

CONCRETE FORMWORK

1. GENERAL

1.1 Work Included

- .1 Forms for all concrete and supporting falsework including design.
- .2 Wood or steel forms for all cast-in-place concrete.
- .3 Void forms between structural elements and soil below.
- .4 Shoring, bracing, and anchorage.
- .5 Form openings for other trades.
- .6 Coordinate installation of concrete accessories.
- .7 Set anchor bolts, anchors, sleeves, frames, and other items supplied by other trades.
- .8 Clean erected formwork prior to concrete placement.
- .9 Remove forms and supporting falsework.
- .10 Design Standards NBC 1995 with Manitoba Amendments, Canadian Standards Association CAN/CSA-A23.1-00, CSA S269.1, CAN/CSA S269.3, ACI 347R, and applicable construction safety regulations.
- .11 Design to be done by a Professional Engineer registered in the Province of Manitoba.

1.2 Quality Assurance

- .1 Construct and erect concrete formwork in accordance with CAN/CSA-A23.1-00, CAN/CSA S269.3, ACI 347R, and all applicable construction safety regulations for the place of Work.

1.3 Shop Drawings

- .1 Submit Shop Drawings in accordance with Section 01300 – Submittals.
- .2 Clearly indicate sizes, methods of construction, materials, arrangement of joints, ties and shores, location and size of falsework, schedule of erection and stripping, reshoring, 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 shall be reviewed by the same Professional Engineer prior to each concrete pour. The Professional Engineer shall submit a written report confirming that formwork, falsework, and reshoring are in accordance with the design.

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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-M 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; conforming to CSA B111.

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 Tubular Column Type: round, spirally wound laminated fibre material, internally treated with release agent: sizes indicated on Drawings.
- .3 Void Form: moisture resistant treated paper faces, bio-degradable, structurally sufficient to support weight of wet concrete mix until initial set and construction loads. Top of Void Form shall be protected with sheet material in accordance with Manufacturer's and construction requirements.

2.5 Accessories

- .1 Form Ties for non-liquid retaining structures: removable snap-off metal type, fixed length, minimum working strength of 13 kN when assembled with minimum 25 mm deep plastic cone snap type or screw type on exposed surfaces. Wire ties are not permitted.
- .2 Form ties for liquid retaining structures: form ties shall be cone-fast coil tie type or she bolt type, to provide a 50 mm deep cone pocket for grouting after use; acceptable product: as manufactured by Dywidag. The portion of the form tie that remains in the concrete wall shall be plated and shall utilize O ring waterstops at midspan. As an alternate to these ties, a tapered removable form tie may be employed. The hole to be grouted after removal must be mechanically cleaned to remove all remnants of release or debonding agents

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- .3 Form Release Agent: colourless mineral oil which will not stain concrete or impair natural bonding or colour characteristics of coating intended for use on concrete.
- .4 Corner or Chamfer Fillets: mill finished pine, widths as indicated on the Drawings, maximum possible lengths, mitre ends.
- .5 Reglets: mill finished pine, shaped to required cross-section, maximum possible lengths, mitre ends.
- .6 Vapour barrier: 0.15 mm clear polyethylene film, with self-adhesive polyethylene or PVC tape for sealing joints.
- .7 Sealing Tape: reinforced, self-adhesive, waterproof kraft.

3. EXECUTION

3.1 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 as necessary.
- .5 Arrange forms to allow removal without removal of principal shores, where these are required to remain in place.
- .6 Obtain Contract Administrator's acceptance before framing openings in concrete slabs, walls, beams, and columns not indicated on Drawings.
- .7 Provide falsework to ensure stability of formwork. Brace 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 internal and external corners and edges of exposed concrete unless shown otherwise.
- .10 Form chases, slots, openings, drips, and recesses as detailed on Drawings.
- .11 Set screeds with top edge level to required elevations.

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- .12 Check and readjust formwork to required lines and levels during placing of concrete.
- .13 Coordinate location construction joints for walls, beams, and suspended slabs with the Contract Administrator prior to erecting formwork.
- .14 Provide reveals or reglets on construction joints as shown on the Drawings.

3.2 Void Form

- .1 Void forms shall be placed on prepared surfaces of levelling sand so that the top of the void forms present flat forming surfaces.
- .2 Protect void form wetting from fresh concrete and moisture from ground as per Manufacturer's instructions.
- .3 Install sheet material protection over top of void forms.
- .4 Install side protection pressure treated plywood around the perimeter of all void form to prevent backfill material from entering the void spaces.
- .5 Ensure collapse of void form after concrete has achieved design strength. Review proposed method and timing with Contract Administrator prior to concrete placement.

3.3 Tolerance

- .1 Construct formwork to produce concrete with dimensions, lines, and levels within tolerances specified in ACI 347R, Guide to Formwork for Concrete.
- .2 Camber slabs and beams 6 mm per 3 m of span unless otherwise indicated on the Drawings. Review method of providing camber with 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 which are to be cast directly into concrete.
- .3 Coordinate Work of other Sections 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 specified in Section 03250 – Concrete Accessories.
- .5 Provide temporary ports or openings in formwork where required to facilitate cleaning and construction review. 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 uniform surface on exposed concrete.

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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 prior to each concrete casting. Submit written report from Professional Engineer responsible for this work as specified in Clause 1.3 Shop Drawings.
- .2 Inform Contract Administrator when formwork is complete and has been cleaned, to allow for review. Contract Administrator's review will be for verification that forms are clean and free from debris.
- .3 Re-use of forms shall be subject to the requirements of CAN/CSA-A23.1-00.

3.6 Cleaning

- .1 Clean formwork in accordance with CAN/CSA-A23.1-00.
- .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 proceed 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 which 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 Contract Administrator prior to removing formwork.
- .2 Forms shall remain in place a minimum of two Calendar Days and the concrete shall have attained 75% of design strength verified by field cured test cylinders.
- .3 Clause 3.8.2 notwithstanding, do not remove forms and falsework until concrete has gained sufficient strength to carry its own weight, plus construction and design loads which are liable to be imposed. Verify strength of concrete by compression tests to satisfaction of Contract Administrator.
- .4 Remove falsework progressively, in accordance with regulatory requirements and ensure that no shock loads or imbalanced loads are imposed on structure.
- .5 Loosen forms carefully without damaging concrete surfaces. Do not apply tools to exposed concrete surfaces.

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- .6 If forms are left loosely in place for protection until curing requirements are complete, ensure all concrete surfaces are kept continuously moist. Otherwise remove forms and start moist cure immediately; curing with curing compound may be an option subject to review by the Contract Administrator on a case by case basis.

3.9 Reshoring

- .1 If reshoring is required, prepare and submit a schedule to Contract Administrator for review.
- .2 Reshore structural members where required due to design requirements or construction conditions under the direction of the Professional Engineer responsible for this work.
- .3 Install reshoring as required to permit progressive construction.

END OF SECTION

CONCRETE REINFORCEMENT

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, and spacers for reinforcing.

1.2 Quality Assurance

- .1 Perform concrete reinforcing Work in accordance with CAN/CSA-A23.1-00.

1.3 Inspection and Testing

- .1 If requested by Contract Administrator, submit three (3) certified copies of 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 Section 01300 – Submittals.
- .2 Clearly indicate bar sizes, spacings, locations, and quantities of reinforcing steel and wire fabric, bending and cutting schedules, and supporting and spacing devices.
- .3 Drawings and details to conform to CAN/CSA-A23.1-00, CAN/CSA-A23.3, and RSIC 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-A23.1-00, unless otherwise shown on the Drawings.

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.

2. PRODUCTS

2.1 Reinforcing Materials

- .1 Reinforcing Steel: minimum 400 MPa yield grade; deformed billet steel bars conforming to CAN/CSA-G30.18; material R and W (where indicated on the Drawings); plain finish.
- .2 Welded Steel Wire Fabric: plain type, conforming to ASTM A185; flat sheets; plain finish.

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2.2 Accessory Materials

- .1 Tie Wire: minimum 1.6 mm annealed type, or patented system accepted by Contract Administrator.
- .2 Chairs, Bolsters, Bar Supports, Spacers: adequately sized for strength and support of reinforcing steel during construction.
- .3 Bar Chairs: to be non-corrosive PVC chairs or concrete chairs purpose made. Steel bar chairs, galvanized bar chairs, concrete bricks, broken concrete blocks, stones, or wood supports are not acceptable.
- .4 Side form spacers to be non-corrosive PVC spacers, purpose made. PVC chairs, steel bar chairs, galvanized bar chairs, concrete bricks, broken concrete blocks, or wood supports are not acceptable.

3. EXECUTION

3.1 Fabrication

- .1 Fabricate reinforcing steel in accordance with CAN/CSA-A23.1-00 and Drawings.
- .2 Locate reinforcing splices not indicated on Drawings at points of minimum stress.
- .3 Fabricate within the following tolerances:
 - .1 Sheared length: + 0, - 25 mm
 - .2 Stirrups, ties, and spirals: +0, - 10 mm
 - .3 Other bends: + 0, - 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 rebent or straightened unless so indicated on the Drawings.
- .6 Heating of reinforcing steel will not be permitted.

3.2 Installation

- .1 Place reinforcing steel in accordance with reviewed placing drawings and CAN/CSA-A23.1-00. Chair slab reinforcing not further apart than 1.2 m in either direction. Tie reinforcing steel at maximum spacing 600 mm.
- .2 Adequately support reinforcing and secure against displacement within tolerances permitted.

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- .3 Place reinforcing steel to provide concrete cover required by CAN/CSA-A23.1-00, but not less than shown below or noted otherwise on the Drawings:
 - .1 Beam stirrups: 40 mm unless noted otherwise; main steel: 50 mm.
 - .2 Slabs (top and bottom): 50 mm.
 - .3 Column ties: 40 mm; main steel: 50 mm.
 - .4 Walls: 50 mm unless noted otherwise.
 - .5 Concrete formed against earth (including bottom of slab on grade): 75 mm.
- .4 Maintain alignment as follows:
 - .1 Slabs: ± 5 mm.
 - .2 Other structural members: ± 10 mm.
 - .3 Rebar bends and ends: ± 50 mm.
- .5 Do not disturb or damage polyethylene film or void form while placing reinforcing steel.
- .6 Install purpose made highly visible protective safety caps on all exposed projecting bar ends.

3.3 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.
- .3 Remove concrete splatter on bars before concrete has hardened.

END OF SECTION

CONCRETE ACCESSORIES

1. GENERAL

1.1 Work Included

- .1 Joint Sealants
- .2 Joint Filler
- .3 Water Stop
- .4 Non-ferrous Grout
- .5 Latex Patching Agent
- .6 Bonding Agent
- .7 Curing Compound
- .8 Fasteners

1.2 Shop Drawings

- .1 Submit Shop Drawings in accordance with Section 01300 – Submittals.
- .2 Submit product information for all materials for review to be incorporated into the Work.

2. PRODUCTS

2.1 Materials

- .1 Joint Sealants:
 - .1 Joint sealants for containment areas, concrete pits and liquid retaining areas: non-staining, non-sagging, grey two-part, polyurethane elastomeric sealant shall be suitable for submerged service such as Sikaflex 2c NS/SL. Polysulphide sealants shall not be used.
 - .2 Joint sealants for non containment areas, non liquid retaining areas: non-staining, non-sagging, grey two-part polysulphide liquid polymer base or a two-part polyurethane base such as Sikaflex 2c NS/SL or Vulkem 245 for horizontal and vertical joints with compatible primer as per sealant manufacturer's requirements.
 - .3 Use compatible primer as per sealant Manufacturer's requirements.
- .2 Joint Filler:
 - .1 Vinyl foam: (for joints to receive sealant): closed cell vinyl foam, sizes indicated on Drawings, 90%+ recovery after 50% compression, 380 kPa pressure for 50% compression, Sika Rodofam GR, CPD Cell Foam Joint Filler, Sealtight Ceramar Expansion Joint Filler.

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- .2 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, such as W. R. Meadows Sealtight Fibre Expansion Joint.
- .3 Waterstop:
 - .1 Expansive Waterstop: SikaSwell S Sealant by Sika and CS-231 Controlled Expansion Waterstop by ConSeal Concrete Sealants.
 - .2 PVC Waterstop: Paul Murphy Wirestop CR-6316 or Greenstreak 647 complete with factory installed hog rings. All flat and vertical PVC waterstop tees, crosses, and L's shall be factory made and tested.
 - .3 Stainless Steel Waterstop: Greenstreak 499. All flat and vertical stainless steel waterstop tees, crosses, and L's shall be factory made and tested.
- .4 Non-ferrous Grout: pre-mixed, non-shrink, Master Builders 713, Sika M-Bed, CPD Non-Shrink Grout, Steel C1 Grout, Grace In-Pakt Grout, minimum 35 MPa compressive strength.
- .5 Latex Bonding Agent: Acrl Stix, Daraweld-C Latex Bonding Agent.
- .6 Epoxy Bonding Agent: Master Builders Concrecive 1001 LPL, Dural Duralbond, Sikadur 32 HI-bond.
- .7 Repair Mortar: Meadow-Crete H by W.R. Meadows.
- .8 Moisture Retention Film: Master Builders Confilm.
- .9 Fasteners: fasteners (all nuts, bolts, washers, screws, etc.) stainless steel for all aluminum items, conforming to ASTM 304 or 316, sizes and locations as required by item Manufacturer.

3. EXECUTION

3.1 Installation

- .1 Pre-installation conference for waterstopping and sealant products: Prior to installation of waterstopping and sealant products, conduct a meeting with applicator, installers of Work adjacent to or that penetrates the waterstop or sealant products, the Contract Administrator and Manufacturer's technical representative 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.

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- .4 The Manufacturer's technical representative is to issue reports to the Contract Administrator identifying that the substrate conditions and installation procedures are being followed for each area where the specific product is being utilized.
- .5 Responsibility and costs associated with verification and correlation of field dimensions, fabrication processes, techniques of construction, installation, and coordination of Work and Manufacturer's technical representative for all parts of the Work rests with the Contractor.
- .2 Install all concrete accessories in accordance with Drawings and Manufacturer's recommendations and ensure compatibility. Install straight, level, and plumb.
- .3 Ensure items are not disturbed during concrete placement.
- .4 Concrete slabs shall be moist cured as per Section 03300 – Cast-In-Place Concrete. Curing and sealing compounds may be used for curing purposes of all other concrete where practical or compatible with finishes.
- .5 Joint sealant shall be applied per Manufacturer's instructions. If joint surfaces are damp, dry the surfaces and apply primer as recommended by Manufacturer. Apply polyethylene debonding tape as indicated on the Drawings.
- .6 PVC Waterstop:
 - .1 Install PVC waterstop in all joints in a continuous and inter-connected manner.
 - .2 All waterstop joints other than straight butt joints shall be factory fabricated and tested by the waterstop Manufacturer. All field splices to 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 instructions.
 - .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 maximum 300 mm spacing 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.
- .7 Expansive Waterstop:
 - .1 Apply expansive waterstop where specifically indicated on the Drawings or as directed by the Contract Administrator.

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- .2 Prepare surfaces and apply beads sized to Manufacturer's instructions.
- .3 Protect expansive waterstop from contact with water prior to concrete placement. Replace waterstop if it has come in contact with water and has begun to absorb water.
- .8 Joint filler shall be installed per Manufacturer's instructions in expansion joints as indicated on Drawings.
- .9 Epoxy bonding agent is to be used to bond new concrete to existing concrete surfaces.
- .10 Latex patching agent is to be used for patching formed concrete surfaces where required.
- .11 Repair Grout:
 - .1 Apply repair grout where patching is required as determined 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

CAST-IN-PLACE CONCRETE

1. GENERAL

1.1 Work Included

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

1.2 Quality Assurance

- .1 Cast-in-place concrete shall conform to the CAN/CSA-A23.1-00.
- .2 Testing shall conform to CAN/CSA-A23.2-00.
- .3 These standards shall be available in the Contractor's Site office for reference by the Contractor, sub-trades, and Contract Administrator.
- .4 A Concrete Review Report will be completed with each concrete pour. Each Concrete Review Report shall be signed by the Contractor and submitted to the Contract Administrator.

1.3 Qualification

- .1 Concrete flatwork finishing is to be done by an established firm having at least five years of proven, satisfactory experience in this trade and employing skilled personnel.
- .2 Submit proof of qualifications in writing to the Contract Administrator.

1.4 Inspection and Testing

- .1 Notify the Contract Administrator at least forty eight (48) hours before complete formwork and concrete reinforcement is ready for review. Reinforcing in walls shall be reviewed prior to closing forms.
- .2 Allow ample time for notification, review, and corrective Work, if required, before scheduling concrete placement.
- .3 Concrete sampling, inspection, and testing is to be performed by a CSA certified inspection and testing firm appointed and paid for by the City.
- .4 Provide unencumbered access to all portions of Work and cooperate with appointed firm.

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- .5 Submit proposed mix design statements of each class of concrete to the Contract Administrator for review four weeks prior to commencement of the Work. If blended cement is proposed for sulphate resistant concrete, testing data supporting conformance to CSA-A3000 satisfactory to the Contract Administrator shall be submitted with the mix design statement.
- .6 Tests of cement and aggregates may be performed to ensure conformance with requirements stated herein.
- .7 At least three (3) concrete test cylinders will be taken for every 75 m³ or less of each class of concrete placed.
- .8 At least three (3) test cylinders will be taken daily for each class of concrete placed.
- .9 One (1) slump test and one (1) air content test will be taken for each set of test cylinders taken.
- .10 Additional slump and air content tests may be taken as necessary (up to every truck) to verify quality of concrete at the discretion of the Contract Administrator.
- .11 Testing of concrete will be performed in accordance with CAN/CSA-A23.2-00. Test results will be issued to the Contractor, the Contract Administrator, and the City.
- .12 The Contractor shall pay costs for required retesting due to defective materials or workmanship.
- .13 If accepted by the Contract Administrator, the Contractor may arrange and pay for additional tests for use as evidence to expedite construction.
- .14 To conform to the strength requirements, the average of all tests shall exceed the specified strength. When three (3) or more tests of the same class of concrete are available, the average of any three (3) consecutive tests shall be equal to, or greater than the specified strength, and no strength test shall fall more than 3.5 MPa below the specified strength. If any of the criteria of the foregoing are not met, the Contract Administrator shall have the right to require one or more of the following:
 - .1 Changes in mix proportions for the remainder of the Work.
 - .2 Cores drilled and tested from the areas in question as directed by the Contract Administrator and in accordance with CAN/CSA-A23.2-00. The test results shall be indicative of the strength of the in-place concrete.
 - .3 Full scale load testing of the structural elements.
 - .4 The changes in the mix proportions, cores drilled and tested, and load testing shall be at the Contractor's expense.
 - .5 Concrete failing to meet the strength requirements shall be strengthened or replaced at the Contractor's expense and to the satisfaction of the Contract Administrator.

CAST-IN-PLACE CONCRETE

2. PRODUCTS

2.1 Concrete Materials

- .1 Cement: Normal Type 10 (Type GU) Portland Cement conforming to CAN/CSA-A3000 and sulphate resistant Type 50 (Type HS) Portland Cement or HSb conforming to CAN/CSA-A3000.
- .2 Fine Aggregate: conforming to Normal-Density Fine Aggregate, CAN/CSA-23.1-00. If requested by the Contract Administrator, submit evidence at least two weeks before use in concrete mix showing conformance to Normal-Density Fine Aggregate, CAN/CSA-A23.1-00, Table 4 and Table 6.
- .3 Coarse Aggregate: conforming to Normal-Density Coarse Aggregate, CAN/CSA-23.1-00, Group I, 20 to 5 mm, and 10 to 2.5 mm. If requested by the Contract Administrator, submit evidence at least two (2) weeks before use in concrete mix showing conformance to Normal-Density Coarse Aggregate, CAN/CSA-A23.1-00, Table 5 and Table 6. Group II may be used for special requirements such as gap grading, pumping, or for blending two (2) 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 report if requested by the Contract Administrator.
- .5 Water: potable, clean, and free from injurious amounts of oil, alkali, organic matter, or other deleterious matter.
- .6 Materials are to be obtained from the same source of supply or Manufacturer for the duration of the Work.
- .7 Supplementary cementing materials: conforming to CAN/CSA-A3000.

2.2 Admixtures

- .1 No admixtures other than air-entraining agent, water-reducing agent, and superplasticizer shall be used without the written authorization of the Contract Administrator, unless specified.
- .2 Air entrainment: conforming to ASTM Standard C260.
- .3 Water-reducing agent: Type WN conforming to ASTM Standard C494.
- .4 Superplasticizer: conforming to ASTM Standard C494.
- .5 General Chemical Admixtures: conforming to ASTM Standard C494.
- .6 Calcium chloride or admixtures containing calcium chloride shall not be used in concrete.

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2.3 Accessories

- .1 Curing Sealer: conforming to ASTM C309.
- .2 Moisture Retention Film: Master Builders Confilm.

2.4 Concrete Mixes

- .1 Pay all costs for mix design.
- .2 Provide concrete mixed in accordance with requirements of CAN/CSA-A23.1-00 and as indicated on Table A at the end of this Section and on the Drawings. Table A and Drawing requirements shall govern where there is a difference between Table A and Drawings, and CAN/CSA-A23.1-00 Tables 6 to 10 requirements.
- .3 Maximum allowable substitution of cement with supplementary cementing materials shall be 20% by weight except that blended cements may contain the amount of supplementary cementing materials as required for the intended purpose such as sulphate resistance. 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 CSA-A3000 satisfactory to the Contract Administrator.
- .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 must be compatible within the mix. Concrete with freezing and thawing exposure must satisfy the durability requirements of CAN/CSA-A23.1-00, Sections 14 and 15.
- .7 All admixtures are subject to acceptance by the Contract Administrator. List all proposed admixtures in mix design submission. Do not change or add admixtures to accepted design mixes without the Contract Administrator's review and acceptance.
- .8 The water:cementing ratio must be calculated and shown based on all available mixing water excluding aggregate absorption.
- .9 Concrete delivered to Site must be accompanied by a delivery slip indicating time of completion of mixing, design strength of concrete, air content, and actual water-cement ratio.
- .10 Patching Mortar:
 - .1 The patching mortar shall be made of the same material and of approximately the same proportions as used for the concrete, except that the coarse aggregate shall be

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omitted and the mortar shall consist of not more than 1 part cement to 2.5 parts sand by damp loose volume.

- .2 White Portland cement shall be substituted for a part of the grey Portland cement on exposed concrete in order to produce a colour matching the colour of the surrounding concrete, as determined by trial patches.
- .3 The quantity of mixing water shall be no more than necessary for handling or placing. Mixing water shall include 1 part latex bonding agent to 3 parts water. Maximum water to cement ratio shall be 0.40.

.11 Self-compacting concrete mixes will not be permitted for use on this Work.

3. EXECUTION

3.1 Placing Concrete

- .1 Place concrete in accordance with requirements of CAN/CSA-A23.1-00 and as indicated on the Drawings. Layout of the Work and accuracy of same is the Contractor's sole responsibility.
- .2 Notify the Contract Administrator a minimum of twenty four (24) hours prior to pouring concrete. Under no circumstances shall concrete be poured without notifying Contract Administrator, or in his absence, arranging for review of the Work and sampling of concrete.
- .3 The concrete shall be placed rapidly and evenly as near to its final position as possible to reduce the risk of segregation, flowlines, and cold joints. Concrete shall be placed within 1.5 hours of mixing.
- .4 Ensure all anchor bolts, seats, plates, and other items to be cast into concrete are securely placed and will not interfere with concrete placement.
- .5 All equipment for transporting the concrete shall be cleaned of hardened concrete and foreign materials before placing concrete.
- .6 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..
- .7 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.
- .8 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.

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- .9 Vibrate concrete using the appropriate size equipment as placing proceeds, in accordance with CAN/CSA-A23.1-00. Check frequency and amplitude of vibrations prior to use. Provide additional standby vibrators in the event of equipment failure.
- .10 Prepare set or existing concrete by removing all laitance and loose or unsound materials and apply bonding agent in accordance with Manufacturer's recommendations.
- .11 Where placing operations would involve dropping the concrete more than 1.5 m, 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.
- .12 In locations where new concrete is dowelled to existing concrete, drill holes in existing concrete, thoroughly clean the holes, place non-shrink grout in holes, and insert steel dowels so that grout is packed solidly for full depth around the dowels.
- .13 A minimum of three (3) Calendar Days shall elapse between adjacent pours separated by construction joints or expansion joints.
- .14 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.
- .15 Honeycomb or embedded debris is not acceptable.
- .16 Remove and replace defective concrete.
- .17 Maintain accurate records of cast-in-place concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.
- .18 Prior to the erection of the formwork for walls and beams, the construction joint shall be sand blasted and cleaned as per Clause 3.15 – Construction Joints, of this specification section.
- .19 At the start of casting of walls or beams on slabs, a layer of grout slurry approximately 12 mm to 25 mm thick shall be placed immediately prior to the placement of concrete.

3.2 Cold Weather Concreting

- .1 The requirements of this section shall be applied to all concreting operations during cold weather, i.e., if the mean daily temperature falls below 5°C during placing or curing.
- .2 Supplementary equipment as required below shall be at the Site if concrete is likely to be placed in cold weather.
- .3 Formwork and reinforcing steel shall be heated to at least 5°C before concrete is placed.

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- .4 The temperature of the concrete shall be maintained at not less than 10°C for seven (7) Calendar Days. In no case, shall the heating be removed until the concrete has reached a minimum compressive strength which will be specified by the Contract Administrator as determined from compressive strength tests on specimens cured under the same conditions as the concrete work in question.
- .5 Aggregates shall be heated to a temperature of not less than 20°C and not more than 65°C. Water shall be heated to a temperature between 55°C and 65°C. The temperature of the concrete at the time of placing in the forms shall be within the range specified in CAN/CSA-A23.1-00 for the thickness of the section being placed.
- .6 When the mean daily temperature may fall below 5°C, a complete housing of the Work, complete with heaters, fuel, maintenance, and attendants, shall be provided.
- .7 Combustion-type heaters may be used if their exhaust gases are vented outside the enclosures and not allowed to come into contact with concrete surfaces. Fire extinguishers must be readily at hand wherever combustion-type heaters are used.
- .8 When the ambient temperature is below -15°C, the housing shall be constructed so as to allow the concrete to be placed without the housing having to be opened. If the mixing is done outside of the housing, the concrete shall be placed by means of hoppers installed through the housing. The hoppers are to be plugged when not in use.
- .9 When the ambient temperature is equal to or above -15°C, the Contractor will be permitted to open small portions of the housing for a limited time to facilitate the placing of the concrete.
- .10 Before depositing any of the concrete, the Contractor shall show that enough heating equipment is available to keep the air temperature surrounding the forms within the specified range. This shall be accomplished by bringing the temperature inside of the housing to the specified 10°C at least 12 hours prior to the start of the concrete placing.
- .11 The Contractor shall supply all required heating apparatuses and the necessary fuel. When dry heat is used, a means of maintaining atmospheric moisture shall be provided.
- .12 Sufficient standby heating equipment must be available to allow for any sudden drop in outside temperatures and any breakdowns that may occur in the equipment.
- .13 The Contractor shall keep a curing record of each concrete pour. The curing record shall include date and location of the pour, mean daily temperature, temperatures above and below the concrete within the enclosures, temperatures of the concrete surface at several points, and notes regarding the type of heating, enclosure, unusual weather conditions, etc. This record shall be available for review by the Contract Administrator at all times, and shall be turned over to the Contract Administrator at the end of the concreting operations.

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3.3 Hot Weather Concreting

.1 General

- .1 The requirements of this Clause shall be applied during hot weather, i.e., when air temperatures are above 25°C during placing.
- .2 Concrete shall be placed at as low a temperature as possible, preferably below 15°C, but not above 27°C. Aggregate stockpiles may be cooled by water sprays and sun shades.
- .3 Ice may be substituted for a portion of the mixing water provided the ice has melted by the time mixing is completed.
- .4 Forms and conveying equipment shall be kept as cool as possible before concreting by shading them from the sun, painting their surfaces white, and/or the use of water sprays.
- .5 Sun shades and wind breaks shall be used as required during placing and finishing.
- .6 Work shall be planned so that concrete can be placed as quickly as possible to avoid “cold joints”.
- .7 The Contract Administrator’s acceptance is necessary before the Contractor may use admixtures such as retardants to delay setting, or water-reducing agents to maintain workability and strength, and these are to be included in the mix designs submitted to the Contract Administrator.
- .8 Curing shall follow immediately after the finishing operation.

.2 Hot-Weather Curing

- .1 When the air temperature is at or above 25°C, curing shall be accomplished by water or by using saturated absorptive fabric, in order to achieve cooling by evaporation. Mass concrete shall be water cured for the basic curing period when the air temperature is at or above 20°C, in order to minimize the temperature rise of the concrete.

.3 Job Preparation

- .1 When the air temperature is at or above 25°C, or when there is the probability of its rising to 25°C during the placing period, facilities shall be provided for protection of the concrete in place from the effects of hot and/or drying weather conditions. Under severe drying conditions, as defined under “Severe Drying Conditions” below, the formwork, reinforcement, and concreting equipment shall be protected from the direct rays of the sun or cooled by fogging and evaporation.

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.4 Concrete Temperature

- .1 The temperature of the concrete as placed shall be as low as practicable and in no case greater than that shown below for the indicated size of the concrete section.

Thickness of Section (metres)	Temperatures (°C)	
	Minimum	Maximum
less than 0.3	10	27
0.3 – 1	10	27
1.2	5	25

.5 Protection from Drying

.1 Moderate Drying Conditions

- .1 When surface moisture evaporation exceeds 0.75 kg/m²/hour, windbreaks shall be erected around the sides of the structural element.

.2 Severe Drying Conditions

- .1 When surface moisture evaporation exceeds 1.0 kg/m²/hour, additional measures shall be taken to prevent rapid loss of moisture from the surface of the concrete. Such additional measures shall consist of the following:

- .1 Erecting sunshades over the concrete during finishing and placing operations.
- .2 Lowering the concrete temperature.
- .3 Placing concrete at cooler part of the day when there is little or no direct sunlight.
- .4 Increasing humidity by applying fog spray immediately after placement and before finishing.
- .5 Care shall be taken to prevent accumulation of water that may reduce the quality of the cement paste.
- .6 Beginning the concrete curing immediately after trowelling. Under certain conditions moisture retention film may be used.

.3 Surface Moisture Evaporation Rate

- .1 The monograph, Figure D1, Appendix D of CAN/CSA-A23.1-00 shall be used to estimate surface moisture evaporation rates.

3.4 Concrete Protection for Reinforcement

- .1 Ensure reinforcement is placed to provide minimum concrete cover in accordance with Section 03200 – Concrete Reinforcement.

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3.5 Concrete Toppings

- .1 Place bonded toppings to thickness and elevations indicated on Drawings, in accordance with CAN/CSA-A23.1-00 unless noted.
- .2 Remove all laitance, dirt, dust, debris, grease and other substances from base slab.
- .3 Prepare the base slab profile to an ICRI CSP-5 profile.
- .4 Saturate the base slab to an SSD condition for a minimum of 24 hours prior to casting of the concrete topping.
- .5 Utilize a cement/sand grout in accordance with the requirements of Clause 23.4.2 in CAN/CSA-A23.1-00.
- .6 Tensile testing of the bonded topping will be performed in accordance with CAN/CSA-A23.2-00.

3.6 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 03100 – Concrete Formwork and 03200 – Concrete Reinforcement.
 - .1 Sizes of Member or Thickness of Slabs: + 6 mm, - 0 mm.
 - .2 Cover of Concrete over Reinforcement: ± 3 mm.
 - .3 Variations from Plumb: 6 mm in 3 m, 10 mm maximum.
 - .4 Variations from Flat: 3 mm in 3 m, 6 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.

3.7 Finishing Slab Surfaces

- .1 Finish all slab surfaces conforming to CAN/CSA-A23.1-00, Clause 22 and as specified below.
 - .1 Main Floor: Class A.
 - .2 Second Floor, Mezzanine and platform floors: Class A.
 - .3 Concrete slabs in liquid retaining structures or containment areas: Maintain surface flatness as per Construction Tolerance shown above. Bull float and hand trowel.

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- .4 Exterior pads and walking surfaces: Nonslip surface by light brooming immediately after first trowelling.
- .2 Bull Floating:
 - .1 Flatness for suspended concrete slabs to be achieved by means of hiway straight edge (minimum 3 m width) in lieu of standard bull float. Immediately after screeding, bull float slab surfaces to remove ridges and fill voids.
 - .2 Complete bull floating before any excess moisture or bleed water is visible on surface.
- .3 Mechanical Floating:
 - .1 Mechanical float slab surfaces when bleed water has disappeared and surfaces are sufficiently hard to prevent working excess mortar to surface.
 - .2 Continue floating as necessary to produce surfaces of uniform texture, free from hollows, bumps, and screed marks.
 - .3 For surfaces to be trowelled, continue floating as necessary to embed coarse aggregate particles firmly below surface mortar.
 - .4 Hand float in corners, restricted areas, and around cast-in items.
- .4 Trowelling:
 - .1 Trowel non-air entrained floor surfaces with mechanical trowelling machines fitted with steel blades. Hand trowel non-air entrained concrete with steel blades. Hand trowel entrained air concrete using magnesium trowel.
 - .2 Commence trowelling when surfaces are sufficiently hard to prevent working excess fine material to surface.
 - .3 Perform additional trowelling at intervals so final trowelling is done just before concrete becomes so hard that further trowelling is ineffective.
 - .4 Finish trowelled surfaces to be hard, dense, and free from blemishes and other imperfections.
 - .5 Hand trowel in corners, restricted areas, and around cast-in items.
 - .6 Cure concrete as specified.
 - .7 Protect all slabs from damage during construction.

3.8 Curing and Protection

- .1 Cure and protect freshly placed concrete in accordance with Clause 21 of CAN/CSA-A23.1-00.

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- .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 The supply (both quantity and time of supply) of water for curing concrete shall be subject to control of the Contract Administrator and prior arrangements shall be made by the Contractor with the Contract Administrator for its supply. The Contractor shall be responsible for, at his own cost, to supply, install, maintain, and move extensions to water services as required for conveying water to the work Site. Water required for curing concrete will be supplied by the City, from the DBPS.

3.9 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.

3.10 Finishing Formed Surfaces

- .1 Interior formed concrete surfaces.
 - .1 Finish surfaces exposed to view or containment areas, to Smooth-Form Finish conforming to CAN/CSA-A23.1-00, Clause 24.3.6.

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- .2 Finish non-exposed surfaces to Rough-Formed Finish conforming to CAN/CSA-A23.1-00, Clause 24.3.5.
- .2 Exterior formed concrete surfaces.
 - .1 Surfaces to receive vapour barrier, insulation, or waterproofing material, are to be finished to Smooth-Formed Finish conforming to CAN/CSA-A23.1-00, Clause 24.3.6.
 - .2 Other surfaces to be finished to Rough-Formed Finish conforming to CAN/CSA-A23.1-00, Clause 24.3.5.

3.11 Equipment Pads and Cast in Frames

- .1 Supply and install concrete pads and supports for equipment where and as required or indicated on Drawings. Adjust dimensions to reviewed equipment Shop Drawings.
- .2 Place dowels in slabs as shown on the Drawings and roughen and clean the slab surfaces prior to placing concrete for the pads.
- .3 Insert bolts and sleeves and pack solidly with non-shrink grout, in accordance with setting details and templates.
- .4 Steel trowel surface smooth. Chamfer exposed horizontal and vertical edges.
- .5 Clean excess concrete from metal frames, inserts, weld plates, etc. Clean and tool concrete around the above noted items.

3.12 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 or as shown on the Drawings.

3.13 Defective Concrete

- .1 Concrete not meeting the requirements of the Specifications and Drawings will be considered defective concrete; the Contractor shall remediate all 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. Finished lines, dimensions, and surfaces shall be correct and true within tolerances specified herein and in Section 03100 – Concrete Formwork.
- .3 Concrete not properly placed resulting in honeycombing and other defects shall be repaired or replaced at the Contractor's expense.

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3.14 Patching

- .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 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.
- .4 Cure all patches thoroughly in accordance to Manufacturer's instructions.

3.15 Construction Joints

- .1 Construction joint locations shall be as shown on the Drawings.
- .2 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. Joints shall be in accordance with CAN/CSA-A23.1-00, or as indicated on the Drawings.
- .3 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.
- .4 For horizontal construction joints, the concrete shall be thoroughly compacted by hand trowel in and around the reinforcing bars and along the PVC waterstops.

3.16 Clean-Up

- .1 As Work progresses and at the completion of Work, remove from Site all debris, excess materials, and equipment.

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Table A

Mix Type	Portion of Structure	Min. Compressive Design Strength @ 28 Days (MPa)	Cement Type	Min. Cementing Material Content (kg/m ³)	Max. Water Cementing Material Ratio	Nominal Aggregate Size (mm)	Slump (mm)	Entrained Air Content (%)
1	Containment structural concrete beams, grade beams, slabs and walls Containment sump pits. Class of exposure: C-1	35	50 (HS)	335	0.40	20 to 5	*80 ± 25	4 to 7
2	Non- containment structural concrete in contact with soil and backfill or exposed to weather or freezing and thawing – pile caps, concrete beams, grade beams, pads, and curbs Class of exposure: C-1	35	50 (HS)	--	0.40	20 to 5	*80 ± 25	5 to 8
3	Interior structural concrete, 150 concrete on steel deck Class of exposure: N	30	10 (GU)	--	0.50	20 to 5	80 ± 25	Less than 3
4	Topping on hollowcore and 103 concrete on steel deck Class of exposure: N	30	10 (GU)	--	0.50	10 to 2.5	80 ± 25	Less than 3
5	Miscellaneous concrete – curbs, equipment bases, pipe supports within heated buildings and benching Class of exposure: N	25	10 (GU)	--	0.50	20 to 5	80 ± 25	Less than 3
6	Grout or Concrete used in Masonry infill	20	10 (GU)	--	--	10 to 2.5	150 ± 30	Less than 3

Note: * Concrete for walls and beams of containment areas shall be superplasticized; other elements with congested reinforcement may also be superplasticized subject to review by the Contract Administrator. Superplasticized concrete slump shall be 200 ± 30.

END OF SECTION

PRECAST CONCRETE DECK

1. GENERAL

1.1 Work Included

- .1 Supply and installation of hollow core deck slabs.
- .2 Supply loose connecting and supporting devices.
- .3 Sealant and back-up materials.
- .4 Provide formed or cut openings for other sections.
- .5 Grouting of all connecting pockets.
- .6 Final cleaning.

1.2 Design Requirements

- .1 Design of precast concrete members and connections to conform to CSA A23.4 and Canadian Prestressed Concrete Institute Design Handbook, under direct supervision of a registered Professional Engineer, fully experienced in design of precast concrete structural units.
- .2 Design all members, connections, and embedded parts to safely support their own weight and all forces and loads to which they may be subjected.
- .3 Design connections to provide for building movement. Provide adjustable connections to accommodate misalignment of structure.
- .4 Design the floor deck for a maximum live load deflection of $\frac{1}{240}$ of the span unless noted otherwise.
- .5 Design openings indicated on the architectural, mechanical, electrical, and equipment Drawings.

1.3 Quality Assurance

- .1 Fabricate and install precast concrete deck in accordance with requirements of CSA A23.4.
- .2 Maximum allowable manufacturing and erection tolerances are not to exceed those given in CSA A23.4.

1.4 Qualifications

- .1 Manufacturer is to be certified for Prestressed Precast Concrete Products under CAN/CSA-A251.

PRECAST CONCRETE DECK

1.5 Inspection and Testing

- .1 Inspection and testing to be performed by a firm appointed and paid by the City. Notify Contract Administrator at commencement of shop work so inspection and testing may be scheduled for the appointed firm.
- .2 Provide free access to all portions of manufacturing plant and cooperate with appointed firm.
- .3 If requested by the Contract Administrator, submit proposed mix design for review prior to commencement of work.
- .4 Testing of cement and aggregates may be required to ensure conformance with requirements stated herein.
- .5 Testing of concrete will be performed in accordance with CAN/CSA A23.2-00 and CSA A23.4.
- .6 If defects are revealed during testing of concrete and/or review of fabricated precast concrete deck members, Contract Administrator will request additional testing and/or review to ascertain full degree of defects.
- .7 Correct defects and/or irregularities to the satisfaction of Contract Administrator. Further testing and/or review, under similar conditions as earlier, will be performed. Pay all costs for retesting and additional review.
- .8 Test results will be issued to Contractor, Contract Administrator, and City.

1.6 Shop Drawings

- .1 Submit Shop Drawings in accordance with Section 01300 – Submittals.
- .2 Prepare Shop Drawings signed and sealed by a Professional Engineer registered in the Province of Manitoba, fully experienced in design of precast concrete structural units.
- .3 Provide for Contract Administrator's review, copies of design calculations for reinforcing, hoisting, and connection and anchorage devices.
- .4 Clearly indicate product locations, fabrication details, unit identification marks, reinforcement, connection details, dimensions, erection support points, openings complete with steel framing if required, anchors and relationship to adjacent materials in sufficient detail to cover manufacture, handling, and erection.
- .5 Do not proceed with fabrication until Shop Drawings and design calculations have been reviewed by Contract Administrator.

1.7 Transportation, Handling, and Storage

- .1 Handle all precast members in a position consistent with their shape and design. Do all lifting and supporting only from support points indicated on Shop Drawings.

PRECAST CONCRETE DECK

- .2 Embedded lifting or handling devices are to be capable of supporting members in all positions anticipated during manufacture, storage, transportation, and erection. Maintain capacity of lifting devices sufficient to resist forces of minimum 2.5 times weight of member.
- .3 Deliver members to Site completely finished. Clearly mark members as indicated on Shop Drawings, with date of production and final position on structure.
- .4 Block and laterally brace members during transport and while stored on Site. Provide lateral bracing sufficient to prevent bowing and warping. Blocking and bracing shall be clean, non-staining, and shall facilitate uniform curing of exposed surfaces.
- .5 Provide edges of members with adequate protection to prevent staining, chipping, or spalling of concrete.

2. PRODUCTS

2.1 Concrete Materials

- .1 Cement: normal Portland cement Type 10 (Type GU), conforming to CAN/CSA-A3000.
- .2 Fine and Coarse Aggregates: conforming to CSA A23.4, from a single source for each type of aggregate for entire Work of this Section.
- .3 Water: potable, free of deleterious matter that may interfere with finish, strength, and colour of concrete.
- .4 Grout: minimum 28 day compressive strength of 30 MPa.

2.2 Concrete Mix

- .1 Concrete for hollow core: exposure Class N, designed to Manufacturer's specifications.

2.3 Admixtures

- .1 Air entrainment: conforming to ASTM Standard C260
- .2 Chemical admixtures: conforming to ASTM Standard C494

2.4 Reinforcement

- .1 Reinforcing Steel: 400 MPa yield grade, deformed billet steel bars conforming to CAN/CSA G30.18 plain finish.
- .2 Reinforcing Wire: 480 MPa yield grade, deformed steel wire, conforming to ASTM A496, plain finish.

PRECAST CONCRETE DECK

- .3 Welded Steel Wire Fabric: plain type conforming to ASTM A185, plain finish. After fabrication, the welded steel wire fabric shall be hot dipped galvanized. Galvanizing to conform to CAN/CSA-G164; minimum 610 g/m².
- .4 Prestressing Tendons: uncoated seven-wire, stress relieved strand, conforming to ASTM A416/A416M.
- .5 Structural Steel: conforming to requirements of Section 05120 – Structural Steel.

2.5 Hardware

- .1 Connections, Supporting Devices: Type W minimum Grade 300 MPa steel, conforming to CAN/CSA G40.21, all galvanized to CAN/CSA-G164, 610 g/m² min. zinc coating after fabrication. Clean all members receiving galvanizing material to SSPC SP-10 “Near-White Blast Cleaning.”
- .2 Bolts, Nuts, and Washers: conforming to ASTM A325, hot dipped galvanized.
- .3 Anchors, Inserts: patented, load-tested galvanized steel.
- .4 Welding Materials: conforming to CSA W48 Series, to match material being welded. No welding of reinforcing steel will be allowed.

2.6 Prime Paint

- .1 Touch-up Primer: zinc dust/zinc oxide alkyd type, Galvalume or Galvalloy.

2.7 Fabrication

- .1 Maintain plant records and quality control program during the production of precast structural concrete, as required by CAN/CSA-A251, Appendix D. Make records available to Contract Administrator upon request.
- .2 Use forms and beds that are rigid, adequate to withstand prestressing forces and constructed of materials that will result in finished products conforming to requirements stated herein and on Drawings.
- .3 Establish concrete mix design by tests on trial batches to achieve required strengths. Maintain water content as constant as possible during manufacture.
- .4 Provide concrete protection of reinforcement in accordance with CSA A23.4.
- .5 Deposit and vibrate concrete to ensure proper consolidation, elimination of unintentional cold joints, and to minimize entrapped air on surfaces.
- .6 Fabricate all required connecting devices, plates, angles, inserts, bolts, and accessories.
- .7 Supply and install anchors and inserts to support loads sized and located as indicated on Drawings.

PRECAST CONCRETE DECK

- .8 Perform shop welding of connecting and supporting devices in accordance with requirements of CSA W59.
- .9 Ensure anchors, inserts, plates, angles, and other cast-in items are accurately located. Maintain in position while concrete is placed and consolidated.
- .10 Incorporate all openings, which are not to be cored or cut on site, during fabrication.

2.8 Finish

- .1 Finish deck slabs to conform to requirements of CSA A23.4 for installation of roofing systems.

3. EXECUTION

3.1 Erection

- .1 Supply and install temporary bracing for all stresses and induced loads during erection. Maintain temporary bracing in place until final support is provided.
- .2 Provide all hoisting equipment and operate in accordance with all applicable safety regulations.
- .3 Discontinue Work and advise Contract Administrator when members require adjustment beyond design criteria. Perform required modifications at no cost to the City.
- .4 Erect members without damage to shape or finish. Replace or repair damaged members to satisfaction of Contract Administrator, at no cost to the City.
- .5 Erect all units level, plumb, square, and true within allowable tolerances.
- .6 Securely fasten units in place.
- .7 Perform welding of connecting and supporting devices in accordance with requirements of CSA W59.
- .8 Prime paint field welds and touch up scratched and damaged galvanized surfaces.
- .9 Field cutting and drilling are not permitted without prior written authorization from the Contract Administration unless shown on the Shop Drawings.
- .10 Openings shall be located through voids only; under no circumstances shall prestress strands be severed without written authorization from Contract Administrator and precast Manufacturer.
- .11 Power actuated fasteners shall not be used for securing supports for pipe, conduits, etc. Locations and types of fasteners shall be acceptable to the Contract Administrator and precast Manufacturer.

PRECAST CONCRETE DECK

- .12 Fill all joints and grout keys between hollow core slabs with 1:3 mixture of cement and sand, trowel smooth.
- .13 Remove all grout from underside of hollow core slabs and walls and floors immediately after grouting.
- .14 Grout all erection pockets upon completion of erection.

3.2 Cleaning

- .1 Clean all exposed precast concrete surfaces and clean all surfaces with spilled or splattered from grouting operations.
- .2 Wash and rinse surfaces in accordance with precast Manufacturer's recommendations. Do not use cleaning solutions that will harm surface finishes and other adjacent construction (concrete, masonry, steel, aluminum, glass, and any other adjacent surfaces).

END OF SECTION