

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Section 03 20 00 - Concrete Reinforcing.
- .2 Section 03 30 00 - Cast-in-Place Concrete.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA)
  - .1 CSA-A23.1-09/A23.2-09(R2014), Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
  - .2 CSA-O86-14, Engineering Design in Wood.
  - .3 CSA-O121-08(R2013), Douglas Fir Plywood.
  - .4 CSA-O151-09(R2014), Canadian Softwood Plywood.
  - .5 CSA-O153-13, Poplar Plywood.
  - .6 CSA-O325-07(R2012), Construction Sheathing.
  - .7 CSA-O437 Series-93(R2011), Standards for OSB and Waferboard.
  - .8 CAN/CSA-S269.1-1975(R2003), Falsework for Construction Purposes.
  - .9 CAN/CSA-S269.3-M92(R2013), Concrete Formwork.
- .2 Council of Forest Industries of British Columbia
  - .1 COFI Exterior Plywood for Concrete Formwork.
- .3 Underwriters' Laboratories of Canada (ULC)
  - .1 CAN/ULC-S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.
- .4 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).

1.3 ACTION AND INFORMATION SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 As directed by the Departmental Representative, submit shop drawings for formwork and falsework.
  - .3 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 33 00 - Submittal Procedures, Section 01 35 29.06 -Health and Safety Requirements or as directed by the Departmental Representative.
  - .4 Contractor to design and indicate method and schedule of construction, shoring, stripping and re-shoring procedures, materials, arrangement of joints, special architectural
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exposed finishes, ties, liners, and locations of temporary embedded parts. Comply with CSA-S269.1 for falsework drawings, comply with CSA-S269.3 for formwork drawings.

.1 Indicate formwork design data: permissible rate of concrete placement, and temperature of concrete, in forms.

#### 1.4 DELIVERY, STORAGE AND HANDLING

##### .1 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/ Demolition Waste Management and Disposal.

.2 Place materials defined as hazardous or toxic in designated containers.

.3 Divert wood materials from landfill to a recycling facility as approved by Departmental Representative.

.4 Divert plastic materials from landfill to a recycling facility as approved by Departmental Representative.

.5 Divert unused from release material from landfill to an official hazardous material collections site as approved by the Departmental Representative.

.6 Store materials in dry location and in accordance with manufacturer's recommendation in clean, dry, well ventilated area.

.7 Replace defective or damaged materials with new.

.8 Use sealers, form release and stripping agents that are non-toxic, biodegradable and have zero or low VOC's.

.2 Deliver, handle and store formwork materials to prevent weathering, warping or damage detrimental to the strength of the materials or to the surface to be formed.

.3 Ensure that formwork surfaces which will be in contact with concrete are not contaminated by foreign matter. Handle and erect the fabricated formwork so as to prevent damage.

#### PART 2 - PRODUCTS

##### 2.2 MATERIALS

##### .1 Formwork materials:

.1 For concrete without special architectural features, use wood and wood product formwork materials to CSA-A23.1/A23.2 and CSA-O121.

.2 The form facing material shall be free from surface defects and meet deflection requirements in accordance with CAN/CSA-S269.3.

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- .2 Form ties:
  - .1 For concrete not designated 'Architectural', use removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm diameter in concrete surface. Holes are to be filled with non-shrink grout.
- .3 Form release agent: non-toxic, biodegradable, low VOC, 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.
- .4 Form stripping agent: colourless mineral oil, non-toxic, biodegradable, low VOC, free of kerosene, with viscosity between 15 to 24 mm<sup>2</sup>/s at 40 deg C, flashpoint minimum 150 deg C, open cup.
- .5 Form liner:
  - .1 Plywood: medium or high density overlay Douglas Fir to CSA-0121.
- .6 Falsework materials: to CSA-S269.1.

### PART 3 - EXECUTION

#### 3.1 FABRICATION AND ERECTION

- .1 Verify lines, levels and centres before proceeding with formwork/falsework and ensure dimensions agree with drawings.
  - .2 All vertical concrete surfaces to be formed.
  - .3 Obtain Departmental Representative approval prior to framing openings not indicated on drawings.
  - .4 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.
  - .5 Assemble formwork so that concrete is not damaged during its removal.
  - .6 Fabricate and erect falsework in accordance with CSA S269.1 and COFI exterior plywood for concrete formwork.
  - .7 Do not place shores and mud sills on frozen ground.
  - .8 Provide site drainage to prevent washout of soil supporting mud sills and shores.
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- .9 Fabricate and erect formwork in accordance with CAN/CSA-S269.3 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA-A23.1/A23.2.
  - .10 Align form joints and make watertight. Keep form joints to minimum.
  - .11 Locate horizontal form joints for walls and pilasters below finished grade.
  - .12 Where concrete is to remain exposed, use 25 mm chamfer strips on external corners and/or 25 mm fillets at interior corners, joints, unless specified otherwise.
  - .13 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.
  - .14 Prior to placing concrete, the elevations of forms shall be checked to verify drainage slopes.
  - .15 Provide 48 hours notice to Departmental Representative for inspection prior to concrete placement.
  - .16 Build in anchors, sleeves, and other inserts required to accommodate Work specified in other sections.
    - .1 Ensure that anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.
  - .17 Secure all anchors and dowels in place using ties, chairs, templates and forms as required prior to placing concrete.
  - .18 Supply and install all supports and ties required to secure all embedded parts.
  - .19 Clean formwork as erection proceeds to remove foreign matter. Remove cuttings, shavings and debris from within forms. Flush completely with water to remove remaining foreign matters. Ensure that water and debris drain to exterior through clean-out ports. Clean to CSA-A23.1/A23.2.
  - .20 During cold weather, remove ice and snow from within forms, do not use de-icing salts. Do not use water to clean out completed forms, unless formwork and concrete construction proceed within a heated enclosure.
  - .21 Patch all form tie holes and finish surface to remove all evidence of tie holes and/or patching.
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- .22 Clean formwork in accordance with CSA-23.1/A23.2, before placing concrete.

3.2 CLEANING

- .1 Leave work area clean at end of each day and perform cleaning after installation.
- .2 Upon completion, remove surplus materials, rubbish, tools and equipment.

END OF SECTION

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PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Section 03 10 00 - Concrete Forming and Accessories.
- .2 Section 03 30 00 - Cast-In-Place Concrete.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA)
  - .1 CSA-A23.1-09/A23.2-09(R2014), Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
  - .2 CSA-A23.3-14, Design of Concrete Structures.
  - .3 CSA-G30.3-M1983(R1998), Cold-Drawn Steel Wire for Concrete Reinforcement.
  - .4 CSA-G30.18-09(R2014), Carbon Steel Bars for Concrete Reinforcement.
  - .5 CSA-G40.20/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
  - .6 CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
  - .7 CSA W186-M1990(R2012), Welding of Reinforcing Bars in Reinforced Concrete Construction.
- .2 Reinforcing Steel Institute of Canada (RSIC)
  - .1 RSIC-2004, Reinforcing Steel Manual of Standard Practice.
- .3 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 Prepare reinforcement drawings in accordance with RSIC Manual of Standard Practice.
  - .3 Shop Drawings:
    - .1 Submit shop drawings for review and approval by Departmental Representative. General contractor to review and provide stamp on shop drawings indicating coordination of trades prior to submission.
    - .2 Indicate placing of reinforcement and bar bending details, lists, quantities of reinforcement, sizes, spacing, locations of reinforcement and mechanical splices if approved by Departmental Representative, with identifying
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code marks to permit correct placement without reference to structural drawings.

.3 Indicate sizes, spacing's and locations of chairs, spacers and hangers.

.4 Detail lap lengths and bar development lengths to CAN/CSA-A23.3, unless otherwise indicated.

.5 Provide type 'B' tension lap splices unless otherwise indicated.

.6 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval of modifications from Departmental Representative prior to placing concrete.

- .4 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 33 00 - Submittal Procedures, Section 01 35 29.06 -Health and Safety Requirements or as directed by the Departmental Representative

#### 1.4 QUALITY ASSURANCE

- .1 Submit in accordance with Section 01 45 00 - Quality Control.
- .1 Mill Test Report: provide Departmental Representative with certified copy of mill test report of reinforcing steel, minimum 4 weeks prior to beginning reinforcing work.
- .2 Submit in writing to Departmental Representative proposed source of reinforcement material to be supplied.

#### 1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
- .1 Store materials off ground, indoors, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect wood products from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Substitute different size bars only if permitted in writing by Departmental Representative.
- .2 Reinforcing steel: billet steel, grade 400, deformed bars to CSA-G30.18, unless indicated otherwise.
- .3 Chairs, bolsters, bar supports, spacers: to CSA-A23.1/A23.2 and adequate for strength and support of reinforcing during construction conditions, all of which to be non-staining.
- .4 Mechanical splices: subject to approval of Departmental Representative.
- .5 Plain round bars: to CSA-G40.20/G40.21

2.3 FABRICATION

- .1 Fabricate reinforcing steel in accordance with CSA-A23.1/A23.2 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.
    - .1 Fabricate and bend all reinforcing steel in the shop.
    - .2 Match dowels from footings to vertical reinforcing in wall or pilaster above.
    - .3 Fabricate to the following tolerances, unless stricter requirements are indicated on drawings or codes:
      - .1 Sheared length: +/- 25mm.
      - .2 Stirrups and spirals: +/- 10mm.
      - .3 Other bends: +/- 25mm.
  - .2 Obtain Departmental Representative's written 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 Have welding performed by workers qualified under CSA-W47.1, Division 1 or 2.
  - .5 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.
  - .6 Clean reinforcing to CSA-A23.1. All reinforcing bars are to be free of scale rust and contamination at time of placing in forms.
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PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Examine work related to this section and report discrepancies to Departmental Representative.
- .2 Commencement of work shall imply acceptance of conditions.

3.2 FIELD BENDING

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

3.3 PLACING REINFORCEMENT

- .1 Place reinforcing steel as indicated on placing drawings and in accordance with CSA-A23.1/A23.2.
  - .1 Use plain round bars as slip dowels in concrete.
    - .1 Paint portion of dowel intended to move within hardened concrete with one coat of asphalt paint.
    - .2 When paint is dry, apply thick even film of mineral lubricating grease.
    - .3 Secure in place as required.
- .2 Prior to placing concrete, obtain Departmental Representative's approval of reinforcing material and placement.
- .3 Ensure cover to reinforcement is maintained during concrete pour.
- .4 Protect epoxy and paint coated portions of bars with covering during transportation and handling.
- .5 Reinforcement shall be adequately supported by metal chairs, spacers or hangers and secured against displacement within the tolerances permitted and in accordance with the RSIC Reinforcing Steel Manual of Standard Practice.
- .6 Concrete trucks are prohibited from travelling over reinforcing during concrete placing operations.
- .7 Ensure concrete reinforcing is clean, free of scale rust and contamination prior to concrete pour.

END OF SECTION

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PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Section 03 10 00 - Concrete Forming and Accessories.
- .2 Section 03 20 00 - Concrete Reinforcing.

1.2 REFERENCES

- .1 ASTM International
    - .1 ASTM C260/C260M-10a, Standard Specification for Air-Entraining Admixtures for Concrete.
    - .2 ASTM C309-11, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
    - .3 ASTM C494/C494M-13, Standard Specification for Chemical Admixtures for Concrete.
    - .4 ASTM C920-14a, Standard Specification for Elastomeric Joint Sealants.
    - .5 ASTM C1017/C1017M-13, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
    - .6 ASTM C1315-11, Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
    - .7 ASTM D412-06a(2013), Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
    - .8 ASTM D624-00(2012), Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomer.
    - .9 ASTM D1751-04(2013), Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
    - .10 ASTM D1752-04a(2013), Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
  - .2 Canadian Standards Association (CSA)
    - .1 CSA-A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
    - .2 CSA-A23.3-14, Design of Concrete Structures.
    - .3 CSA A283-06(2011), Qualification Code for Concrete Testing Laboratories.
    - .4 CSA A3000-13, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
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- .3 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-37.2-M88, Emulsified Asphalt, Mineral Colloid-Type, Unfilled, for Damp-proofing and Waterproofing and for Roof Coatings.
  - .2 CAN/CGSB-51.34-M86(R1988), Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
- .4 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).

### 1.3 LIST OF ABBREVIATIONS

- .1 Abbreviations and Acronyms:
  - .1 Portland Cement: hydraulic cement, blended hydraulic cement (XXb - b denotes blended) and Portland-limestone cement.
    - .1 Type GU, GUb and GUL - General use cement.
    - .2 Type MS and MSb - Moderate sulphate-resistant cement.
    - .3 Type MH, MHb and MHL - Moderate heat of hydration cement.
    - .4 Type HE, HEb and HEL - High early-strength cement.
    - .5 Type LH, LHb and LHL - Low heat of hydration cement.
    - .6 Type HS and HSb - High sulphate-resistant cement.
- .2 Fly ash:
  - .1 Type F - with CaO content less than 15%.
  - .2 Type CI - with CaO content ranging from 15 to 20%.
  - .3 Type CH - with CaO greater than 20%.
- .3 GGBFS or Slag - Ground, granulated blast-furnace slag.

### 1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-installation Meetings: in accordance with Section 01 32 16.07 - Construction Progress Schedules - Bar (GANTT) Chart, as applicable, convene pre-installation meeting one week prior to beginning concrete works.
  - .1 Ensure key personnel attend.
  - .2 Verify project requirements.

### 1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
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- .2 Minimum 4 weeks prior to starting concrete work, submit concrete mix design showing:
  - .1 Exposure class.
  - .2 Content of cement, SCM, water, aggregates (coarse & fine), additives/admixtures, and air.
  - .3 Concrete strength.
  - .4 Intended application.
  - .5 Nominal maximum aggregate size.
  - .6 Slump.
  - .7 Water to cement ratio (w/cm).
- .3 Provide testing and inspection results and reports for review by Departmental Representative and do not proceed without written approval when deviations from mix design or parameters are found.
- .4 Concrete pours: provide 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 Concrete hauling time: provide for review by Departmental Representative deviations exceeding maximum allowable time of 120 minutes for concrete to be delivered to site of Work and discharged after batching.
- .6 Contractor to provide letter confirming that the various cast-in-place concrete mixes and all contractor/vendor supplied additives, admixtures, etc. are compatible; including but not limited to, performance enhancers, cementing materials, finishing products, hardeners, sealers, joint products, etc.
- .7 Provide WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 33 00 - Submittal Procedures, Section 01 35 29.06 -Health and Safety Requirements or as directed by the Departmental Representative.

1.6 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Provide Departmental Representative, minimum 4 weeks prior to starting concrete work, with valid and recognized certificate from plant delivering concrete.
  - .1 Provide test data and certification by qualified independent inspection and testing laboratory that materials and mix designs used in concrete mixture will meet specified requirements.

- .3 Minimum 4 weeks prior to starting concrete work, provide proposed quality control procedures for review by 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.
  - .8 Securing of dowels and anchor bolts.
- .4 Quality Control Plan: provide written report to Departmental Representative verifying compliance that concrete in place meets performance requirements of concrete as established in PART 2 - PRODUCTS
- .5 Sustainability Standards Certification:
  - Construction Waste Management: provide copy of plan.
    - .1 Recycled content: Provide listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-consumer and pre-consumer content, and total cost of materials for project.
      - .1 When Supplementary Cementing Materials (SCMs) are used, provide evidence to certify reduction in cement from Base Mix to Actual SCMs Mix, as percentage.
- .6 Health and Safety Requirements:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements:
  - .1 Concrete hauling time: deliver to site of Work and discharged within 120 minutes maximum after batching.
    - .1 Do not modify maximum time limit without receipt of prior written agreement from Departmental Representative and concrete producer as described in CSA A23.1/A23.2.
    - .2 Deviations to be submitted for review by Departmental Representative.
  - .2 Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.
- .2 Packaging Waste Management: remove for reuse recyclable materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 DESIGN CRITERIA

- .1 To CSA A23.1/A23.2, and as described in MIXES of PART 2 - PRODUCTS.

2.2 PERFORMANCE CRITERIA

- .1 Quality Control Plan: ensure concrete supplier meets performance criteria of concrete as established by DEPARTMENTAL Representative and provide verification of compliance as described in PART 1 - QUALITY ASSURANCE.

2.3 MATERIALS

- .1 Portland Cement: to CSA A3001, Type GU, or as specified in Mixes of Part 2-Products.
    - .1 Reduction in cement from Base Mix to Actual Supplementary Cementing Materials (SCMs) Mix, as percentage.
  - .2 Supplementary cementing materials: with maximum 15%: Type F fly ash replacement or GGBFS, by mass of total cementitious materials to CSA A3001.
  - .3 Water: to CSA A23.1.
  - .4 Aggregates: to CSA A23.1/A23.2.
  - .5 Admixtures:
    - .1 Air entraining admixture: to ASTM C260.
    - .2 Chemical admixture: to ASTM C494 or ASTM C1017. Structural Designer to approve accelerating or set retarding admixtures during cold and hot weather placing.
  - .6 Concrete to have a unit weight of 2350 kg/m<sup>3</sup>.
  - .7 All below ground concrete for thrust blocks to be 20 MPa sulfate-resistant.
  - .8 Shrinkage compensating grout: premixed compound consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agents to CSA A23.1/A23.2.
    - .1 Compressive strength: 50 MPa at 28 days.
    - .2 Net shrinkage at 28 days: maximum 0.03%.
  - .9 Non premixed dry pack grout: composition of non metallic aggregate Portland cement with sufficient water for mixture to retain its shape when made into ball by hand and capable of developing compressive strength of 50 MPa at 28 days.
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- .10 Curing compound: to ASTM C1315, Type 1 with low VOC, suitable for exterior industrial use.
  - .1 Apply curing compound to minimum coverage rate of 7.5 m<sup>2</sup>/L.
- .11 Premoulded joint fillers:
  - .1 Bituminous impregnated fiber board: to ASTM D1751.
- .12 Joint Sealants:
  - .1 Provide joint sealant by manufacturer's recommendation for exterior use subject to vehicular traffic. Submit data sheets and supporting literature for review and approval by Departmental Representative to ASTM C920, Type M, Grade P, Class 25, unless noted otherwise.

#### 2.4 MIXES

- .1 Alternative 1 - Performance Method for specifying concrete: to meet Departmental Representative performance criteria to CSA A23.1/A23.2.
  - .1 Ensure concrete supplier meets performance criteria as established below and provide verification of compliance as in Quality Control Plan.
  - .2 Provide concrete mix to meet following plastic state requirements:
    - .1 Uniformity, placeability, workability, finishability and set time: as per CSA-A23.1/A23.2. Generally concrete is to be free of surface blemishes, loss of mortar, colour variations, and segregation.
  - .3 Provide concrete mix to meet following hard state requirements:
  - .4 Mix "1" for mud slabs, concrete fill under over-excavated areas below footings/pads, thrust blocks:
    - .1 Durability and class of exposure: N.
    - .2 Compressive strength at 28 days: 20 MPa minimum.
    - .3 Nominal maximum aggregate size: 10 mm.
    - .4 Admixture: air-entraining to ASTM C260. Chemical admixtures to ASTM C494/C494M or ASTM C1017/C1017M.
    - .5 Supplementary cementing materials: with maximum 15% Type F fly ash replacement or GGBFS of total cementitious material.
    - .6 Air content category: 1, as per CSA- A23.1/A23.2.
    - .7 Slump: at time and point of discharge: maximum 80 mm.
    - .8 Maximum w/cm ratio: 0.65.
  - .5 Mix "2" for exterior concrete pads and slab-on-grade:
    - .1 Durability and class of exposure: C-1, with type GU Portland Cement.
    - .2 Compressive strength at 28 days: 35 MPa minimum.
    - .3 Nominal maximum aggregate size: 20 mm.

- .4 Admixture: air-entraining to ASTM C260. Chemical admixtures to ASTM C494/C494M or ASTM C1017/C1017M.
- .5 Supplementary cementing materials: with maximum 15% Type F fly ash replacement or GGBFS of total cementitious material.
- .6 Air content category: 2, as per CSA- A23.1/A23.2.
- .7 Slump: at time and point of discharge: maximum 80 mm.
- .8 Maximum w/cm ratio: 0.40.
- .6 For sulphate resistant cement, use of chlorides is to be limited in concrete mix, de-icing chemicals, etc.
- .7 Slump values are before addition of plasticizer. Add plasticizer as approved by Departmental Representative to achieve workability. Contractor to cover cost of plasticizer.
- .8 Provide quality management plan to ensure verification of concrete quality to specified performance.
- .9 Concrete supplier's certification: both batch plant and materials meet CSA A23.1 requirements.
- .10 Ensure materials used in concrete mix have been submitted for testing and meet requirements of CSA A23.1.
- .11 Identify and report immediately to Departmental Representative when concrete mix design and parameters pose anticipated problems or deficiencies related to construction.
- .12 Do not use aggregates that are susceptible to alkali-aggregate reactivity.
- .13 Use of calcium chloride not permitted.

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- .1 Obtain Departmental Representative's written approval before placing concrete.
  - .1 Provide 24 hours minimum notice prior to placing of concrete.
  - .2 Place concrete reinforcing in accordance with Section 03 20 00 - Concrete Reinforcing.
  - .3 During concreting operations:
    - .1 Development of cold joints not allowed.
    - .2 Ensure concrete delivery and handling facilitates placing with minimum of re-handling, and without damage to existing structure or Work.
  - .4 Pumping of concrete is permitted only after approval of equipment and mix.
  - .5 Ensure reinforcement and inserts are not disturbed during concrete placement.
  - .6 Prior to placing of concrete obtain Departmental Representative's approval of proposed method for protection of concrete during placing and curing in adverse weather.

- .7 Protect previous Work from staining.
- .8 Clean and remove stains prior to application for concrete finishes.
- .9 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
- .10 Do not place load upon new concrete until authorized by Departmental Representative.
- .11 Ensure that reinforcement and formwork are thoroughly clean before placing concrete.
- .12 Place concrete in the dry.
- .13 Place footings/pads on undisturbed soil or engineered fill meeting the specified requirements. Geotechnical engineer shall confirm bearing capacity in writing prior to placing concrete. As a minimum, place exterior concrete pads on soil that has a minimum allowable bearing capacity of 150 kPa, unless noted otherwise.
- .14 Ensure that foundation bearing materials are free from water and frost.
- .15 Maintain adequate frost protection to soils under footings and slab-on-grade for entire duration of work.

### 3.2 INSTALLATION / APPLICATION

- .1 Do cast-in-place concrete work to CSA A23.1/A23.2.
- .2 Concrete shall not be placed on or against any surface, including rebar, that is at a temperature below 5 deg. C.
- .3 Concrete at time of deposit shall be between 10 deg. C and 30 deg. C.
- .4 Excessive honeycomb or embedded debris in any concrete shall deem it defective. Remove and replace defective concrete. Contractor to pay for costs to repair defective work.
- .5 Pour concrete continuously between predetermined construction and control joints.
- .6 Sleeves and inserts:
  - .1 Do not permit penetrations, sleeves, ducts, pipes or other openings to pass through joists, beams, column capitals or columns, except where indicated or approved by Departmental Representative.
  - .2 Where approved by Departmental Representative, set sleeves, ties, pipe hangers and other inserts and openings as indicated or specified elsewhere.
  - .3 Sleeves and openings greater than 100 x 100 mm not indicated, must be reviewed by Departmental Representative.
  - .4 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as

specified, obtain written approval of modifications from Departmental Representative before placing of concrete.

.5 Confirm locations and sizes of sleeves and openings shown on drawings.

.6 Set special inserts for strength testing as indicated and as required by non-destructive method of testing concrete.

.7 Anchor bolts:

.1 Set anchor bolts to templates in co-ordination with appropriate trade prior to placing concrete.

.2 Grout anchor bolts in preformed holes or holes drilled after concrete has set only after receipt of written approval from Departmental Representative.

.1 Formed holes: 100 mm minimum diameter.

.2 Drilled holes: 25 mm minimum diameter larger than bolts used and to manufacturers' recommendations.

.3 Protect anchor bolt holes from water accumulations, snow and ice build-ups.

.4 Set bolts and fill holes with shrinkage compensating grout or epoxy grout.

.5 Locate anchor bolts used in connection with expansion shoes, rollers and rockers with due regard to ambient temperature at time of erection.

.8 Drainage holes and weep holes:

.1 Form weep holes and drainage holes in accordance with Section 03 10 00 - Concrete Forming and Accessories. If wood forms are used, remove them after concrete has set.

.2 Install weep hole tubes and drains as indicated.

.9 Grout under base plates using procedures in accordance with manufacturer's recommendations which result in 100% contact over grouted area. Coordinate required grouted areas with vendor/supplier requirements.

.10 Finishing and curing:

.1 Finish and cure concrete to CSA A23.1/A23.2.

.2 Use procedures as reviewed by Departmental Representative or those noted in CSA A23.1/A23.2 to remove excess bleed water. Ensure surface is not damaged.

.3 Use curing compounds compatible with applied finish on concrete surfaces. Provide written declaration that compounds used are compatible.

.4 Finish concrete pads and slab-on-grade to CSA A23.1/A23.2. Class A minimum.

.5 For exterior concrete pads and slab on grade, provide broom finish unless otherwise indicated.

.6 Rub exposed sharp edges of concrete with carborundum to produce 3 mm minimum radius edges unless otherwise indicated.

- .7 At slab-on-grade locations, control joints as indicated on drawings shall be made to reduce cracking with cutting being done at the earliest timing that will not cause raveling of the joints.
- .8 Protect finished installation in accordance with manufacturer's instructions.
- .9 Coordinate curing methods with product manufacturer's requirements.
- .10 Follow the requirements of curing duration for the different classes of concrete.
- .11 Ensure that freshly placed concrete is protected from freezing, dehydration, mechanical shock and contact with injurious substances.
- .12 The concrete shall be protected from premature drying and extremes of temperature, and shall be cured at a temperature of at least 10°C for a minimum period of 3 days.
- .13 Concrete slab on grade shall undergo curing as per Table 2 and Table 20 of CSA-A23.1 for the applicable class of concrete. Apply curing/sealing compounds as indicated in Part 2 - Products.
- .14 Foot traffic shall be kept off curing concrete for 1 day.
- .15 Vehicles shall be kept off concrete for 7 days.
- .16 Do not use curing compounds that would have a detrimental effect on bonding, adhesion, curing, appearance, or similar qualities of materials applied to concrete surfaces. Use only moisture curing for surfaces where finishes are incompatible with curing compound.

### 3.3 SURFACE TOLERANCE

- .1 Concrete tolerance to CSA A23.1, Class A, Straightedge Method, FF = 20: FL = 15, unless stricter requirements are noted on drawings.

### 3.4 FIELD QUALITY CONTROL

- .1 Site tests: conduct tests as follows in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
  - .1 Concrete pours.
  - .2 Slump.
  - .3 Air content.
  - .4 Compressive strength at 7 and 28 days, and as required by CSA-A23.1/A23.2 for class of concrete specified.
  - .5 Air and concrete temperature.
- .2 For compressive strength testing of concrete, a minimum of 4 cylinders and 3 field cured cylinders are required for:
  - .1 Each day's pour.
  - .2 Each type of grade of concrete.
  - .3 Each change of supplier.

- .4 Each 50 m<sup>3</sup> or fraction thereof for concrete pads and slab-on-grade.
  - .5 Test cylinders are required for testing at 7, 14 and 28 days, and as required by CSA-A23.1/A23.2.
  - .6 Additional test specimen shall be taken whenever requested by the Departmental Representative to verify the concrete quality.
  - .7 If the Contractor anticipates that the construction schedule will subject cast concrete to loading that may exceed the capacity of the concrete prior to it reaching design strength, the Contractor shall provide additional test cylinders as required to determine the concrete strength at the time the loading is applied.
- .3 Inspection and testing of concrete and concrete materials will be carried out by testing laboratory designated by Departmental Representative for review to CSA A23.1/A23.2.
    - .1 Ensure testing laboratory is certified to CSA A283.
  - .4 Ensure test results are distributed for discussion at pre-pouring concrete meeting between testing laboratory and Departmental Representative.
  - .5 Inspection and testing of concrete and concrete materials will be carried out by a testing laboratory designated Departmental accordance with CSA-A23.1/A23.2 and paid for by the Departmental Representative.
  - .6 Departmental Representative will take additional test cylinders during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they represent.
  - .7 Non-Destructive Methods for Testing Concrete: to CSA A23.1/A23.2.

### 3.5 CONCRETE COVER OVER REINFORCING

- .1 Ensure reinforcement steel is placed to specified tolerances.
- .2 Concrete cover around reinforcing steel shall be as follows unless noted on drawings:
  - .1 Surfaces placed against soil: 75 mm.
  - .2 Exterior pads and slab-on-grade, Top: 60 mm.
- .3 Provide continuous supervision during the placement of concrete to ensure that the reinforcing steel is maintained in its correct position.

3.6 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave work area clean at end of each day and perform cleaning after installation.
  - .2 Upon completion, remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .3 Provide appropriate area on job site where concrete trucks and be safely washed.
- .4 Divert unused admixtures and additive materials (pigments, fibres) from landfill to official hazardous material collections site as approved by Departmental Representative.
- .5 Do not dispose of unused admixtures and additive materials into sewer systems, into lakes, streams, onto ground or in other location where it will pose health or environmental hazard.
- .6 Prevent admixtures and additive materials from entering drinking water supplies or streams.
- .7 Using appropriate safety precautions, collect liquid or solidify liquid with inert, non-combustible material and remove for disposal.
- .8 Dispose of waste in accordance with applicable local, Provincial/Territorial and National regulations.

3.7 DEFECTIVE WORK

- .1 Repairs and classification of unacceptable concrete to be in accordance with CSA-A23.1/A23.2.
  - .2 Remove defective concrete and embedded debris and repair as directed by Departmental Representative.
  - .3 Remove to bare concrete curing compounds detrimental to application of specified finishes.
  - .4 Concrete to be supplied at the minimum strength requirement at 28 days. Tests indicating strengths lower than specified will necessitate further testing as required by the Departmental Representative. Cost for such testing to be at the Contractor's expense. Should further tests confirm low values, the Departmental Representative has the right to
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require strengthening of the affected area or removal and replacing of the weak concrete all to the Contractor's expense.

- .5 Repair all shrinkage cracks in the completed slabs-on-grade to remain exposed employing a suitable epoxy injection technique acceptable to Departmental Representative to completely seal all such cracks, all to the Contractor's expense.

END OF SECTION

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