

1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA).
 - .1 CAN/CSA-A23.1-14, Concrete Materials and Methods of Concrete Construction.
 - .2 CAN/CSA-O86-09, Engineering Design in Wood.
 - .3 CSA O121-08 (R2013), Douglas Fir Plywood.
 - .4 CSA O151-09, Canadian Softwood Plywood.
 - .5 CSA S269.1-1975 (R2003), Falsework for Construction Purposes.
 - .6 CAN/CSA-S269.3-M92 (R2013), Concrete Formwork.
- .2 Council of Forest Industries of British Columbia (COFI).
 - .1 COFI Exterior Plywood for Concrete Formwork.

1.2 SUBMITTALS

- .1 SHOP DRAWINGS
 - .1 Comply with CSA S269.1 for falsework. Comply with CSA A23.1 for formwork.
 - .2 Formwork and falsework shall be designed by a professional engineer registered or licensed in the Province of New Brunswick.
 - .3 Each shop drawing shall bear stamp and signature of professional engineer registered or licensed in the Province of New Brunswick.
 - .4 Indicate method and schedule of construction, shoring, stripping and re-shoring procedures, materials, arrangement of joints, special architectural exposed finishes, ties, liners, and locations of temporary embedded parts.
 - .5 For concrete walls exposed to view or with special Architectural features, submit shop drawings indicating form tie pattern and methods to achieve architectural features. Architectural concrete shall comply with CSA A23.1, Section 8.3.
 - .6 Indicate formwork design data, such as permissible rate of concrete placement and temperature of concrete in forms.
 - .7 Indicate sequence of erection and removal of formwork/falsework.
 - .8 Keep a copy of shop drawings on site at all times and have available for reference if requested by the Departmental Representative.

1.3 SUSTAINABLE DESIGN SUBMITTALS

- .1 Construction waste management plan.
 - .1 A Construction Waste Management Plan is in place to divert waste material from landfill. Wherever practical, send waste material for reuse or recycling, and generally document this for the contractor's waste management final report.
- .2 Recycled Content.
 - .1 Refer to Section 01 47 15 - Sustainable Requirements for "List of Products Requiring Recycled Content".
 - .2 If products within this section are indicated on the "List of Products Requiring Recycled Content", only products with recycled content will be acceptable.
 - .3 For products not identified on list, source products with highest recycled content available when practical.
 - .4 Include following information with product data submission.
 - .1 Percentage of pre-consumer and post-consumer recycled content for each product.

- .3 Regional Materials.
 - .1 Refer to Section 01 47 15 - Sustainable Requirements for “List of Products Required to be Locally Sourced”.
 - .2 If products within this section are indicated on the “List of Products Required to be Locally Sourced”, include following information with Product Data submission:
 - .1 Extraction/Manufacturing location(s): Indicate location of extraction site or manufacturing plant, and indicate distance between extraction site or manufacturing plant and Project site.
- .4 Adhesives and Sealants.
 - .1 Include following information with Product Data submission for materials specified under this section:
 - .1 Submit manufacturer’s certification indicating VOC limits of Products used onsite and within the building envelope. Product shall comply with California’s SCAQMD #1168.
 - .5 If requesting substitute product, ensure proposed substitution achieves above stated goals.

2 Products

2.1 MATERIALS

- .1 Formwork materials:
 - .1 For concrete without special architectural features, use plywood and wood product formwork materials to CSA-O86. Square-edged, smooth surfaced panels true in plane, free of holes, surface markings or defects
 - .2 For concrete with special architectural features or exposed to view, use formwork materials to CSA-A23.1, including Section 8.3 Architectural Concrete.
- .2 Form ties:
 - .1 For concrete not designated 'Architectural' or not exposed to view, use removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm dia. in concrete surface. Wire ties are not permitted.
 - .2 For Architectural concrete or concrete exposed to view, use snap ties complete with plastic cones and light grey concrete plugs.
- .3 Form stripping agent: colourless mineral oil, non-toxic, biodegradable, low VOC, free of kerosene, with viscosity between 15 to 24 mm²/s at 40°C, flashpoint minimum 150°C, open cup.
- .4 Falsework materials: to CSA-S269.1.
- .5 Form tubes: non-absorptive spirally wound fibre form tube, premium grade, coated both sides. Spiral pattern not to show in hardened concrete.
- .6 Void form: purpose made, designed to collapse and crush under soil expansion yet sufficiently strong to support wet concrete at time of casting.

3 Execution

3.1 FABRICATION AND ERECTION

- .1 Verify lines, levels and centre’s before proceeding with formwork/falsework and ensure dimensions agree with drawings.

- .2 Fabricate and erect falsework in accordance with CSA S269.1, CSA A23.1 and COFI Exterior Plywood for Concrete Formwork.
- .3 Do not place shores and mud sills on frozen ground.
- .4 Provide site drainage to prevent washout of soil supporting mud sills and shores.
- .5 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 CAN/CSA-A23.1.
- .6 Align form joints and make watertight. Keep form joints to minimum.
- .7 Use 25 mm chamfer strips on external corners and/or 25 mm fillets at interior corners, joints, unless specified otherwise.
- .8 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.
- .9 Construct forms for architectural concrete, and place ties as indicated and/or as directed. Joint pattern not necessarily based on using standard size panels or maximum permissible spacing of ties.
- .10 Build in anchors, sleeves, and other inserts required to accommodate Work specified in other sections. Assure that all anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.
- .11 Clean formwork in accordance with CAN/CSA-A23.1, before placing concrete.
- .12 Re-use of formwork and falsework subject to the requirements of CAN/CSA-A23.1.

3.2 TOLERANCES

- .1 Construct formwork to produce concrete with dimensions, lines and levels within the following tolerances. Tolerances are not cumulative.
 - .1 Deviation from Vertical Line: 6 mm in 3 m, 9 mm in 6 m, and 20 mm in 12 m or more.
 - .2 Deviation from Flat Surface, for Walls and Floors: 3 mm in 3 m.
 - .3 Deviation from Horizontal Line: 6 mm in 3 m, 10 mm in any bay.
 - .4 Deviation from Linear Building Lines from Drawings and Position of Columns, Walls and Partitions: 6 mm.
 - .5 Deviation in cross sectional dimensions of columns and beams, and in thickness of slabs and walls: plus or minus 6 mm.

3.3 INSERTS, EMBEDDED ITEMS, AND OPENINGS

- .1 Provide formed openings where required for pipes, conduits, sleeves or other work to be embedded in and passing through concrete members. Obtain Departmental Representatives approval before framing openings in slabs, beams and columns, not shown on drawings.
- .2 Accurately locate and set in place items which are to be cast directly into concrete.
- .3 Coordinate forming of openings, slots, recesses, chases, and setting of sleeves, bolts, anchors and other inserts with work of other Sections as required.
- .4 Coordinate installation of concrete accessories.
- .5 Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings in bottom of forms to allow flushing water to drain.

3.4 CLEANING

- .1 Clean forms as erection proceeds, to remove foreign matter. Remove cuttings, shavings and debris from within forms. Clean with compressed air to remove foreign matter. Ensure that water and debris drain to the exterior through clean-out ports.
- .2 Before depositing concrete, all forms shall be rigid and mortar tight, and shall be thoroughly cleaned. The forms shall be surface treated with a non-staining mineral oil.
- .3 Any oil which contacts reinforcing shall be removed with purpose made solvents capable of removing the oil. Forms which have been left in place for such a period that they have dried out shall have surface treatment reapplied.
- .4 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. Use compressed air or other means to remove foreign matter.

3.5 REMOVAL OF FORMWORK AND RESHORING

- .1 Leave formwork in place for following minimum periods of time after placing concrete, unless more stringent requirements are specified elsewhere.
 - .1 Three (3) days for walls, columns and sides of beams.
 - .2 Twenty-one (21) days for beam soffits, fourteen (14) days for slabs, decks and other structural members, or seven (7) days when replaced immediately with adequate shoring to standard specified for falsework.
 - .3 Two (2) days for footings.
- .2 For shored concrete work, remove formwork when concrete has reached a minimum of 75% of its design strength or minimum period noted above, whichever comes later, and replace immediately with adequate reshoring.
- .3 Provide all necessary reshoring of members where early removal 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 2000 mm apart.
- .5 Re-use formwork and falsework subject to requirements of CAN/CSA-A23.1.

END OF SECTION

1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA).
 - .1 CAN/CSA-A23.1-14, Concrete Materials and Methods of Concrete Construction.
 - .2 CAN/CSA-A23.3-04 (R2010), Design of Concrete Structures for Buildings.
 - .3 CAN/CSA-G30.18-09, Billet-Steel Bars for Concrete Reinforcement.
 - .4 CAN/CSA-G40.21-13, Structural Quality Steels.
 - .5 CSA W186-M1990 (R2012), Welding of Reinforcing Bars in Reinforced Concrete Construction.
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A185/A185M-07, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
 - .2 ASTM A775/A775M-07b(2014), Standard Specification for Epoxy-Coated Steel Reinforcing Bars.
- .3 Reinforcing Steel Institute of Canada
 - .1 Reinforcing Steel Manual of Standard Practice, 4th Edition 2004.

1.2 SUBMITTALS

- .1 Shop Drawings.
 - .1 Shop drawings shall be made available on site to Departmental Representative when requested, but are not required to be submitted for review.
 - .2 Shop drawings shall be stamped by a professional engineer licensed to practice in the Province of New Brunswick.
 - .3 Indicate on shop drawings bar bending details, lists, quantities of reinforcement, sizes, spacings and locations of reinforcement.
 - .4 Substitute different size bars only if permitted in writing by Departmental Representative.
 - .5 Indict mechanical splices if accepted by Departmental Representative with identifying code marks to permit correct placement without reference to structural drawings.
 - .6 Indicate sizes, spacings and locations of chairs, spacers and hangers.
 - .7 Prepare reinforcement drawings in accordance with Reinforcing Steel Manual of Standard Practice - by Reinforcing Steel Institute of Canada .
 - .8 Detail lap lengths and bar development lengths to CAN3-A23.3. Provide Type B tension lap splices unless otherwise indicated.

1.3 SUSTAINABLE DESIGN SUBMITTALS

- .1 Construction waste management plan.
 - .1 A Construction Waste Management Plan is in place to divert waste material from landfill. Wherever practical, send waste material for reuse or recycling, and generally document this for the contractor's waste management final report.
- .2 Recycled Content.
 - .1 Refer to Section 01 47 15 - Sustainable Requirements for "List of Products Requiring Recycled Content".
 - .2 If products within this section are indicated on the "List of Products Requiring Recycled Content", only products with recycled content will be acceptable.

- .3 For products not identified on list, source products with highest recycled content available when practical.
 - .4 Include following information with product data submission.
 - .1 Percentage of pre-consumer and post-consumer recycled content for each product.
 - .3 Regional Materials.
 - .1 Refer to Section 01 47 15 - Sustainable Requirements for “List of Products Required to be Locally Sourced”.
 - .2 If products within this section are indicated on the “List of Products Required to be Locally Sourced”, include following information with Product Data submission:
 - .1 Extraction/Manufacturing location(s): Indicate location of extraction site or manufacturing plant, and indicate distance between extraction site or manufacturing plant and Project site.
 - .4 Adhesives and Sealants.
 - .1 Include following information with Product Data submission for materials specified under this section:
 - .1 Submit manufacturer’s certification indicating VOC limits of Products used onsite and within the building envelope. Product shall comply with California’s SCAQMD #1168.
 - .5 If requesting substitute product, ensure proposed substitution achieves above stated goals.
- 1.4 QUALITY ASSURANCE
- .1 Upon request, submit certified Mill Test Report of reinforcing steel to Departmental Representative within 2 weeks prior to beginning reinforcing work.
 - .2 Upon request, 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 manufacturer's written instructions and in a manner so as to prevent damage and contamination.
 - .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
 - .3 Use padded bundling bands and multiple supports to prevent bar abrasion for epoxy coated bars.
 - .4 Storage and Handling Requirements:
 - .1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.
- 1.6 RECYCLED CONTENT
- .1 Concrete reinforcement to have minimum post-consumer recycled content of 75% and minimum post-industrial recycled content of 25%.

- .2 Provide certification of recycled content as well as total reinforcing weight. Documentation shall provide a breakdown of post consumer and post industrial recycled content.

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 CAN/CSA-G30.18, unless indicated otherwise; Plain finish.
- .3 Epoxy Coated Rebar to ASTM A775M.
- .4 Chairs, bolsters, bar supports, spacers: to CAN/CSA-A23.1, adequately sized for strength and support of reinforcing steel during construction. Concrete bricks: acceptable for support of bottom layer of bars in slabs on fill. Broken concrete blocks, stones and wood blocking are not acceptable
- .5 Mechanical splices: subject to acceptance of Departmental Representative.

2.2 FABRICATION

- .1 Fabricate reinforcing steel in accordance with CAN/CSA-A23.1 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada unless indicated otherwise.
- .2 Obtain Departmental Representative's acceptance for locations of reinforcement splices other than those shown on placing drawings.
- .3 Welding of reinforcement is not permitted unless accepted in writing by Departmental Representative.
- .4 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.
- .5 Fabricate within the following tolerances:
 - .1 Sheared Length: +/- 25 mm
 - .2 Stirrups, Ties and Spirals: +/- 10 mm
 - .3 Other Bends: +/- 25 mm

Locate reinforcing splices not shown on drawings at points of minimum stress.

3 Execution

3.1 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.
- .3 Replace bars which develop cracks or splits.

3.2 PLACEMENT DETAILING

- .1 Conform to CSA-A23.1 and CSA-A23.3 for hooks, bends, laps and similar details not specifically shown.

- .2 All reinforcing bar lap splices to be Class “B”, Unless noted otherwise.
- .3 Detail reinforcing to ensure there are no interferences with anchor rods and other embedments.
- .4 For support bars not shown on drawings, use the sizes and spacing for applications as follows:
 - .1 Slab Top Reinforcing (10M): 10M bars spaced at 800 mm o.c. maximum.
 - .2 Slab Top Reinforcing (15M and larger): 900 mm o.c. maximum.
 - .3 Slab Bottom Reinforcing: 15M bars spaced at 900 mm o.c. maximum.
 - .4 Beam Stirrups: 15M bar in each corner.
- .5 Reinforce slab and wall openings, unless otherwise shown, as follows:
 - .1 Openings with greatest dimension of 600 mm or less: four 15M diagonal bars, 900 mm longer than greatest opening dimension.
 - .2 Openings with greatest dimension larger than 600 mm: two 15M bars on each side, top and bottom, 1500 mm longer than greatest opening dimension.
 - .3 Reinforce circular openings as square.
- .6 Provide horizontal "L" shaped corner bars of same cross section and spacing as horizontal bars or welded wire fabric around wall and grade beam corners unless detailed otherwise.
- .7 Cover electrical conduit, ductwork or piping buried in slabs with 600 mm wide strip of 102 x 102 x MW13.3 x MW13.3 welded wire fabric. If principal slab reinforcement is placed above conduit then place 600 mm strip under conduit. Position of reinforcing steel takes precedence over conduit, ductwork or piping.

3.3 PLACING REINFORCEMENT

- .1 Place reinforcing steel as indicated on reviewed approved placing drawings and in accordance with CAN/CSA-A23.1.
- .2 Place, support and secure reinforcement against displacement. Do not deviate from required position.
- .3 Ensure cover to reinforcement is maintained to provide required concrete cover to reinforcement during concrete placement.
- .4 Ensure the reinforcing steel foreman and crew are present prior to and during all concrete placement to ensure all reinforcement remains in proper position and to take adequate measures where reinforcing has displaced.
- .5 Prior to concrete placement, ensure all reinforcing is in correct position and tied securely to prevent displacement.

3.4 CLEANING

- .1 Ensure concrete reinforcing is clean and free from oil and deleterious matter.
- .2 Remove all loose scale, loose rust and other deleterious matter from surfaces of reinforcing.
- .3 Store reinforcing on site in a manner to ensure it is kept free of water, dirt, mud or other deleterious material.

END OF SECTION

1 General

1.1 REFERENCES

- .1 American Society for Testing and Materials (ASTM).
 - .1 ASTM D1751-04 (2013), Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
 - .2 ASTM C309-11, Specification for Liquid Membrane Forming Compounds for Curing Concrete.
 - .3 ASTM E1745-11, Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.
 - .4 ASTM D1752-04, Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
- .2 Canadian Standards Association (CSA)
 - .1 CSA-A23.1-14, Concrete Materials and Methods of Concrete Construction.
 - .2 CSA-A23.2-14, Methods of Test for Concrete.
 - .3 CAN/CSA A3000-13, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - .4 CAN/CSA A283-06 (R2011), Qualification Code for Concrete Testing Laboratories.

1.2 STANDARDS

- .1 Concrete materials and methods of concrete construction: to CSA A23.1 unless otherwise specified.
- .2 Contractor shall have a copy of CSA A23.1 at the site office, and make available to the Departmental Representative for reference.

1.3 SUBMITTALS

- .1 Submit samples, certificates and mix designs in accordance with Section 01 10 01 - General Requirements.
- .2 All items are to be submitted to Departmental Representative within 3 weeks prior to start of concrete construction. Submit the following:
 - .1 Proposed source of aggregates, and provide samples if requested.
 - .2 Manufacturer's test data, catalogue data sheet and/or certification by qualified independent inspection and testing laboratory the following materials will meet specified requirements:
 - .1 Portland cement.
 - .2 Supplementary cementing materials.
 - .3 Admixtures.
 - .4 Aggregates.
 - .5 Water.
 - .3 Concrete mix proportions selected will produce concrete of quality, yield and strength as specified in concrete mixes, and will comply with CAN/CSA-A23.1.

- .4 Valid certification indicating the concrete supplier is certified in accordance with the Atlantic Provinces Ready Mix Concrete Association Program or equivalent. Only concrete supplied from such certified plants shall be acceptable to the Departmental Representative. Plant certification shall be maintained for the duration of the fabrication and erection until the warranty period expires.
- .5 Self-consolidating concrete (SCC):
 - .1 Submit evidence that plastic concrete meets workability requirements outlined in Table 23 of CSA A23.1.
 - .2 Mix design must include air content and slump flow requirements.
- .6 Certification report, for fine and coarse aggregate, for alkali-aggregate reactivity tests carried out in accordance with CSA A23.2-14A except:
 - .1 Testing period shall be two years.
 - .2 Minimum cement content shall be 430 kg/m³.
 - .3 Specimen expansion shall not exceed 0.035% during test period.
- .7 Quality control plan, specified in Paragraph 1.4 – Quality Assurance.

1.4 SUSTAINABLE DESIGN SUBMITTALS

- .1 Construction waste management plan.
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 - .1 Include following information with Product Data submission for materials specified under this section:
 - .1 Submit manufacturer's certification indicating VOC limits of Products used onsite and within the building envelope. Product shall comply with California's SCAQMD #1168.
- .5 If requesting substitute product, ensure proposed substitution achieves above stated goals.

1.5 MAX. VOC CONTENT FOR SOLVENT CLEANING ACTIVITIES

- .1 Following are some of the Maximum allowed VOC Content for following activities, as per SCAQMD Rule 1171-9 (refer to SCAQMD manual for complete list and updates):
 - .1 Product cleaning during onsite surface preparation for coatings or adhesives application, and repair and maintenance cleaning:
 - .1 General maximum VOC 25g/L.
 - .2 Electrical apparatus components and electronic components.
 - .3 Cleaning of coatings or adhesives application equipment max. VOC 25g/L.
 - .2 Refer to SCAQMD for additional information and clarification and complete list of applications.
 - .3 Any discrepancies are to be approved by Departmental Representative. Obtain written approval prior to use on site.

1.6 CONTRACTOR QUALITY ASSURANCE

- .1 As part of the General Contractor's Quality Assurance, the Contractor shall submit a Concrete Quality Control Plan. The Quality Control Plan shall include a description of the item, a detailed procedure on how each item will be carried out, including but limited to the following items:
 - .1 Concrete pours – method to record concrete pours and information to be recorded.
 - .2 Hot weather concrete procedures (if applicable).
 - .3 Cold weather concrete procedures (if applicable).
 - .4 Methods to maintain construction within construction tolerances.
 - .5 Formwork removal procedures.
 - .6 Placement method(s).
 - .7 Curing method(s) and materials to be utilized.
 - .8 Protection of finished work during curing.
 - .9 Method of confirmation that concrete has been cured according to specifications.
 - .10 Finishes.
 - .11 Joints.
 - .12 Provisions to address potential problems such as high winds, monitoring of curing concrete during weekends, breakdown of cold weather heating equipment.
- .2 Stating only in the Quality Control Plan that the above items will be done according to specifications is not acceptable.

1.7 PRECONSTRUCTION MEETING

- .1 A meeting shall be scheduled one (1) week prior to start of concrete work to review construction documents, proposed construction methodology, schedule and reviewed submittals.
- .2 Representatives of the General Contractor, formwork sub-contractor, reinforcing sub-contractor, concrete placing sub-contractor and Departmental Representative shall attend.
- .3 All required submittals are to be completed and reviewed prior to meeting.
- .4 The General Contractor shall be responsible for recording and distributing the minutes of the meeting.

1.8 REINFORCING DOWEL AND DRILLED-IN ANCHOR QUALITY ASSURANCE

- .1 Drilled-in anchors and dowels shall be installed by experienced installers.

- .2 Conduct a thorough on-site training with anchor manufacturer's technical representative. Training to consist of a review of complete installation procedure for drilled-in anchors and adhesive anchored reinforcing dowels.
- .3 Submit written evidence of training to Departmental Representative prior to undertaking work.

1.9 RECYCLED CONTENT

- .1 Include Supplementary Cementing Materials (SCM's - slag/fly ash) content in concrete in the range of 15% to 25% for footings, 10% to 20% elsewhere, dependent on Departmental Representative's performance requirements and time of year of construction. **Note: No slag/fly ash to be placed in the Slab on Grade mix designs.**
- .2 Submit documentation for each mix including how much fly ash or slag is used in lieu of Portland cement. Provide replacement ratio, and total percentage of used.

2 Products

2.1 MATERIALS

- .1 Portland cement: to CAN/CSA-A3000.
- .2 Supplementary cementing materials: to CAN/CSA-A23.1.
- .3 Water: to CAN/CSA-A23.1.
- .4 Aggregates: to CAN/CSA-A23.1. Coarse aggregates to be normal density.
- .5 Air entraining admixture: to CAN/CSA-A23.1.
- .6 Chemical admixtures: to CAN/CSA-A23.1, subject to Departmental Representative's acceptance of accelerating or set retarding admixtures during cold and hot weather placing.
- .7 Bonding agent:
 - .1 CPD Concentrated Latex Adhesive.
 - .2 Intralok by W. R. Meadows.
 - .3 Emaco P24 by BASF.
- .8 Curing compound: to CAN/CSA-A23.1 and to ASTM C309, water-based, and compatible with floor finishes.
- .9 Shrinkage Compensating Grout (baseplates): non-shrink grout, premixed compound consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agents. Minimum 50 MPa compressive strength at 28 days. Utilize 'Winter Grade' version of the grout during winter conditions.
 - .1 Acceptable Materials:
 - .1 Sikagrout 212 HP by Sika.
 - .2 Construction Grout by BASF Construction Chemicals.
 - .3 Planigrout 750 by Mapei.
- .10 Adhesive grout and anchors:
 - .1 Acceptable Materials:
 - .1 HIT HY 200 by Hilti,
 - .2 Epcon S7 by Red Head,
 - .3 SET-XP by Simpson Strong-Tie.

- .11 Wall Control Joint Sealant: To CAN/CGSB 19.13-M87, Classification C-1-25-B-N. One part polyurethane, suitable for vertical surfaces.
 - .1 Acceptable Materials:
 - .1 SIKA/Sternson,
 - .2 Sonneborn/BASF,
 - .3 Tremco.
- .12 Slab Control Joint Sealant:
 - .1 Per Division 7.
- .13 Slab isolation joint sealant:
 - .1 Self leveling, one part polyurethane.
 - .2 Acceptable Materials:
 - .1 Sika Self-Leveling Sealant.
 - .2 Sonolastic SL 1 by BASF.
 - .3 Vulkem 45 by Tremco.
- .14 Perimeter Insulation:
 - .1 Per Division 7.
- .15 Slab-on-grade vapour barrier/retarder: To ASTM E 1745, Class B, complete with all tape and accessories for a complete installation.
 - .1 Acceptable Materials:
 - .1 Vapor Block 10 by Raven Industries.
 - .2 Perminator by W. R. Meadows.
 - .3 Moistop Ultra 10 by Fortifiber.
- .16 Premoulded isolation joint filler:
 - .1 To ASTM D 1751.
- .17 PVC Pipe Sleeve:
 - .1 To CAN/CSA B181.2
- .18 Compressible Filler:
 - .1 Expandable Foam Tape: precompressed polyurethane 140 kg/m density
 - .1 Standard of acceptance: Will-Seal 150G by Illbruck, Greyflex by Emseal Corporation.
- .19 Backer rod: closed-cell, polyethylene foam joint-filler.
- .20 Floor hardener:
 - .1 Dry shake, mineral aggregate hardener.
 - .2 Acceptable Materials:
 - .1 MasterTop 110 ABR by MasterBuilders Solutions.
 - .2 Surfex by Euclid Chemical.
 - .3 Sika Diameg 7 by Sika.

2.2 MIXES

- .1 Proportion normal density concrete in accordance with CAN/CSA-A23.1, Table 5, Alternative 1 for the following elements and applications.
- .2 Have mix designs prepared by concrete supplier and tested by a CSA Certified Materials Testing Laboratory.
- .3 Use of calcium chloride or admixture containing calcium chloride not permitted.

ITEM	Typical	Interior Slab	Exterior Concrete	Fill Concrete (CLSM)	Light Pole Base Concrete (SCC) ⁽³⁾
Cement Type	GU	GU	GU	GU	GU
Class	F-2	N	C-2	N	C-2
Aggregate max., mm	20	25	20	20	14
Slump, mm ^(1,2)	80 +/- 20	80 +/- 20	80 +/- 20	80 +/- 20	675 +/- 75 ⁽⁴⁾
Air Content, %	4 - 7	< 3	5 - 8	< 3	5 - 8
f _c min. at 28 days, MPa	25	25	32	15	32
Curing Type	1	3	1	1	1

1. 150 mm maximum with chemical admixture.
2. At point of discharge into work.
3. Mechanical consolidation is not permitted for SCC concrete.
4. Slump flow of plastic concrete shall be tested per CSA A23.2-19c.

3 Execution

3.1 PREPARATION

- .1 Provide Departmental Representative with 24 hours' notice prior to placing of concrete.
- .2 Place concrete reinforcing in accordance with Section 03 20 00 - Concrete Reinforcement.
- .3 Pumping of concrete is permitted only after Departmental Representative's acceptance of equipment and mix.
- .4 Water is not permitted to be added to concrete after it has left the batch plant.
- .5 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .6 Prior to placing of concrete obtain Departmental Representative's acceptance of proposed method for protection of concrete during placing and curing in adverse weather.
- .7 Protect previous work from staining.

3.2 WORKMANSHIP

- .1 Do cast-in-place concrete work in accordance with CAN/CSA-A23.1.
- .2 Concrete shall be deposited in the forms in a manner that prevents segregation and in accordance with CAN/CSA-A23.1.
- .3 Prior to concrete placement, anchor rod placement to be verified by a licensed surveyor to confirm anchor rod positions. Adjust or repair misaligned anchor rods. Resurvey to confirm positions conform to contract documents. Submit copy of survey to Departmental Representative.
- .4 Maintain accurate records of placed concrete items to indicate date, location of placement, quality, air temperature and test samples taken.
- .5 Prior to placement of concrete, ensure:
 - .1 All formwork complete.

- .2 Excess water, debris and ice removed.
- .3 All reinforcement, embedded reinforcing dowels, inserts, anchor rods and other embedments installed in proper position and secured.

3.3 COLD WEATHER REQUIREMENTS

- .1 As a minimum, the requirements of CSA A23.1 shall be followed for cold weather concreting
- .2 If the temperature of concrete is expected to drop below 5 °C then protection is required.
- .3 When there is a probability of the air temperature falling below 5 °C within 24 hours of placing concrete (as forecast by the nearest meteorological office), all materials and equipment needed for the protection and curing of the concrete in cold weather shall be on site before the concrete placement begins.
- .4 All snow, ice and frost shall be removed from the area of work prior to concrete placement.
- .5 Calcium chloride or other de-icing salts shall not be used as a de-icing agent.
- .6 Concrete shall not be placed on frozen subgrade. Subgrade temperature shall be minimum 2 °C.
- .7 Protection must be provided immediately after concrete placement.
- .8 Cold weather protection shall be applied in order to maintain the concrete temperature at or above 10°C for the time of the curing periods specified. Protection shall be provided by heated enclosures, coverings, insulation or a suitable combination of these methods.
- .9 The Contractor shall be responsible for recording air, enclosure air and concrete surface temperatures to ensure compliance. Locations monitored shall include corners and edges. Temperatures shall be checked a minimum of twice daily. Records shall be forwarded to the Departmental Representative daily.
- .10 Measures shall be taken to prevent subsequent frost penetration to the footing level.
- .11 When placing suspended slabs when the air temperature is at or below 4°C, enclose working area and supply moist heat under the slabs. Supply moist heat over the slabs as required to ensure all surfaces are above 5°C prior to placing and as required for finishing the concrete. Maintain and reduce temperatures as per code requirements.
- .12 To avoid cracking of the concrete due to a sudden temperature change near the end of the curing period, the protection shall not be removed until the concrete has cooled to the temperature differential given in Table 20 of CSA A23.1

3.4 HOT WEATHER REQUIREMENTS

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

3.5 CONCRETE MUD SLAB

- .1 Place slab on clean, undisturbed soil or rock.
- .2 Completely expose and clean all rock prior to placing mud slab.
- .3 Remove all loose rock prior to placing slab mud.
- .4 After trowelling and curing, apply waterproofing membrane as specified and as per manufacturer's written instructions.

3.6 SLEEVES AND INSERTS

- .1 No sleeves, ducts, pipes or other openings shall pass through walls or slabs, except where indicated or approved by Departmental Representative.
- .2 Sleeves and openings greater than 100 x 100 mm not indicated on drawings must be accepted by Departmental Representative.
- .3 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain acceptance of modifications from Departmental Representative before placing of concrete.
- .4 Confirm locations and sizes of sleeves and openings shown on drawings.
- .5 Set special inserts for strength testing as indicated and as required by non-destructive method of testing concrete.

3.7 VAPOUR RETARDER/BARRIER

- .1 Install in accordance with manufacturer's written instructions.
- .2 Lap all joints a minimum of 150 mm and seal with manufacturer's recommended tape.
- .3 Seal at all penetrations using manufacturer's recommended accessories and details.
- .4 Seal all punctures, tears and damaged areas.

3.8 ANCHOR RODS

- .1 Place anchor rods using templates prior to placing concrete.
- .2 Place rods plumb and protect alignment.
- .3 Tie top and base of anchor rods to prevent movement or rotation.
- .4 Prior to concrete placement, survey foundation to determine anchor rod positions. Adjust or repair misaligned anchor rods. Resurvey to confirm positions conform to contract documents. Submit copy of survey to Departmental Representative.
- .5 Protect anchor rods from damage after placement of concrete by means acceptable to Departmental Representative.
- .6 Misplaced and damaged anchor rods shall be repaired without increase in contract price, and to the satisfaction of the Departmental Representative.

3.9 CONCRETE CONSOLIDATION

- .1 Consolidated concrete shall be dense, homogenous and free of cold joints, voids and honeycombing. Concrete shall be bonded to all reinforcing steel, anchors, and embedded parts.
- .2 Concrete, except SCC concrete, shall be consolidated by means of mechanical internal vibrators in accordance with CSA A23.1.
- .3 Concrete shall be placed in approximately 300 mm to 600 mm horizontal lifts. Lifts shall be consolidated before the next lift is deposited.
- .4 The rate of placement shall be such that each successive lift can be vibrated into the previous lift for proper bonding. The rate of concrete placement shall not exceed form designer's recommendations.

- .5 Do not use vibrator as a means to move concrete from one location to another.
- .6 Allow vibrator to go into and out of concrete at approximately 90 degree angle. Do not insert or remove at an angle.

3.10 DEFECTIVE CONCRETE

- .1 All defective concrete less than 30 mm deep including, but not limited to, honeycombing, embedded debris, voids and stone pockets shall be patched within 24 hours of form removal.
- .2 Defects shall be removed to sound concrete and to a minimum depth of 25 mm, leaving edges perpendicular.
- .3 Thoroughly wet surface of area to be patched and the surrounding area.
- .4 Brush surface of defective area with a 1:1 cement-sand grout mixture.
- .5 Patch with 1:2 cement-sand mortar with 10% hydrated lime.
- .6 Repair tie holes immediately after formwork removal in a manner similar to defective concrete. Cut back form ties to a minimum depth of 20 mm from the surface of the concrete.
- .7 Repair areas deeper than 30 mm with structural repair grout in strict accordance with Manufacturer's written instructions. Submit proposed grout and repair method to Departmental Representative for review prior to undertaking repair.
- .8 Surface irregularities due to movement of forms shall be corrected by grinding or by repair with concrete repair mortar.

3.11 FINISHING

- .1 Rough form finish not exposed to view: as specified in Clause 7.7.2.5 of CSA A23.1-09.
- .2 Formed surfaces exposed to view: smooth form finish as specified in Clause 7.7.2.6 of CSA A23.1.
- .3 Interior floor slabs to be left exposed or to receive epoxy, carpet, resilient flooring or other covering requiring a smooth surface: initial finishing operations - screeding followed immediately by bull floating or darbying, followed by final finishing comprising mechanical floating and steel trowelling as specified in Section 7.5.4 of CSA A23.1 to produce hard, smooth, dense trowelled surface free from blemishes; finishing tolerance classification: Class A.
- .4 Rub exposed sharp edges of concrete with carborundum to produce 3 mm radius edges unless otherwise indicated.

3.12 BONDING NEW CONCRETE

- .1 Prior to placement of new concrete that has set, the forms shall be retightened
- .2 The hardened concrete surface shall be cleaned of all laitance and foreign matter.
- .3 Hardened concrete shall be thoroughly saturated with water in advance of new concrete placement. Remove any excess, free-standing water.

3.13 CONSTRUCTION JOINTS

- .1 Provide construction joints in slab and walls where work is left off at day's end.

- .2 Construct as detailed on drawings.

3.14 CONTROL JOINTS

- .1 Provide saw-cut or formed control joints in slabs as detailed on drawings. Clean by compressed air and fill per Division 7.
- .2 Provide control joints in walls at maximum 10 m spacing. Provide key and run 50 percent of horizontal reinforcing through joint, unless detailed otherwise. Fill joint as detailed.

3.15 BASEPLATE GROUTING

- .1 Grout under baseplates in strict accordance with Manufacturer's written instructions and with 100% contact with baseplate and concrete.
- .2 Grout shall be placed in a flowable state using plywood forms. Dry pack is not acceptable.
- .3 Ensure air is properly vented out during grout placement to ensure no air voids are formed.
- .4 All surfaces which will be in contact with grout to be clean of debris and foreign matter. All standing water to be removed.
- .5 Grout shall be cured in accordance with Manufacturer's written instructions and these specifications, whichever is most stringent.

3.16 CURING AND PROTECTION

- .1 Cure and protect concrete in accordance with CSA A23.1, as specified herein and to the reviewed Quality Control Plan.
- .2 Contractor is responsible for verifying that curing has been done in accordance with specifications and reviewed Quality Control Plan.
- .3 Curing types:
 - .1 Type 1 - Basic, for all concrete except as specified otherwise. Basic curing is defined as curing at a minimum temperature of 10° C for a minimum of 3 days or the time necessary to attain 40% of the specified strength.
 - .2 Type 2 - Additional. Additional curing is defined as curing at a minimum temperature of 10° C for a minimum of 7 days and the time necessary to attain 70% of the specified strength.
 - .3 Type 3 - Extended. Extended curing is defined as wet curing at a minimum temperature of 10° C for a minimum of 7 days.
- .4 Curing compounds shall not be used on surfaces where bond is required by subsequent topping or coating.
- .5 If curing compound is utilized for Type 1 or Type 2 curing, apply curing compound to concrete surfaces immediately after form removal.

3.17 FIELD QUALITY ASSURANCE

- .1 Inspection and testing of concrete and concrete materials.
 - .1 Inspection and testing by independent Testing Agency is undertaken to inform the Departmental Representative of the Contractor's performance and shall in no way augment the Contractor's quality control or relieve the Contractor of contractual responsibility.

- .2 Inspection and testing of concrete and concrete materials will be carried out by a Testing Laboratory designated by Departmental Representative in accordance with CAN/CSA-A23.1 and Section 01 10 01 – General Requirements.
- .3 Testing lab shall be certified in accordance with CSA A283.
- .4 Departmental Representative will pay for costs of inspection and testing except where specified otherwise.
- .5 Provide access to the work for selection of samples, and provide materials required for test specimens.
- .6 Cast a minimum of one set of three standard cylinders for each day concrete is placed or for each 100 m³ of concrete, and as required below.
- .7 One additional cylinder shall be taken during cold weather concreting and be cured on site under same conditions as concrete it represents.
- .8 Additional test cylinders required for confirmation of curing or cold weather concreting requirements:
 - .1 Cure cylinders on job site under same conditions as concrete which they represent.
 - .2 Contractor is responsible for field cure cylinders and any additional testing, including field storage and all associated costs.
- .9 Take slump and air tests as required to ensure concrete meets specifications.
- .10 Testing lab shall also review cold weather concrete placement conditions prior to, during and following cold weather concrete placement. Conditions shall meet requirements of CSA A23.1-09. Submit letter report to Departmental Representative and Contractor.
- .11 Non-destructive Methods for Testing Concrete shall be in accordance with CAN/CSA-A23.2.
- .12 One cylinder shall be tested at 7 days, remaining two at 28 days. When additional cylinders are taken during cold weather concrete conditions, minimum one cylinder shall be tested at 3 days.
- .13 When defects or non-conforming work is revealed, the Departmental Representative may request, at the Contractor's expense, additional review or testing to ascertain the full extent of the defect or non-conforming work.

3.18 DEPARTMENTAL REPRESENTATIVE'S GENERAL REVIEW

- .1 Departmental Representative will identify non-conforming work during general reviews and will submit written reports to Contractor.
- .2 Pay cost of Departmental Representative services incurred resulting from non-conforming work identified by Departmental Representative and requiring remedial Departmental Representative services to correct the work.
- .3 The Departmental Representative's general review during construction is undertaken to inform of the Contractor's performance and shall in no way augment the Contractor's quality control or relieve the Contractor of contractual responsibility.

END OF SECTION