mm thick, closed cell polyethylene joint filler with a pre-scored removable strip to suit joint sealant installation.
- .10 Joint sealer/filler: a two (2) component, polysulphide sealant, self levelling for slabs.
- .11 Rigid insulation: as specified in Section 31 23 10 - Excavating, Trenching and Backfilling.

## 2.2 CONCRETE MIXES

- .1 General: Where practically possible, for all concrete mixes listed below, except for concrete flat slab work, concrete supplier to maximize the amount Portland cement replaced with fly ash or another approved cementitious recycled material while maintaining the characteristics listed for each concrete mix listed as well as the workability of each mix. Concrete supplier to provide written confirmation of the percent replacement of Portland cement for fly ash/supplementary cementing materials for all mix designs.
- .2 Proportion normal density concrete in accordance with CSA A23.1, Alternative 1 to give the following properties for concrete in building frost walls and footings:
  - .1 Cement: Type GU.
  - .2 Minimum compressive strength at 28 days: 25 MPa.
  - .3 Class of exposure: F-2.
  - .4 Nominal size of coarse aggregate: 20 mm.
  - .5 Slump at time and point of discharge: 80 mm  $\pm$  30 mm.
  - .6 Air content: 4-7%.
  - .7 Chemical admixtures: type as approved, and in accordance with ASTM C494.

- .3 Proportion normal density concrete in accordance with CSA A23.1, Alternative 1 to give the following properties for concrete in slabs on grade within the building:
  - .1 Cement: Type GU.
  - .2 Minimum compressive strength at 28 days: 30 MPa.
  - .3 Class of exposure: N.
  - .4 Nominal size of coarse aggregate: 20 mm.
  - .5 Slump at time and point of discharge: 80 mm  $\pm$ 30 mm.
  - .6 Air content: 3% maximum.
  - .7 Chemical admixtures: type as approved, and in accordance with ASTM C494.
- .4 Proportion normal density concrete in accordance with CSA A23.1, Alternative 1 to give the following properties for curbs and walkways.
  - .1 Cement: Type GU.
  - .2 Minimum compressive strength at 28 days: 25 MPa.
  - .3 Class of exposure: C-2.
  - .4 Nominal size of coarse aggregate: 20 mm.
  - .5 Slump at time and point of discharge: 80 mm  $\pm$ 30 mm.
  - .6 Air content: 5 to 8%.
  - .7 Chemical admixtures: type as approved, and in accordance with ASTM C494.
- .5 Proportion normal density concrete in accordance with CSA A23.1, Alternative 1 to give the following properties for concrete in mud slabs:
  - .1 Cement: Type GU.
  - .2 Minimum compressive strength at 28 days: 20 MPa.
  - .3 Class of exposure: N.
  - .4 Nominal size of coarse aggregate: 20 mm.
  - .5 Slump at time and point of discharge: 80 mm  $\pm$ 30 mm.
  - .6 Air content: 4 to 7%.
  - .7 Chemical admixtures: type as approved, and in accordance with ASTM C494.
- .6 Provide concrete mix designs based on trial mixes that have been designed and tested by a qualified professional engineer registered or licensed to practice in the Province of New Brunswick and submitted for review to the Departmental Representative.

PART 3      EXECUTION

3.1      EXAMINATION

- .1 Confirm founding material on which footings and other concrete work are to be placed are free from water. Place concrete only on frost-free ground. Remove previously frozen bearing surfaces.
- .2 Confirm foundations bear on structural fill in accordance with Section 31 23 10. All structural fill as directed by the Geotechnical engineer and in the presence of the Geotechnical engineer or one of their qualified representatives.

- .3 Inspect all foundation bearing surfaces and obtain approval from the Owner's geotechnical engineer prior to placing concrete. If bearing surfaces are deemed unacceptable because conditions do not meet those anticipated during design, make adjustments as directed.
- .4 Do not place plumbing and electrical conduit under foundations or their associated zone of influence. Coordinate with mechanical and electrical contractor so that all services either sleeve through foundation walls or run above footings/zone of influence.

### 3.2 WORKMANSHIP

- .1 Obtain the Departmental Representative's approval before placing concrete. Provide 48 hours notice prior to placing of concrete.
- .2 Pumping of concrete is permitted only after approval of equipment and mix.
- .3 Confirm reinforcement and inserts are not disturbed during concrete placement.
- .4 Prior to placing of concrete obtain the Departmental Representative's approval of proposed method for protection of concrete during placing and curing.
- .5 Do not place load upon new concrete until authorized by the Departmental Representative.
- .6 Concrete protective cover to reinforcement as noted on the drawings.
- .7 Support bars on plastic coated steel chairs to maintain exact cover requirements.
- .8 Confirm all concrete construction is moist cured using either an approved curing compound or burlap maintained in moist conditions.
- .9 In cold weather protect concrete work to CSA A23.1 and following:
  - .1 Cold weather is defined as a period when the mean air temperature drops below 5°C for more than three successive days.
  - .2 When air temperature is above 0°C and is forecast to remain so for 48 hours after placing, insulated tarps are acceptable protection provided concrete temperatures are monitored and comply with temperature limits specified in the following paragraph.
  - .3 For all other cold weather conditions protect concrete with a windproof enclosure of canvas or other material to allow free circulation of inside air around fresh concrete. At no point let walls of enclosure touch formwork and provide sufficient space for removal of formwork and for finishing. Supply approved heating equipment capable of keeping inside air at sufficiently curing temperatures:

- .1 For an initial three days, at a temperature of not less than 15°C.
  - .2 Maintain concrete at temperatures of not less than 10°C for a total period of seven days plus the initial three days specified above.
  - .3 At no time shall concrete temperatures exceed 30°C at surfaces.
  - .4 Reduce enclosure air temperature at a rate not exceeding 10°C per day until outside air temperature has been reached.
  - .5 Take temperature readings both of air and of concrete surfaces at several points within area protected at start and at end of working day. Maintain complete records of temperature readings.
  - .4 Monitor concrete so it cures without suffering damage. When enclosure is provided, avoid rapid drying of the concrete.
- .10 In hot weather protect concrete Work to CAN/CSA A23.1 and following:
- .1 When air temperature is at or above 25°C, do not use curing compounds and keep concrete surfaces moist continually during protection stage using burlap maintained in a moist condition.
  - .2 Regulate the generation of heat through hydration to control thermal gradients to prevent thermal cracking.
- .11 Monitor concrete temperature and moisture evaporation rates and provide appropriate hot weather protection as defined in clause 7 of CSA A23.1. Maintain records of all measurements during hot weather periods for review by the Departmental Representative.
- .12 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.

### 3.3 CONSTRUCTION

- .1 Do cast-in-place concrete work in accordance with CSA A23.1.
- .2 Concrete to be dense, homogenous and free of cold joints, voids and honeycombing. Concrete to be fully bonded to reinforcing steel, anchors and embedded parts.
- .3 Consolidate concrete using a mechanical form vibrator method complete with mechanical hand held vibrators, if required, and subject to the approval of Departmental Representative.
- .4 Place concrete in consolidated lifts and keep approximately horizontal and evenly distributed throughout the formed assembly. The rate of placement to be such that each successive lift is vibrated into the preceding lift to achieve proper bonding.
- .5 Place concrete monolithically without any cold and/or construction joints unless noted otherwise on the drawings.

- .6 Concrete placement and vibrating activities to be in accordance with the formwork design data, limitations and parameters provided by the Contractor.
- .7 Foundations, sleeves and inserts:
  - .1 Set sleeves, ties, pipe hangers and other inserts and openings as indicated or specified elsewhere. Sleeves and openings greater than 100mm x 100mm not indicated, must be approved by the Departmental Representative.
  - .2 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval of modifications from Departmental Representative before placing of concrete.
  - .3 Check locations and sizes of foundations, sleeves and openings shown on drawings. Provide confirmation by qualified surveyor.
  - .4 Set special inserts for strength testing as indicated and as required by non-destructive method of testing concrete.
- .8 Finishing:
  - .1 Finish concrete in accordance with CSA A23.1, and Part 3.7 Finishing of this section.
  - .2 Use procedures acceptable to Departmental Representative or those noted in CAN/CSA-A23.1 to remove excess bleed water. Confirm surface is not damaged.
  - .3 Use curing compounds compatible with applied finish on concrete surfaces. Provide written declaration that compounds used are compatible.
  - .4 Cut back form ties and plug openings in a manner acceptable to Departmental Representative.
  - .5 Repair holes and surface defects to the satisfaction of Departmental Representative.
  - .6 Remove honeycombed or otherwise defective concrete and repair in a manner approved and to the satisfaction of Departmental Representative.
  - .7 Confirm that all exposed concrete has neatly formed, 45 degree bevelled, 25mm chamfered edges where designated in accordance with Section 03 10 00 - Concrete Forms and Accessories.
- .9 Curing and protection:
  - .1 Do not use curing compounds where bond is required for subsequent topping or coating.
  - .2 Use approved curing compounds in accordance with the manufacturer's written instructions.
- .10 Anchor bolts:
  - .1 Place anchor bolts to templates under supervision of trade supplying anchors prior to placing concrete.
  - .2 Protect anchor bolt holes from water accumulations.
- .11 Core-drilling/cutting of holes in any concrete element is not permitted without written consent from the Departmental Representative. Submit all proposed core-drilling/cutting to the

Departmental Representative for review prior to execution of work. Request for core- drilling/cutting must have 72 hours notice to allow Departmental Representative adequate time to review proposed locations.

### 3.4 PLACING CONCRETE

- .1 Place concrete as specified in CSA A23.1.
- .2 Inform the Departmental Representative at least 48 hours before each concrete placing operation. Do not place concrete until authorized by the Departmental Representative and following satisfactory site review and observations of geotechnical base preparations, formwork, reinforcing steel and other associated concrete batching and placement operations.
- .3 Do not place concrete when it is raining or likely to rain. If rain begins after concrete is placed, protect with waterproof covers until set.
- .4 Do not permit vertical free fall of concrete mix to exceed 1500mm.
- .5 For exposed concrete, take special precautions when placing to prevent segregation of concrete, and to avoid cold joints, honeycombing or voids. Do not allow vibrator to touch formwork.
- .6 Use form vibrators only when sections are too narrow for internal type. Employ a sufficient number of vibrators to achieve complete consolidation of concrete throughout entire volume of each layer. Have available at least one extra vibrator on hand for emergency.
- .7 Do not use vibrators for interior and exterior concrete slabs on fill or for the use of moving concrete for concrete slabs.
- .8 Use only tools and handling equipment that are clear of rust or other harmful and foreign material to avoid efflorescence and staining of slabs or hardened concrete.
- .9 Use concrete pumps to place concrete only with approval of methods, equipment and mix design.
- .10 Provide continuous supervision during placement of concrete including concrete grout to maintain reinforcing steel in the correct position.

### 3.5 PLACING GROUT

- .1 Grout where indicated using procedures in accordance with manufacturer's recommendations which result in 100% contact over grouted area.

3.6 SAW CUTTING

- .1 Commence sawing as soon as the concrete has hardened sufficiently to permit cutting without chipping, spalling or tearing and before all controlled shrinkage cracking occurs. Refer to clause 7.3.2 of CSA A23.1. Locate and complete all saw cuts in accordance with the Project Drawings and terminate all saw cuts at the face of columns, foundation walls and other control joints as shown on the Project Drawings.

3.7 FINISHING

- .1 Finish concrete in accordance with CSA A23.1 and in accordance with the drawings.
- .2 Use smooth form finish for all concrete surfaces. Use form facing material that will produce a smooth, hard, uniform texture on the concrete. Do not use material with raised grain, torn surfaces, worn edges, patches, dents or other defects that will impair the texture of the concrete surface. Patch the holes and defects. Completely remove fins.
- .3 Use a smooth, hard steel troweled finish for the top of walls, pedestals and foundations. Unless noted otherwise, the top surface of exterior slab/pads to have a light broom finish in even continuous strokes applied in the transverse or short direction. Do not power trowel slabs.
- .4 Rub exposed sharp edges of concrete with carborundum to produce 5mm radius edges unless otherwise indicated.
- .5 Apply curing compounds to concrete surfaces as required. Confirm in writing the compatibility of curing compound with the applied finish on each concrete surface.
- .6 Tolerance:
  - .1 All slabs/pads to have concrete surfaces finished to within 2mm in 1m as measured with a 1m straight edge placed on surface unless noted otherwise.
  - .2 All interior slabs in accordance with CSA A23.1, Classification B surfaces finished to suit slopes and grades. The transition to existing, adjacent surfaces to be smooth and continuous without hollows, bumps, ridges, or potential tripping hazards.
- .7 Elevation survey: if requested by Owner, carry out an elevation survey on finished slabs in accordance with the measurement procedures outlined in CSA A23.1, clause 7.5.1 to ensure all concrete slabs meet the specified surface finishes/tolerances.

3.8 PLACING GROUT

- .1 Grout where indicated using procedures in accordance with

manufacturer's recommendations which results in 100% contact over grouted area.

### 3.9 REPAIRS

- .1 In the event that the post-finishing survey shows that the slab surface does not meet the specified tolerances, take corrective action within five (5) working days, or as directed by the Departmental Representative.
- .2 Submit proposed corrective action in writing, with complete details of methods, tools, and materials for the Departmental Representative's approval. Upon acceptance of the proposed method, prepare a test area, and upon acceptance, this will be the standard for the remainder of the repairs.
- .3 Grind down high points to a smooth surface conforming to the specifications and with a surface finish equal to the remainder of the slab. If cutting or chipping by hammer is required at high areas, then cut the area low with square saw cut edges and patched as noted below.
- .4 Fill low areas by patching with a bonded topping. Chip edges of patch areas and saw cut square a minimum of 25mm deep. Alternatively, the Departmental Representative may approve feather edging if epoxy type topping is used and a properly bonded smooth finish can be removed before placing patch material. Patches are to be finished to a smooth surface equal to the finish on the remainder of the slab, and cured adequately. Do all patching procedures in strict accordance with the manufacturer's directions and to the approval of the Departmental Representative.

### 3.11 SLAB-ON-GRADE JOINTS

- .1 Provide construction joint between adjacent concrete pours.
- .2 Provide an isolation joint where the slab-on-grade abuts a vertical element.
- .3 Provide saw cut control joints as indicated on the drawings except at those locations where construction joints or isolation joints are provided.

### 3.12 VAPOUR RETARDER MEMBRANE

- .1 Vapour retarder membrane:
  - .1 Install under slab vapour retarder membrane under all concrete slabs-on-grade inside building.
  - .2 Install membrane in strict accordance with membrane manufacturer's printed instructions.
  - .3 Lap under slab vapour retarder membrane minimum 150mm at joints and seals using high density polyethylene tape with pressure sensitive adhesive to create vapour and gas tight joints.

.4 Seal all pipe and conduit penetrations through the membrane using 'The Boot' and high density polyethylene tape to create vapour and gas tight seals.

.5 Seal to inside of concrete foundation walls to create a vapour and gas tight connection.

.6 Seal punctures in damp-proof membrane before placing concrete. Use patching material at least 150mm larger than puncture and seal.

3.13 FIELD QUALITY CONTROL

.1 Site observations and testing of concrete and concrete materials will be carried out by a Testing Laboratory designated or acceptable by Departmental Representative in accordance with CSA-A23.1.

.2 Provide test cylinders (a minimum of three (3) cylinders), as follows:

.1 Each day's pour.

.2 Each change of supplier.

.3 Each 50m<sup>3</sup> or fraction thereof.

.4 Additional test at the request of the Departmental Representative.

.5 If Contractor wants to strip formwork early, request additional cylinders to be cast and pay for additional cylinders and testing of the additional cylinders.

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

.4 Non-destructive Methods for Testing Concrete shall be in accordance with CSA A23.2.

.5 Site observations or testing by Departmental Representative will not augment or replace Contractor quality control nor relieve them of their contractual responsibility.

**END OF SECTION**