

Part 1 General

1.1 Work Included

- .1 Forms for all concrete and supporting falsework including design
- .2 Wood and or steel forms for all cast-in-place concrete
- .3 Shoring, bracing, and anchorage
- .4 Form openings for other trades
- .5 Coordinate installation of concrete accessories
- .6 Set anchor bolts, anchors, sleeves, frames and other items supplied by other trades
- .7 Clean erected formwork prior to concrete placement
- .8 Remove forms and supporting falsework
- .9 Reshoring

1.2 Design Standards

- .1 Design and detail forms and supporting falsework in accordance with the current editions of the NBC of Canada, CAN/CSA-A23.1, CSA S269.1, CAN/CSA S269.3, ACI 347R and applicable construction safety regulations.
- .2 Design to be done by a Professional Engineer, registered in the Province of Manitoba. The Engineer doing the design shall review the in-place formwork and certify in writing that the formwork is in conformance with his or her design.

1.3 Quality Assurance

- .1 Construct and erect concrete formwork in accordance with CAN/CSA-A23.1, CAN/CSA S269.3, ACI 347R and all applicable construction safety regulations for the place of Work.

1.4 Shop Drawings

- .1 Submit Shop Drawings in accordance with Section CW 1100.
- .2 Clearly indicate sizes, methods of construction, materials, arrangement of joints, ties and shores, location and size of falsework, schedule of erection and stripping, restoring, etc.
- .3 Shop Drawings and design briefs are to bear the seal of a Professional Engineer, registered in the Province of Manitoba.
- .4 Formwork, falsework and reshoring are to be reviewed by the same Professional Engineer prior to each concrete casting.
- .5 Professional Engineer to report, in writing, that reviewed formwork, falsework and reshoring are in accordance with the design, prior to each concrete casting.
- .6 Shop Drawings shall be reviewed and returned by contract Administrator within 7 Business Days of submittal.

Part 2 PRODUCTS

2.1 Exposed Surfaces

- .1 Square-edged, smooth surfaced panels true in plane, free of holes, surface markings or defects.

2.2 Unexposed Surfaces

- .1 Square-edged T&G lumber, plywood or other material, suitable to retain concrete without leakage or distortion.

2.3 Wood Materials

- .1 Plywood: Douglas Fir, conforming to CSA O121 solid one side, sheathing grade. Sound undamaged sheets with clean true edges.
- .2 Lumber: conforming to CAN/CSA-O141.
- .3 Nails, Spikes and Staples: galvanized.

2.4 Prefabricated Forms

- .1 Steel Type: minimum 1.6 mm steel thickness; well matched, tight fitting and adequately stiffened to support weight of concrete without deflection detrimental to structural tolerances and appearance of finished concrete surface.

2.5 Accessories

- .1 Form Ties: removable snap-off metal type, fixed length, minimum working strength of 13 kN when assembled; free of defects that will leave holes deeper than 25 mm from concrete surface. Use plastic cone snap type or screw type on exposed surfaces. Wire ties are not permitted.
- .2 Form Release Agent: colourless mineral oil that will not stain concrete or impair natural bonding or colour characteristics of coating intended for use on concrete.
- .3 Corner or Chamfer Fillets: mill finished pine, 25 mm width, maximum possible lengths, mitre ends.
- .4 Reglets: mill finished pine, shaped to required cross-section, maximum possible lengths, mitre ends.
- .5 Sealing tape: reinforced, self-adhesive, waterproof kraft.

Part 3 EXECUTION

3.1 Examination

- .1 Before starting this work, examine work done by others which affects this work.
- .2 Notify the Contract Administrator of any conditions which would prejudice proper completion of this work.
- .3 Prior to the erection of the formwork, the construction joint shall be sand blasted and cleaned in accordance with Section 03 30 00 – Cast-in-Place Concrete.
- .4 Commencement of the work implies acceptance of existing conditions.

3.2 Erection

- .1 Verify lines, levels and centres before proceeding with formwork. Ensure dimensions agree with Drawings.
- .2 Construct formwork and falsework to meet design and regulatory requirements and to produce finished concrete conforming to surfaces, shapes, lines and dimensions indicated on Drawings.
- .3 Arrange and assemble formwork to permit removal without damage to concrete.
- .4 Align joints and make watertight to prevent leakage of cement paste and disfiguration of concrete. Keep form joints to a minimum. Tape joints as necessary.
- .5 Arrange forms to allow removal without removal of principal shores, where these are required to remain in place.
- .6 Obtain the Contract Administrator's acceptance before framing openings in concrete slabs, beams, walls and columns not indicated on Drawings.
- .7 Provide falsework to ensure stability of formwork. Prop or strengthen all previously constructed parts liable to be overstressed by construction loads.
- .8 Position form joints to suit any expressed lines required in exposed concrete.
- .9 Provide chamfer on all external corners and fillets on all internal corners and edges of exposed concrete unless shown otherwise.
- .10 Form chases, slots, openings, drips and recesses as detailed on the Drawings.
- .11 Set screeds with top edge level to required elevations.
- .12 Check and readjust formwork to required lines and levels during placing of concrete.
- .13 Where construction joints are required in beams and suspended slabs, form joints at the one third point in the span unless shown or noted otherwise on Drawings.
- .14 Provide reveal or reglet on construction joints as shown on the Drawings.

3.3 Tolerance

- .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.
 - .4 Deviation of 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.
- .2 Camber beams and suspended slabs 6 mm per 3 m of span unless otherwise indicated on the Drawings. Review method of providing camber with the Contract Administrator prior to proceeding. Maintain beam depth and slab thickness from cambered surface.

3.4 Inserts/Embedded Items/Openings

- .1 Provide formed openings where required for pipes, conduits, sleeves and other work to be embedded in and passing through concrete members.
- .2 Accurately locate and set in place items that are to be cast directly into concrete.
- .3 Coordinate work of other Sections and Divisions and cooperate with trades involved in forming openings, slots, recesses, chases and setting sleeves, bolts, anchors and other inserts.
- .4 Coordinate installation of concrete accessories as specified in Section 03 25 00 – Concrete Accessories.
- .5 Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.
- .6 Close temporary ports or openings with tight fitting panels, flush with inside face of forms, neatly fitted so no leakage occurs and to provide a uniform surface on exposed concrete.

3.5 Field Quality Control

- .1 Inspect and check complete formwork, falsework, shoring and bracing to ensure that work is in accordance with formwork design and that supports, fastenings, wedges, ties and parts are secure.
- .2 Inform the Contract Administrator when formwork is complete and has been cleaned, to allow for review. The Contract Administrator's review will be for verification that earth bottoms are clean and that forms are clean and free from debris.
- .3 Allow the Contract Administrator to review each section of formwork prior to re-use. Formwork may be re-used if acceptable to the Contract Administrator. Re-use of forms shall be subject to the requirements of CAN/CSA-A23.1.

3.6 Cleaning

- .1 Clean formwork in accordance with CAN/CSA-A23.1. Clean forms as erection proceeds to remove foreign matter. Remove cuttings, shavings and debris from within forms. Flush completely with water to remove remaining foreign matter. Ensure that water and debris drain to exterior through cleanout ports.
- .2 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 is within a heated enclosure. Use compressed air or other means to remove foreign matter.

3.7 Formwork Preparation

- .1 Apply form release agent in accordance with Manufacturer's recommendations, prior to placing reinforcing steel, anchoring devices and embedded parts.
- .2 Do not apply form release agent where concrete surfaces are to receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces moist prior to placing concrete.

3.8 Form Removal

- .1 Notify the Contract Administrator prior to removing formwork.
- .2 Do not remove forms and falsework until concrete has gained either sufficient strength to carry its own weight, plus construction loads and design loads that are liable to be imposed or 75% of design compressive strength, whichever is greater. Verify strength of concrete by compression tests to satisfaction of Contract Administrator.
- .3 Remove falsework progressively, in accordance with regulatory requirements and ensure that no shock loads or imbalanced loads are imposed on structure.
- .4 Loosen forms carefully without damaging concrete surfaces. Do not apply tools to exposed concrete surfaces.
- .5 Leave forms loosely in place for protection until curing requirements are complete.

END OF SECTION

Part 1 General

1.1 Work Included

- .1 Reinforcing steel bars for cast-in-place concrete complete with tie wire.
- .2 Support chairs, bolsters, bar supports, spacers and tie wire for reinforcing.

1.2 Quality Assurance

- .1 Perform concrete reinforcing work in accordance with CAN/CSA-A23.1.

1.3 Inspection and Testing

- .1 If requested by the Contract Administrator, submit three (3) certified copies of the mill test report of reinforcement supplied, indicating physical and chemical analysis.

1.4 Shop Drawings

- .1 Submit bar lists and placing drawings in accordance with CW1100
- .2 Clearly indicate bar sizes, spacings, locations and quantities of reinforcing steel, bending and cutting schedules and supporting and spacing devices.
- .3 Drawings and details to conform to CAN/CSA-A23.1, CAN/CSA-A23.3 and RSIC's Reinforcing Steel Manual of Standard Practice.
- .4 Detail placement of reinforcing where special conditions occur.
- .5 Detail lap lengths and bar development lengths to CAN/CSA-A23.1, unless otherwise shown on the Drawings.
- .6 Shop Drawings shall be reviewed and returned by contract Administrator within 7 Business Days of submittal.

1.5 Delivery and Storage

- .1 Deliver, handle and store reinforcement in a manner to prevent damage and contamination.
- .2 Deliver bars in bundles, clearly identified in relation to bar lists.

Part 2 PRODUCTS

2.1 Reinforcing Materials

- .1 Reinforcing Steel: 400 MPa yield grade; deformed billet steel bars conforming to CAN/CSA-G30.18; plain finish.

2.2 Accessory Materials

- .1 Tie Wire: minimum 1.6 mm annealed type or patented system accepted by the Contract Administrator.
- .2 Chairs, Bolsters, Bar Supports and Spacers: adequately sized for strength and support of reinforcing steel during construction.

- .3 Bar chairs to be non-corrosive PVC chairs or purpose made concrete chairs. Steel bar chairs, galvanized bar chairs, concrete bricks, broken concrete blocks, or wood supports are not acceptable.
- .4 Side form spacers to be non-corrosive PVC spacers, purpose made, PVC chairs or purpose made concrete chairs. Steel bar chairs, galvanized bar chairs, concrete bricks, broken concrete blocks, or wood supports are not acceptable.

Part 3 EXECUTION

3.1 Examination

- .1 Before starting this work, examine work done by others that affects this work.
- .2 Notify the Contract Administrator of any conditions that would prejudice proper completion of this work.
- .3 Commencement of work implies acceptance of existing conditions.

3.2 Fabrication

- .1 Fabricate reinforcing steel in accordance with CAN/CSA-A23.1 and the Drawings.
- .2 Locate reinforcing splices not indicated on the Drawings at points of minimum stress.
- .3 Fabricate within the following tolerances:
 - .1 Sheared length: plus 0, minus 25 mm
 - .2 Depth of truss bars: plus 0, minus 10 mm
 - .3 Stirrups, ties and spirals: plus 0, minus 10 mm
 - .4 Other bends: plus 0, minus 25 mm
- .4 All bending shall be done cold with a suitable machine accurately producing all lengths, depths and radii shown on the bending details.
- .5 After initial fabrication, reinforcing steel shall not be re-bent or straightened unless so indicated on the Drawings.
- .6 Heating of reinforcing steel will not be permitted.

3.3 Installation

- .1 Place reinforcing steel in accordance with reviewed placing drawings and CAN/CSA-A23.1. Chairs supporting slab reinforcing shall not be further apart than 1200 mm in either direction. Tie reinforcing steel at maximum spacing 600 mm.
- .2 Adequately support reinforcing and secure against displacement within tolerances permitted.
- .3 Place reinforcing steel to provide concrete cover required by CAN/CSA-A23.1, but not less than shown in following sentence.
- .4 Place reinforcing steel to provide concrete cover as follows, unless shown otherwise on the Drawings:

Item	Coverage (mm)
Beam Stirrups	40
Suspended slabs (top and bottom)	50
Walls (both faces)	50
Concrete formed against earth (bottom of slab on grade)	75

.5 Maintain alignment as follows:

Item	Tolerances (mm) Plus or Minus
Slabs	5
Other structural members	10
Rebar bends and ends	50

.6 Install purpose made highly visible protective safety caps on all exposed projecting bar ends.

3.4 Safety Protection for Reinforcing Ends

- .1 Highly visible protection safety caps shall be installed for all reinforcing ends immediately following placement of bars.
- .2 The protection caps shall be highly visible and shall be made secure so that accidental contact will not easily dislodge the caps. Dislodged caps shall be re-installed immediately.

3.5 Cleaning

- .1 Ensure concrete reinforcing is clean and free from oil and deleterious matter.
- .2 Remove all loose scale, loose rust, concrete from prior pours and other deleterious matter from surfaces of reinforcing.

END OF SECTION

Part 1 General

1.1 Work Included

- .1 Backer Rods
- .2 Joint sealants
- .3 PVC Waterstop
- .4 Non-ferrous grout
- .5 Latex patching agent
- .6 Epoxy bonding agent
- .7 Curing and sealing compounds
- .8 Moisture retention film
- .9 Repair mortar

1.2 Qualifications

- .1 All waterstopping and sealant installations are to be done by an established firm having at least five (5) years of proven, satisfactory experience in this trade and employing skilled personnel.
- .2 If requested by the Contract Administrator, submit proof of qualifications in writing to the Contract Administrator prior to commencement of work.

Part 2 PRODUCTS

2.1 Materials

- .1 Pre-moulded expansion joint filler (for joints associated with slabs on grade such as pads at doors): asphalt impregnated vegetable or cane fibreboard, conforming to ASTM D1751, sizes indicated on Drawings. Acceptable products: W. R. Meadows Sealtight Fibre Expansion Joint Filler complete with Snap-Cap and Sealtight #164, Hi-Spec, or Cold Applied SOF-Seal sealant or Fosroc Fibreboard complete with Pliastic or Colpor 200PF sealant.
- .2 Backer Rod: closed cell vinyl foam.
- .3 PVC Waterstop: to conform to CGSB 41-GP-35M PVC, edges wire looped for tying. Acceptable product is Wirestop CR-6380 by Paul Murphy. Factory fabricated and tested PVC waterstop vertical and horizontal cross, L and T shaped junction sections are to be used.
- .4 Non-ferrous grout: pre-mixed, non-shrink, minimum 35 MPa compressive strength; Master Builders 713, Sika M-Bed, CPD Non-Shrink Grout or Steel C1 Grout.
- .5 Latex Patching Agent: Duraweld-C Latex Bonding Agent.
- .6 Epoxy Bonding Agent: Master Builders Coneresive 1001 LPL, Dural Duralbond or Sikadur 32 HI-bond.

- .7 Curing and sealing compound: conforming to ASTM C 1315, Type II, Class A; shall be compatible with scheduled finishes and coatings and permeability shall not exceed 0.40 kg/m²/72 hrs. Acceptable products: Sika Florseal WB 25 or Sonneborn Kure-N-Seal 30.
- .8 Moisture Retention Film: Master Builders Confilm, Sika Film or TK Products Tri-Film.
- .9 Repair Mortar: Meadow-Crete H by W.R. Meadows.
- .10 Penetrating Sealing: Sikafloor 3S by Sika, colour clear.

Part 3 EXECUTION

3.1 Examination

- .1 Before starting this work, examine work done by others that affects this work.
- .2 Notify the Contract Administrator of any conditions that would prejudice proper completion of this work.
- .3 Commencement of work implies acceptance of existing conditions.

3.2 Installation

- .1 Pre-installation conference for waterstopping, sealant and epoxy injection products: 1 (one) week prior to installation of the above products, the Contractor shall conduct a meeting with applicators, installers of work adjacent to or that penetrates the waterstop or sealant products and the Contract Administrator to review the following:
 - .1 General project requirements.
 - .2 Manufacture's product data sheets and installation guides.
 - .3 Substrate conditions and procedures for substrate preparation and product installations.
 - .4 Responsibility and costs associated with verification and correlation of field dimensions, fabrication processes, techniques of construction, installation and coordination for all parts of the work rests with the Contractor.
- .2 Install all concrete accessories in accordance with Drawings and Manufacturers' recommendations and ensure compatibility. Install straight, level and plumb.
- .3 Ensure items are not disturbed during concrete placement.
- .4 Coordinate work of this Section with other construction.

3.3 PVC Waterstop

- .1 Install PVC waterstop in all joints in a continuous and inter-connected.
- .2 All waterstop joints other than straight butt joints shall be factory fabricated and tested by the waterstop supplier. All field splices shall be heat-fused and tested for complete seals by use of a corona discharge unit, costs for testing to be paid for by Contractor.
- .3 Install waterstop continuous without displacing reinforcement. Butt weld splices to Manufacturer's directions. Secure in place to prevent dislodgment during placing of concrete.
- .4 Take particular care to correctly position the waterstop during installation. Tie the waterstop adequately for support in accordance with Manufacturer's instructions, but at

spacings no greater than 300 mm to ensure proper embedment, symmetrical about the joint and to prevent displacement during concrete placement. Fully compact the concrete in the region of the waterstop during the placing of the concrete.

- .5 Do not place concrete until waterstop has been reviewed by the Contract Administrator.

3.4 Latex Patching Agent

- .1 Latex patching agent is to be used for patching formed concrete surfaces where required, installed to Manufacturer's instructions.

3.5 Repair Mortar

- .1 Apply repair mortar for defective concrete where directed by the Contract Administrator.
- .2 Prepare surfaces and apply repair mortar to Manufacturer's instructions. Use pea gravel to extend the mixture in accordance with the Manufacturer's instructions.

END OF SECTION

Part 1 General

1.1 Work Included

- .1 Supply of all reinforced cast-in-place concrete shown on the Drawings
- .2 Setting anchors, inserts, frames, sleeves and other items supplied by other Sections
- .3 Placing and curing of concrete
- .4 Finishing concrete slab surfaces
- .5 Finishing formed concrete surfaces
- .6 Repairing concrete imperfections

1.2 Quality Control

- .1 The Contractor shall be fully responsible for quality control of all aspects of production, pre-placement, placement and post-placement of concrete
- .2 Contractor will arrange, conduct and pay for Quality Control related testing.
- .3 Cast-in-place concrete shall conform to the CAN/CSA-A23.1. Concrete shall be delivered under the Performance alternative as outlined in CAN/CSA-A23.1, Table 5.
- .4 Testing of cast-in-place concrete shall be performed by a CAN/CSA-A23.1 certified Third Party Testing Agency. Testing shall conform to CAN/CSA-A23.1/A23.02. Third Party testing for quality control shall be paid for by the Contractor.
- .5 Distribute the Third Party Testing Agency test data to the Contract Administrator and Owner immediately upon receiving.
- .6 Submit a Quality Control Plan a minimum of six (6) weeks prior to first scheduled concrete casting and implement the Quality Control Plan for all castings. The Quality Control Plan shall as a minimum include:
 - .1 Identify the Quality Control Manager
 - .2 Concrete supplier certification with Manitoba Ready Mixed Concrete Association
 - .3 Qualifications of construction supervisory personnel
 - .4 Quality Control testing plan for concrete
 - .5 Pre-placement procedures, checklists and project specific finishing procedures for concrete
 - .6 During placement contingency plans and procedures
 - .7 Post-placement procedures and checklists for concrete
- .7 Submit documentation a minimum of six (6) weeks prior to the first scheduled concrete casting demonstrating that the proposed mix designs and materials will achieve the required strength, durability and performance requirements.

1.3 Quality Assurance

- .1 Checklists supplied by the Contractor will be used for reviewing the work.

- .2 Notify the Contract Administrator at least forty-eight (48) hours before complete formwork, embedded items and concrete reinforcement is ready for review. Embedded items and reinforcing in walls shall be reviewed prior to closing forms.
- .3 Allow ample time for review and for corrective work, if required, before scheduling concrete placement.
- .4 The Owner reserves the right to arrange and pay for an Owner's CAN/CSA-A23.1 certified Third Party Testing Agency to test the concrete works. Provide unencumbered access to all portions of the work and cooperate with appointed Third Party Testing Agency.

Part 2 PRODUCTS

2.1 General

- .1 All materials in concrete mixes shall be compatible.

2.2 Concrete Materials

- .1 Portland Cement: Type GU and Type HS or HSb conforming to CSA-A3000. When HSb is proposed, submit supporting testing data showing conformance to sulphate expansion requirements in CSA-A3000 satisfactory to the Contract Administrator. Blended cements shall be used as blended by the Manufacturer without additional substitution of cement with supplementary cementing materials unless the resulting blend is supported with testing data showing conformance to sulphate expansion requirements in CSA-A3000 satisfactory to the Contract Administrator.
- .2 Fine aggregate: conforming to Normal-Density Fine Aggregate, CAN/CSA-23.1, Table 10 and Table 12.
- .3 Coarse aggregate: conforming to Normal-Density Coarse Aggregate, CAN/CSA-23.1, Table 11, Group I, 20-5 mm. Group II may be used for special requirements such as gap grading, pumping or for blending two or more sizes to produce Group I gradings.
- .4 Ensure that no aggregates are used that may undergo volume change due to alkali reactivity, moisture retention or other causes. Confirm suitability of aggregate with a petrographic analysis.
- .5 Water: potable, clean and free from injurious amounts of oil, alkali, organic matter or other deleterious matter, meeting requirements of CAN/CSA-A23.1, Table 9.
- .6 Materials are to be obtained from the same source of supply or Manufacturer for the duration of the project.
- .7 Supplementary cementing materials: conforming to CSA-A3000.

2.3 Admixtures

- .1 Air entrainment: conforming to ASTM Standard C260.
- .2 Chemical admixtures, water-reducing agent, superplasticizer: conforming to ASTM Standard C494.
- .3 Admixtures containing chloride will not be permitted.

2.4 Accessories

- .1 For accessories refer to Section 03 25 00 – Concrete Accessories.

2.5 Concrete Mixes

- .1 Provide concrete mixed in accordance with requirements of CAN/CSA-A23.1 and this specification Section. Pay all costs for the mix design.
- .2 Concrete design compressive strength and class of exposure as indicated in attached Table 1.
- .3 Concrete mixes are to be designed to mitigate dry and plastic temperature and shrinkage cracks.
- .4 Use accelerating admixtures in cold weather only when accepted by the Contract Administrator. If accepted, the use of admixtures will not relax cold weather placement requirements. Do not use calcium chloride.
- .5 Use set-retarding admixtures during hot weather only when accepted by the Contract Administrator.
- .6 All admixtures are subject to acceptance by the Contract Administrator. List all proposed admixtures in mix design statement submission. Do not change or add admixtures to accepted design mixes without the Contract Administrator's review and acceptance.
- .7 Concrete delivered to Site must be accompanied by a delivery slip in accordance with CAN/CSA-A23.1.

Part 3 EXECUTION

3.1 Pre-Installation Conference

- .1 Pre-Installation Conference for cast-in-place concrete: one (1) week prior to installation of concrete works, the Contractor shall conduct a meeting with mix designer, batch plant Quality Control Manager, Third Party Testing Agency Representative, concrete installers, concrete finishers, waterstop installers, concrete curing applicators, reinforcing steel installers, installers of work adjacent to or that penetrates the concrete works and the Contract Administrator to review the following:
 - .1 General project requirements
 - .2 Contractors Quality Control Plan for each class of concrete
- .2 Provide agenda and meeting minutes. Distribute agenda to the attendees four (4) days prior to the Pre-Installation Conference. Distribute Pre-Installation Conference meeting minutes within four (4) days of the meeting.
- .3 Pay for all costs associated with the Pre-Installation Conference excluding the Contract Administrator cost.

3.2 Placing Concrete

- .1 Place concrete in accordance with requirements of CAN/CSA-A23.1 and as indicated on the Drawings. Layout of the work and accuracy of same is the Contractor's sole responsibility.
- .2 Place concrete to mitigate dry and plastic temperature and shrinkage cracks.

- .3 Prior to the erection of the formwork, the construction joint shall be sand blasted and cleaned as per Clause below titled "Construction Joints".
- .4 Notify the Contract Administrator a minimum of forty-eight (48) hours prior to placing concrete. Under no circumstances shall concrete be placed without notifying Contract Administrator.
- .5 Arrange for testing of cast-in-place concrete.
- .6 The concrete shall be placed rapidly and evenly as near to its final position as possible to reduce the risk of segregation, flow lines and cold joints.
- .7 Ensure all anchor bolts, seats, plates and other items to be cast into concrete are securely placed and will not interfere with concrete placement or be displaced during casting.
- .8 All equipment for transporting the concrete shall be cleaned of hardened concrete and foreign materials before placing concrete.
- .9 Immediately before concrete is placed, Contractor shall carefully inspect all forms to ensure that they are properly placed, sufficiently rigid and tight and that all reinforcing steel and embedded parts are in the correct position and secured against movement during the placing operation. All forms shall be thoroughly cleaned and material removed.
- .10 Concrete shall be handled from the mixer to the place of final deposit as rapidly as practicable by methods that will prevent the separation or loss of the ingredients. Concrete shall be deposited in the forms as nearly as practicable in its final position to avoid re-handling or flowing. Vibrators shall not be used to move concrete. Under no circumstances shall the concrete, which has partially hardened, be deposited in the forms.
- .11 Concrete shall be thoroughly compacted by mechanical vibrators during placing operations. Concrete shall be thoroughly worked around the reinforcement, embedded fixtures and into the corners of the forms.
- .12 Vibrate concrete using the appropriate size equipment as placing proceeds, in accordance with CAN/CSA-A23.1. Check frequency and amplitude of vibrations prior to use. Provide additional standby vibrators in the event of equipment failure.
- .13 Where placing operations would involve dropping the concrete more than 1500 mm, it shall be placed through canvas hoses or galvanized iron chutes. Concrete shall not be raised at a rate greater than that for which proper vibration may be affected.
- .14 In locations where new concrete is dowelled to existing concrete, drill holes in existing concrete, insert steel dowels and pack solidly with epoxy grout suitable for intended exposure.
- .15 At construction or expansion joints a minimum of three days shall elapse between adjacent castings and the adjacent casting shall have obtained 75% of the design strength.
- .16 Do not place concrete if carbon dioxide producing equipment has been in operation in the building or in the enclosure during the twelve (12) hours preceding the pour. This equipment shall not be used during placing or for twenty-four (24) hours after placing. During placing and curing concrete, surfaces shall be protected by formwork or an impermeable membrane from direct exposure to carbon dioxide, combustion gases or drying from heaters.
- .17 Honeycomb or embedded debris is not acceptable.
- .18 Remove and replace defective concrete.

- .19 Maintain accurate records of cast-in-place concrete items. Record date, location of pour, quantity, air temperature and test samples taken.
- .20 Prepare set or existing concrete by removing all laitance and loose or unsound materials and apply bonding agent in accordance with Manufacturer's recommendations.

3.3 Hot and Cold Weather Concreting

- .1 Deliver, place and cure concrete in hot or cold weather in accordance with the requirements in CAN/CSA-A23.1.

3.4 Concrete Protection for Reinforcement

- .1 Ensure reinforcement is placed to provide minimum concrete cover in accordance with Section 03 20 00 – Concrete Reinforcement.

3.5 Construction Tolerance

- .1 The work shall be carefully and accurately set out; true to the positioning, levels, slopes and dimensions shown on the Drawings and conforming to Sections 03 10 00 – Concrete Formwork and 03 20 00 – Concrete Reinforcement.
 - .1 Sizes of member or thickness of slabs: ± 6 mm
 - .2 Cover of concrete over reinforcement: ± 3 mm
 - .3 Variations from plumb: 6 mm in 3.0 m, 10 mm maximum
- .2 If these tolerances are exceeded, the Contractor may, at the discretion of the Contract Administrator, be required to remove and replace or to modify the placed concrete before acceptance. The costs incurred by the Contract Administrator for such investigation, testing or review of reconstruction and the cost of reconstruction shall be borne by the Contractor.

3.6 Finishing Slab Surfaces

- .1 Screeding, bull floating or darbying, floating and trowelling of slab surfaces shall conform to CAN/CSA-A23.1, Clause 7.5.
- .2 Finish interior floor slab surfaces to CAN/CSA-A23.1, Clause 7.5.4.3.2. Maintain surface flatness of maximum 6 mm in 3 m. Bull float and hand trowel surface to obtain a level finish free of float marks. Hand trowel entrained air concrete using magnesium trowel.
- .3 Finish exterior main slab surface to non-slip surface to CAN/CSA-A23.1, Clause 7.5.6.1 (b).

3.7 Finishing Formed Concrete

- .1 Allow the Contract Administrator to review concrete surfaces immediately upon removal of the forms.
- .2 Modify or replace concrete not conforming to qualities, lines, details and elevations specified herein or indicated on the Drawings to the acceptance of the Contract Administrator.
- .3 Finish surfaces for the valve chamber concrete works to Smooth-Form Finish conforming to CAN/CSA-A23.1, Clause 7.7.3.6.
- .4 Finish interior surfaces above the main floor elevation to Smooth-rubbed finish conforming to CAN/CSA-A23.1, Clause 7.7.3.7.2.

- .5 Finish exterior surfaces to receive dampproofing or insulation to Smooth-Form Finish conforming to CAN/CSA-A23.1, Clause 7.7.3.6.

3.8 Construction Joints

- .1 Construction joint locations shall be as shown on the Drawings.
- .2 For horizontal construction joints, the concrete of the first casting shall be thoroughly compacted by hand trowel in and around the reinforcing bars and along the waterstop.
- .3 Joints not indicated on the Drawings shall be located so as to least impair the strength of the structure. The location of these joints shall be subject to prior review and acceptance by the Contract Administrator. Submit location and detail of joints to Contract Administrator a minimum of four (4) weeks prior to scheduled concrete casting. Joints shall be in accordance with CAN/CSA-A23.1 or as indicated on the Drawings.
- .4 The surface of hardened concrete shall be thoroughly cleaned of foreign matter and laitance by sand blasting, and shall be thoroughly wetted with water, but not saturated, and the forms shall be re-tightened against the face of the hardened concrete before depositing additional concrete. Any concrete splatter on reinforcing bars shall be removed by sand blasting or other mechanical means.
- .5 The first layer of concrete to be placed over hardened concrete shall be proportioned to have an excess of mortar, have a depth of approximately 150 mm and be well vibrated to achieve maximum bond.

3.9 Curing and Protection

- .1 Cure and protect freshly placed concrete in accordance with CAN/CSA-A23.1.
- .2 All concrete shall receive moist curing for a period of at least seven (7) calendar days. One of the following methods shall be used as soon as the concrete has hardened sufficiently to prevent marring:
 - .1 Surface covered with canvas or other satisfactory material and kept thoroughly and continuously wet with soaker hoses.
 - .2 A liquid membrane forming curing sealer, applied at the rate recommended by the Manufacturer. Curing sealer shall not be used on a surface where bond is required for the finishes.
 - .3 Surfaces of concrete, which are protected by formwork that is left in place for seven (7) calendar days, shall not require any additional curing (except as specified for hot weather). If the formwork is removed in less than seven (7) calendar days, the concrete shall receive moist curing as above.
- .3 No concreting will be allowed until all materials required for the curing phase are on Site and ready for use.
- .4 At the end of the curing and protection period, the temperature of the concrete shall be reduced gradually at a rate not exceeding 10°C per day until the outside air temperature has been reached.
- .5 Concrete that is allowed to freeze or attain insufficient curing conditions shall be subject to all necessary investigations and testing as deemed necessary by the Contract Administrator and all such concrete shall be removed and the portion reconstructed as directed by the Contract Administrator, at the Contractor's cost.
- .6 Supply and arrange for water for curing concrete.

3.10 Equipment Pads, Pipe Supports and Cast in Metal Items

- .1 Provide concrete pads and supports for equipment where and as indicated on Drawings. Adjust dimensions to reviewed equipment Shop Drawings.
- .2 Insert bolts and sleeves and pack solidly with non-shrink grout in accordance with setting details and templates.
- .3 Steel trowel surface smooth. Chamfer all exposed horizontal and vertical edges.
- .4 Clean excess concrete from metal frames, inserts, weld plates, etc. Clean and tool concrete around the above noted items.

3.11 Grouting

- .1 Grout all miscellaneous anchor bolts with non-ferrous or epoxy grout as specified using templates for accurate positioning.
- .2 Grout under base plates and other items to provide continuous support over the entire contact area as required and shown on the Drawings.

3.12 Defective Concrete

- .1 Concrete not meeting the requirements of the Specifications and Drawings will be considered defective concrete.
- .2 Concrete not conforming to the lines, details and grades specified herein or as shown on the Drawings shall be modified or replaced at the Contractor's expense and to the satisfaction of the Contract Administrator. Finished lines, dimensions and surfaces shall be correct and true within tolerances specified herein and in Section 03 10 00 – Concrete Formwork.
- .3 Concrete not properly placed resulting in honeycombing and other defects shall be repaired or replaced at the Contractor's expense and to the satisfaction of the Contract Administrator.

3.13 Repair

- .1 Allow Contract Administrator to review concrete surfaces immediately upon removal of all formwork.
- .2 Remove all exposed metal form ties, nails and wires, break off fins and remove all loose concrete.
- .3 Any imperfect joints, voids, stone pockets or other defective areas and tie holes, as specified, shall at once be patched before the concrete is thoroughly dry. Defective areas shall be chipped away to a depth of not less than 40 mm with the edges perpendicular to the surface. The area to be repaired and a space at least 150 mm wide entirely surrounding it shall be wetted to prevent absorption of water from the repair mortar.
- .4 Cure all repairs thoroughly in accordance to Manufacturer's instructions.

Table 1

Mix Type	Intended Application	Minimum Compressive Strength (MPa)	Class of Exposure
1	Structural concrete for the Valve Chamber slab on grade and walls in contact with soil including: excess mortar concrete used at construction joints	35 at 56 days	S-1
2	Structural concrete for main slab, pipe supports, equipment pads	30 at 28 days	F-1
3	Grout or concrete used in Masonry infill	20 at 28 days	N
4	Lean Mix	15 at 28 days	N

END OF SECTION