

**Part 1 General**

**1.1 REFERENCES**

- .1 Canadian Standards Association (CSA), Contractor to reference latest in force standard.
  - .1 CSA-A23.1- Concrete Materials and Methods of Concrete Construction.
  - .2 CSA-A23.2- Test Methods and Standard Practices for Concrete
  - .3 CSA-S269.3 – Concrete Formwork
  - .4 CSA O121, Douglas Fir Plywood.
  - .5 CSA-O86 Engineering Design in Wood
  - .6 CSA O151, Canadian Softwood Plywood.
  - .7 CSA O153, Poplar Plywood.
  - .8 CAN3-O188.0, Standard Test Methods for Mat-Formed Wood Particleboards and Waferboard.
  - .9 CSA O437, Standards for OSB and Waferboard.
  - .10 CSA S269.1, Falsework for Construction Purposes.
  - .11 CAN/CSA-S269.3, Concrete Formwork.
- .2 A copy of the latest A23.1 and A23.2 shall be kept by the Contractor on site for the duration of the work and be made available for reference.

**1.2 SHOP DRAWINGS**

- .1 Submit shop drawings for formwork and falsework.
- .2 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.
- .3 Indicate formwork design data, such as permissible rate of concrete placement, and temperature of concrete, in forms.
- .4 Indicate sequence of erection and removal of formwork/falsework.
- .5 Each shop drawing submission shall bear stamp and signature of qualified professional engineer registered or licensed in Province of Alberta, Canada.

**Part 2 Products**

**2.1 MATERIALS**

- .1 Form Material
  - .1 For concrete without special architectural features, use wood and wood product formwork materials to CSA-O121, CSA-O86.1, CSA O437, and Series CSA-O153.

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- .2 For concrete with special architectural features, use formwork materials to CSA-A23.1 and CSA-A23.2.
  - .3 Exposed surfaces - metal, plywood or plywood lined. Plywood to conform to the Standard.
  - .4 Unexposed surfaces - metal, plywood, or wood lumber to conform to the Standard.
  - .5 Plywood and wood formwork materials shall, conform to the Standard, be free from warp and sawn straight so that lines and shapes will be accurately retained.
  - .6 Un-lined forms for unexposed surfaces shall be made with a good grade of lumber\_or plywood and fitted so that there will be no leakage of mortar.
  - .7 Use metal forms, plywood lined forms or plywood forms of sufficient structural strength for exposed surfaces. Plywood for lining shall be GIS exterior grade fir plywood with waterproof glue.
  - .8 Proprietary and/or modular forming systems shall be designed such that they do not interfere with the specified placement of reinforcement or other embedded hardware and must be pre-approved by the Department Representative.
- .2 Ties and Spreaders
- .1 Use metal form ties that are adjustable in length to permit tightening of forms. Use only the snap-off type of form ties which will permit no metal within 25mm (1") of the concrete surface after removal. Twisted wire form ties will not be accepted.
  - .2 Wood spreaders inside wall forms will not be permitted.
- .3 Form Release and Stripping Agents
- .1 Use a non-staining, non-toxic, biodegradable, low VOC form release agent that is compatible with any finishes specified elsewhere in the contract documents.
- .4 Void Form
- .1 Void form shall be of a deteriorating material.

**Part 3 Execution****3.1 GENERAL**

- .1 All phases of concrete formwork construction shall be in accordance with the Standard unless otherwise specified herein or on the drawings. Only workers who are skilled and experienced in their trade shall do the work.

**3.2 LINES AND LEVELS**

- .1 Verify lines, levels and column centers before proceeding with work and ensure that dimensions agree with drawings.
- .2 Co-ordinate and co-operate with all other trades in forming and setting of recesses, chases, sleeves, inserts, bolts, and hangers.

**3.3****DESIGN OF FORMWORK, FALSEWORK AND RESHORING**

- .1 The Contractor shall assume full responsibility for the structural adequacy of the forms to withstand all concrete, environmental, and construction loads.
- .2 All formwork, falsework and reshoring are to be designed and sealed by a professional engineer registered in the province of Alberta.
- .3 As a minimum, the work shall conform to CSA-A23.1, Section 6.5 for regular work and Section 8.3.4 for architectural concrete.
- .4 Where concrete is exposed to view, forms are to be laid out so that joints are kept to a minimum and located in an orderly and symmetrical arrangement wherever possible. Form ties shall be evenly spaced and located in straight horizontal and vertical lines. Spacing and location of form tie holes shall be detailed by the Contractor and approved. See also the architectural drawings and specifications for any special requirements for architectural concrete.
- .5 The strength and rigidity of forms shall be such that they will not leak mortar or result in visible irregularities in the finished concrete. In addition, the deflection of facing materials between studs, as well as the deflection of studs and walers, shall not exceed 0.0025 times the span.
- .6 Forms shall be so constructed that the finished concrete will conform to the shape, dimensions and tolerances as specified in the Standard or on the structural drawing, whichever is most rigorous. They shall also incorporate the cambers specified on the structural drawings. Movement resulting from form support deflection, closure of form joints, and elastic shortening of forms and shoring, must be calculated and added to the cambers indicated on the drawings.
- .7 Construct forms so that they may be dismantled and removed without damaging the concrete.
- .8 The Contractor shall submit details of the sequence and extent of formwork removal and re-shoring to the Departmental Representative for review. Such details shall include magnitude of loads and location of all re-shores at each level. Forms shall not be removed or adjusted until the review is complete. Such review does not relieve the Contractor of responsibility for formwork and safety during construction.
- .9 Set shores on wedges or use adjustable shores so they may be removed without causing undue strains in the concrete.
- .10 Do not exceed the safe capacity of the structure with any construction or shoring loads. The safe capacity of the structure may be taken as the design live load, as indicated on the structural drawings, multiplied by the ratio of the concrete strength at the time of loading to the specified concrete strength, but not greater than 1.0.

**3.4****FABRICATION AND ERECTION**

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

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- .2 Obtain approval or use of earth forms framing openings not indicated on drawings.
- .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 and COFI Exterior Plywood for Concrete Formwork.
- .5 Refer to architectural drawings for concrete members requiring architectural exposed finishes.
- .6 Do not place shores and mud sills on frozen ground.
- .7 Provide site drainage to prevent washout of soil supporting mud sills and shores.
- .8 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 and CSA-A23.2.
- .9 Align form joints and make watertight. Keep form joints to minimum.
- .10 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.
- .11 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.
- .12 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.
- .13 Sleeves and openings shown on the structural drawings must be confirmed with mechanical, electrical and architectural drawings. Any discrepancies are to be reported.
- .14 Sleeves and openings not shown on the structural drawings must be approved.
- .15 Keep all untreated forms moist to prevent shrinkage prior to placing of concrete and wet the surface at time of placing.
- .16 Treated formwork surfaces shall have the approved form coating applied in accordance with the manufacturer's recommendations, prior to placing reinforcing steel. Remove any excess form coating.

**3.5 TOLERANCES**

- .1 The tolerances for all concrete work shall conform to the requirements of the Standard and Drawings.

**3.6 PRODUCT HANDLING**

- .1 Protect formwork materials before, during and after installation and protect installed work and materials of other trades.
- .2 In the event of damage, immediately make required repairs or replacements necessary for approval at no extra cost.

**3.7 REMOVAL AND RESHORING**

- .1 Forms shall not be removed until concrete has attained sufficient strength that no damage to strength or continuity of concrete will occur when forms are removed. Time for formwork removal of suspended concrete shall be approved.
- .2 Prying against face of concrete to remove forms is not allowed, only wooden wedges shall be used.
- .3 Removal of form ties shall be done carefully to avoid marking concrete and to allow for patching. Grout bottom of form tie hole to prevent rust staining.
- .4 Remove formwork when concrete has reached its design strength or minimum approved period, whichever comes later, and replace immediately with adequate reshoring.
- .5 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.
- .6 Space reshoring in each principal direction at not more than 3000 mm apart.
- .7 Re-use formwork and falsework subject to requirements of CSA-A23.1 and CSA-A23.2.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 American Concrete Institute (ACI), Contractor to reference latest in force standard.
  - .1 SP-66-04, ACI Detailing Manual 2004.
- .2 ASTM International, Contractor to reference latest in force standard.
  - .1 ASTM A82/A82M, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
  - .2 ASTM A185/A185M, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
- .3 CSA International, Contractor to reference latest in force standard.
  - .1 CSA-A23.1 A23.2 Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
  - .2 CAN/CSA-A23.3 Design of Concrete Structures.
  - .3 CSA-G30.18-09 , Carbon Steel Bars for Concrete Reinforcement.
  - .4 CSA-G40.20/G40.21 General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
  - .5 CSA W186-M1990, Welding of Reinforcing Bars in Reinforced Concrete Construction.
- .4 Reinforcing Steel Institute of Canada (RSIC), Contractor to reference latest in force standard.
  - .1 RSIC-2004, Reinforcing Steel Manual of Standard Practice.

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 45 00.
- .2 Prepare reinforcement drawings in accordance with RSIC Manual of Standard Practice.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province Alberta of Canada.
    - .1 Indicate placing of reinforcement and:
      - .1 Bar bending details.
      - .2 Lists.
      - .3 Quantities of reinforcement.
      - .4 Sizes, spacings, locations of reinforcement and mechanical splices if approved by Department Representative, with identifying code marks to permit correct placement without reference to structural drawings.

- .5 Indicate sizes, spacings and locations of chairs, spacers and hangers.
  - .2 Detail lap lengths and bar development lengths to CAN/CSA-A23.3, unless otherwise indicated.
    - .1 Provide type B unless otherwise indicated.
  - .4 When Chromate solution is used as replacement for galvanizing non-prestressed reinforcement, provide product description for review by Departmental Representative prior to its use.

### **1.3 QUALITY ASSURANCE**

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

### **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 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 in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 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 400R, deformed bars to CSA-G30.18, unless indicated otherwise.
- .3 Reinforcing steel: weldable low alloy steel deformed bars to CSA-G30.18.
- .4 Welded steel wire fabric: to ASTM A185/A185M.
  - .1 Provide in flat sheets only.
- .5 Welded deformed steel wire fabric: to ASTM A82/A82M.
  - .1 Provide in flat sheets only.
- .6 Chairs, bolsters, bar supports, spacers: to CSA-A23.1/A23.2.

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.7 Mechanical splices: subject to approval of Departmental Representative.

.8 Plain round bars: to CSA-G40.20/G40.21.

**2.2 FABRICATION**

.1 Fabricate reinforcing steel in accordance with CSA-A23.1/A23.2 Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.

.1 SP-66 unless indicated otherwise.

.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 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.

**2.3 SOURCE QUALITY CONTROL**

.1 Upon request, provide Departmental Representative with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis, minimum 4 weeks prior to beginning reinforcing work.

.2 Upon request inform Departmental Representative of proposed source of material to be supplied.

**Part 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 slow and steady pressure.

.3 Replace bars, which develop cracks or splits.

**3.2 PLACING REINFORCEMENT**

.1 Place reinforcing steel as indicated on placing drawings in accordance with CSA-A23.1/A23.2.

.2 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 Prior to placing concrete, obtain Departmental Representative's approval of reinforcing material and placement.

.4 Ensure cover to reinforcement is maintained during concrete pour.



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- .5 Protect paint coated portions of bars with covering during transportation and handling.

**3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

**END OF SECTION**

**Part 1        General****1.1        REFERENCES**

- .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 Reference Standards, Contractor to reference latest in force standard.
  - .1 ASTM International
    - .1 ASTM C260/C260M-10a, Standard Specification for Air-Entraining Admixtures for Concrete.
    - .2 ASTM C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
    - .3 ASTM C494/C494M-10a, Standard Specification for Chemical Admixtures for Concrete.
    - .4 ASTM C1017/C1017M, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
    - .5 ASTM D412-06ae2, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
    - .6 ASTM D624-00, Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomer.
    - .7 ASTM D1751-04, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
    - .8 ASTM D1752-04a, Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
  - .2 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, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
  - .3 CSA International
    - .1 CSA A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
    - .2 CSA A283, Qualification Code for Concrete Testing Laboratories.
    - .3 CSA A3000, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 45 00.
- .2 At least 4 weeks prior to beginning Work, provide Departmental Representative with samples of materials proposed for use as follows:
  - .1 5 L of curing compound.
  - .2 1 m length of each type of joint filler.
  - .3 1 m length of each type of water-stops.
  - .4 3 kg of each type of supplementary cementing material.
  - .5 10 kg of each type of blended hydraulic cement.
  - .6 5 kg of each admixture.
  - .7 1 kg of each fine and coarse aggregate.
- .3 Provide testing results 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.

**1.3 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.

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- .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.

**1.4 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 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.

**Part 2 Products****2.1 DESIGN CRITERIA**

- .1 Performance: 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.
- .2 Water: to CSA A23.1.
- .3 Aggregates: to CSA A23.1/A23.2.
- .4 Admixtures:
  - .1 Air entraining admixture: to CAN3-A266.1.
  - .2 Chemical admixture: to CAN3-A266.2
- .5 Curing compound: to CSA A23.1/A23.2.
- .6 Polyethylene film: 150 micrometre thickness, to CAN/CGSB-51.34.

**2.4 MIXES**

- .1 Alternative 1 - Performance Method for specifying concrete: to meet 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.

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- .2 Provide concrete mix to meet the Performance Alternative outlined in Table 5 of CAN/CSA-A23.1
- .3 Provide concrete mix to meet following hard state requirements:
  - .1 Durability and class of exposure: C-1
  - .2 Compressive strength at 28 days age: 35 MPa minimum.
- .4 Provide quality management plan to ensure verification of concrete quality to specified performance.
- .5 Concrete supplier's certification: both batch plant and materials meet CSA A23.1 requirements.

**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 In locations where new concrete is dowelled to existing work, drill holes in existing
- .11 Do not place load upon new concrete until authorized by Departmental Representative.

**3.2 INSTALLATION/APPLICATION**

- .1 Do cast-in-place concrete work to CSA A23.1/A23.2.
- .2 Sleeves and inserts:

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- .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 Department Representative.
  - .4 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain written approval of modifications from Department 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.
- .3 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: to manufacturers' recommendations.
  - .3 Protect anchor bolt holes from water accumulations, snow and ice build-ups.
  - .4 Set bolts and fill holes with 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.
- .4 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.
- .5 Grout under base plates using procedures in accordance with manufacturer's recommendations which result in 100 % contact over grouted area.
- .6 Finishing and curing:
- .1 Finish concrete to CSA A23.1/A23.2.
  - .2 Use procedures as reviewed by 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 Provide screed is to be applied.

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- .5 Provide screed finish unless otherwise indicated.
- .6 Rub exposed sharp edges of concrete with carborundum to produce 3 mm minimum radius edges unless otherwise indicated.
- .7 Waterstops:
  - .1 Install waterstops to provide continuous water seal.
  - .2 Do not distort or pierce waterstop in way as to hamper performance.
  - .3 Do not displace reinforcement when installing waterstops.
  - .4 Use equipment to manufacturer's requirements to field splice waterstops.
  - .5 Tie waterstops rigidly in place.
  - .6 Use only straight heat sealed butt joints in field.
  - .7 Use factory welded corners and intersections unless otherwise approved by Departmental Representative.
- .8 Joint fillers:
  - .1 Furnish filler for each joint in single piece for depth and width required for joint, unless otherwise authorized by Departmental Representative.
  - .2 When more than one piece is required for joint, fasten abutting ends and hold securely to shape by stapling or other positive fastening.
  - .3 Locate and form expansion joints as indicated.
  - .4 Install joint filler.
  - .5 Use 12 mm thick joint filler to separate slabs-on-grade from vertical surfaces and extend joint filler from bottom of slab to within 12 mm of finished slab surface unless indicated otherwise.
- .9 Dampproof membrane:
  - .1 Install dampproof membrane under concrete slabs-on-grade inside building.
  - .2 Lap dampproof membrane minimum 150 mm at joints and seal.
  - .3 Seal punctures in dampproof membrane before placing concrete.
  - .4 Use patching material at least 150 mm larger than puncture and seal.

**3.3 SURFACE TOLERANCE**

- .1 Concrete tolerance to CSA A23.1.

**3.4 FIELD QUALITY CONTROL**

- .1 Site tests: conduct tests as follows and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
  - .1 Concrete pours.
  - .2 Slump.
  - .3 Air content.
  - .4 Compressive strength at 28 days.
  - .5 Air and concrete temperature.

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- .2 Inspection and testing of concrete and concrete materials will be carried out by testing laboratory designated to CSA A23.1/A23.2.
  - .1 Ensure testing laboratory is certified to CSA A283.
- .3 Ensure test results are distributed for discussion at pre-pouring concrete meeting between testing laboratory and Departmental Representative
- .4 The cost of test results and mix design beyond those called for in the contract documents or beyond those required by law of place of work shall be appraised by Department Representative and may be authorized as recoverable.
- .5 Departmental Representative will take additional test cylinders during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they represent.
- .6 Non-Destructive Methods for Testing Concrete: to CSA A23.1/A23.2.
- .7 Inspection or testing by Departmental Representative will not augment or replace Contractor quality control nor relieve Contractor of his contractual responsibility.

**3.5 CLEANING**

- .1 Clean in accordance with Section 01 74 00 - Cleaning.

**3.6 TESTING – CONCRETE**

- .1 All strength tests shall be numbered consecutively and the cylinders marked as follows:
  - .1 7-Day Test: Marked "A".
  - .2 28-Day Test: Two (2) cylinders marked "B" and "C".
  - .3 56-Day Test: Where these are required by the drawings and specifications, two (2) cylinders marked "D" and "E".
- .2 All tests reports shall record:
  - .1 Name of Project
  - .2 Date and time of sampling
  - .3 Name of supplier
  - .4 Delivery truck number
  - .5 Batch time and discharge time
  - .6 Identification of sampling and testing technicians
  - .7 Exact location in the structure of the concrete sampled
  - .8 Design strength of concrete sampled
  - .9 Admixtures, cement type, maximum aggregate size
  - .10 Air and concrete temperature
  - .11 Slump and air content
- .3 All field cured cylinders shall be marked "F"
- .4 Slump tests shall be performed prior to the addition of superplasticizers.



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- .5 Tests for slump and air content shall be taken with each strength test and as required by the specifications and drawings.
- .6 Regular testing of concrete
  - .1 To confirm to the standard, except each test consist of three (3) cylinders – one (1) for 7-days strength and two (2) for 28-days strength. Provide two (2) extra cylinders for 56-days strength requirements on S-2 exposure class concrete.
  - .2 Regular testing applied to all concrete elements.

**3.7 FILED CURED CYLINDERS**

- .1 Field cured cylinders shall be protected against wind and be stored on the floor immediately below the slab they represent unless the floor below is heated. In that case they shall be stored on top of the slab but covered with a plywood box. The cylinders are to be undisturbed at this location until picked up by the Testing Agency. Field core cylinders are not to be stored in temperature controlled containers

**END OF SECTION**