DIVISION 3

CONCRETE

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DIVISION 3 - CONCRETE

CONCRETE FORMWORK

1. GENERAL

1.1 Work Included

.1 Forms for all concrete.

.2 Wood 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.

1.2 Related Work

.1	Concrete reinforcement:	Section 03200
.2	Concrete accessories:	Section 03250
.3	Concrete:	Section 03300

1.3 Design Standards

.1 Design and detail forms and supporting falsework in accordance with the National Building Code of Canada, CAN/CSA-A23.1-LATEST, CSA S269.1, ACI 347 and applicable construction safety regulations.

.2 Design for suspended formwork and scaffolding or shoring to be performed by a Professional Engineer licensed in NT/NU.

1.4 Quality Assurance

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

1.5 Shop Drawings

.1 Submit shop drawings in accordance with Section 01300.

.2 Clearly indicate sizes, methods of construction, materials, arrangement of joints, ties and shores, schedule of erection and stripping, restoring, etc.

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 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 or Spruce, conforming to CSA O151-M, sheathing. Sound undamaged sheets with clean true edges.

.2 Lumber: conforming to CSA O141-M.

.3 Nails, Spikes and Staples: galvanized or phosphatized; conforming to CSA B111.

.4 Where formwork cannot be recovered after concrete casting and will be in contact with reservoir water, the wood shall consist of untreated solid boards (no laminates, plywood, pwf, etc.) and shall not contain any coating or chemical treatment of any kind, to ensure water quality is not affected.

2.4 Accessories

.1 Form Ties: removable metal type, 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 oil which will not stain concrete. Use non-toxic form oil that is approved for use in potable water reservoir construction. Product shall be compatible with specified waterproofing products.

.3 Corner or Chamfer Fillets: extruded plastic or mill finished pine, 20 mm width, maximum possible lengths, mitre ends.

.4 Void Form: Expanded polystyrene – low density maximum designed to collapse and crush under soil expansion yet sufficiently strong to support wet concrete at time of casting.

3. EXECUTION

3.1 Examination

.1 Before starting this work, examine work done by others which affects this work.

.2 Notify the Engineer of any conditions which would prejudice proper completion of this work.

.3 Commencement of 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 as necessary.

.5 Arrange forms to allow removal without removal of principal shores, where these are required to remain in place.

.6 Obtain Engineer's approval before framing openings in concrete slabs, not indicated on drawings.

.7 Provide 20 mm chamfer on all internal and external corners and edges of exposed concrete unless shown otherwise.

.8 Form chases, slots, openings, drips and recesses as detailed on drawings.

.9 Set screeds with top edge level to required elevations.

.10 Check and readjust formwork to required lines and levels during placing of concrete.

3.3 Tolerance

.1 Construct formwork to produce concrete with dimensions, lines and levels within tolerances specified in ACI 347.

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 co-operate 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 and/or as shown on drawings or specified in other Divisions of the Specification.

.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 uniform surface on exposed concrete.

3.5 Field Quality Control

.1 Inspect and check complete formwork, and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties and parts are secure.

.2 Allow Engineer to review formwork prior to re-use. Formwork may be re-used if approved by the Engineer.

.3 Cleaning

.4 Clean forms as erection proceeds, to remove foreign matter. Remove cuttings, shavings and debris from within forms. Clean with compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.

.5 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.

3.6 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.

3.7 Form Removal

.1 Notify Engineer prior to removing formwork.

.2 Do not remove forms and falsework until concrete has gained sufficient strength to carry its own weight, plus construction loads and design loads which are liable to be imposed. Verify strength of concrete by compression tests to satisfaction of Engineer.

.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

CONCRETE REINFORCEMENT

1. GENERAL

1.1 Work Included

.1 Reinforcing steel bars for cast-in-place concrete, complete with tie wire.

.2 Support chairs, bar supports and spacers for reinforcing.

1.2 Quality Assurance

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

1.3 Shop Drawings

.1 Submit bar lists and placing drawings in accordance with Section 01300.

.2 Clearly indicate bar sizes, spacings, locations and quantities of reinforcing steel.

1.4 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: 400 MPa yield grade; deformed billet steel bars conforming to CSA G30.18-M-92; plain finish.

2.2 Accessory Materials

.1 Tie Wire: minimum 1.6 mm annealed type.

.2 Chairs, Bolsters, Bar Supports, Spacers: adequately sized for strength and support of reinforcing steel during construction.

3. EXECUTION

3.1 Examination

.1 Before starting this work, examine work done by others which affects this work.

.2 Notify the Engineer of any conditions which 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-LATEST, and drawings.

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

.3 Fabricate within the following tolerances:

.1 Sheared length: ±25 mm.

.2 Depth of truss bars: plus 0, minus 10 mm.

.3 Stirrups, ties and spirals: ±10 mm.

.4 Other bends: ±25 mm.

.4 Weld reinforcing bars in accordance with CSA W186.

.5 All bending shall be done cold with a suitable machine accurately producing all lengths, depths and radii shown on the bending details.

.6 After initial fabrication, reinforcing steel shall not be rebent or straightened unless so indicated on the drawings.

.7 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-LATEST. Chair slab reinforcing sufficiently such that specified position is maintained, but not further apart than 1.2 m in either direction.

.2 Adequately support reinforcing, and secure against displacement within tolerances permitted.

.3 SPEC NOTE: Select from following clauses to suit.

.4 Place reinforcing steel to provide concrete cover required by CAN/CSA-A23.1-LATEST.

.5 Place reinforcing steel to provide concrete cover as follows unless noted otherwise on the drawings:

Item	Coverage (mm)
Slabs and Toppings	40
Curbs	40

.6 Maintain alignment as follows:

Item	Tolerances Plus or Minus
Slabs	5 mm
Other Structural Members	10 mm
Rebar Bends and Ends	50 mm

.7 Do not disturb or damage vapour barrier while placing reinforcing steel.

3.4 Cleaning

.1 Ensure concrete reinforcing is clean and free from oil and deleterious matter.

.2 Remove all loose scale, loose rust and other deleterious matter from surfaces of reinforcing.

END OF SECTION

CONCRETE ACCESSORIES

1. GENERAL

1.1 Work Included

.1 Anchored inserts.

.2 Joint sealants.

.3 Vapour barrier.

1.2 Related Work

.1 Concrete formwork: Section 03100

.2 Concrete: Section 03300

2. PRODUCTS

2.1 Anchors/Inserts

.1 Epoxy inserts: designs are based on Hilti HAS & HY150 epoxy. Use cold weather grade if application temperature is below 10°C. If alternatives are proposed submit engineering design criteria to Engineer for written acceptance prior to installation.

.2 Mechanical inserts: designs are based on Hilti Kwik Bolts.

2.2 Sealants

.1 Polyurethane Sealant (Horizontal Joint): withstand a maximum of 25% joint movement, Sikaflex 12-SL, PRC 6006, Vulkem 45.

.2 Polyurethane Sealant (Vertical Joint): withstand a maximum of 25% joint movement, Sikaflex la, PRC 270, Vulkem 116.

.3 Interior Saw Cut Joint or Control Joint Sealant: catalyst cured epoxy rubber, Sternson Loadflex, Sealtight Bondflex, Concrete Chemicals 903B Flexible Sealant, Allied Coatings AC-1210 Flexible Epoxy Sealant.

.4 Primers: as supplied by sealant manufacturers.

2.3 Vapour Barrier

.1 Vapour Barrier: 0.15 mm clear polyethylene film, unreinforced, with self-adhesive polyethylene tape for joints, suitable for use below grade.

3. EXECUTION

3.1 Examination

.1 Before starting this work, examine work done by others which affects this work.

.2 Notify the Engineer of any conditions which would prejudice proper completion of this work.

.3 Commencement of work implies acceptance of existing conditions.

3.2 Installation

.1 Coordinate work of this Section with other construction.

.2 Install all concrete accessories in accordance with drawings and manufacturer's recommendations; straight, level, and plumb.

.3 Ensure embedded items are not disturbed during concrete placement.

.4 When installing seals, clean contact surfaces free from dirt, water, oil, rust, frost, and any other loose foreign matter. When recommended by manufacturer, prime contact surfaces of concrete.

.5 Install protective boards over joint covers when potentially damaging construction activities are not complete.

END OF SECTION

CAST-IN-PLACE CONCRETE

1. GENERAL

1.1 Work Included

.1 All plain and reinforced cast-in-place concrete shown on drawings.

.2 Setting anchors, inserts, frames, sleeves and other items supplied by other Sections.

.3 Repairing concrete imperfections.

.4 Finishing formed concrete surfaces.

.5 Waterproofing reservoir walls and floor slab. This includes both existing concrete surfaces and new concrete surfaces as indicated on the drawings.

1.2 Related Work

.1	Concrete formwork:	Section 03100
.2	Concrete reinforcement:	Section 03200
.3	Concrete accessories:	Section 03250

1.3 Quality Assurance

.1 Cast-in-place concrete to conform to CAN/CSA-A23.1-LATEST.

.2 Testing shall conform to CAN/CSA-A23.2-M90.

1.4 Inspection and Testing

.1 Notify Engineer at least 24 hours before complete formwork and concrete reinforcement will be ready for inspection.

.2 Allow ample time for inspection and corrective work, if required, before scheduling concrete placement.

.3 Concrete sampling, inspection and testing is to be performed by an Inspection and Testing Firm appointed and paid by the Owner.

.4 Provide free access to all portions of work and cooperate with appointed firm.

.5 Submit proposed mix design to Engineer for review prior to commencement of work.

.6 Tests of cement and aggregates may be performed to ensure conformance with requirements stated herein.

.7 Notify Inspection and Testing Firm before placing concrete, in ample time to permit scheduling.

.8 Three concrete test cylinders will be taken for every 50 m3 or less of concrete placed at any one time.

.9 At least three test cylinders will be taken daily for each class of concrete placed. Record atmospheric and concrete temperatures.

.10 One additional test cylinder will be taken during cold weather concreting, and be cured on job site under same conditions as concrete it represents.

.11 One slump test and one air content test will be taken for each set of test cylinders taken.

.12 Additional slump tests may be taken as necessary to verify quality of concrete.

.13 Testing of concrete will be performed in accordance with CAN/CSA-A23.2-M-90. Test results will be issued to Contractor and Engineer.

.14 Pay costs for retesting required due to defective materials or workmanship.

.15 Contractor may arrange and pay for additional tests for use as evidence to expedite construction.

2. PRODUCTS

2.1 Concrete Materials

.1 Cement: Type 10 Portland type, conforming to CAN/CSA-A5-LATEST.

.2 Fine Aggregate: conforming to Normal Density Fine Aggregate, CAN/CSA-A23.1-LATEST.

.3 Coarse Aggregate: conforming to Normal Density Coarse Aggregate, CAN/CSA-A23.1-LATEST, Group I.

.4 Coarse Aggregate for Toppings: conforming to Normal Density Coarse Aggregate, CAN/CSA-A23.1-LATEST, Group I.

.5 Ensure that no aggregates are used which may undergo volume change due to alkali reactivity, moisture retention or other causes. Confirm suitability of aggregate with a petrographic analysis if deemed necessary by the Engineer.

.6 Water: clean and free from injurious amounts of oil, alkali, organic matter or other deleterious material.

2.2 Admixtures

.1 Air Entrainment: conforming to CAN 3-A266.1-LATEST.

.2 Chemical: conforming to CAN 3-A266.2-LATEST.

.3 Pozzolanic Mineral: conforming to CAN/CSA-A23.5(LATEST).

2.3 Accessories

.1 Epoxy Bonding Agent: two component epoxy resin.

.2 Acrylic Bonding Agent: CPD Acrylic Concrete Adhesive, Thorosystems Acryl 60, Sternson Duraweld C, Elsro Flex-Con 710, mixed with cement as recommended by manufacturer.

.3 Non-Ferrous Grout: pre-mixed, non-shrink, Master Builders 713, Sternson M-Bed, CPD Non Shrink Grout, Steel CI Grout, minimum 35 MPa compressive strength. Or: Epoxy Grout: Sternson Talygrout.

2.4 Concrete Mixes

.1 Pay all costs for mix design. Submit design of a proven mix to Engineer for review.

.2 Provide concrete mixed in accordance with requirements of CAN/CSA-A23.1-LATEST.

.3 All concrete unless noted otherwise on the Drawings: 30 MPa 28 day compressive strength, slump 70 ±20 mm.

.4 Use accelerating admixtures in cold weather only when approved by Engineer. If approved, 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 approved by Engineer.

.6 All admixtures are subject to the approval of the Engineer. List all proposed admixtures in mix design submission. Do not change or add admixtures to approved design mixes without Engineer's approval.

3. EXECUTION

3.1 Examination

.1 Before starting this work, examine work done by others which affects this work.

.2 Notify the Engineer of any conditions which would prejudice proper completion of this work.

.3 Commencement of work implies acceptance of existing conditions

3.2 Placing Concrete

.1 Place concrete in accordance with requirements of CAN/CSA-A23.1-LATEST, and as indicated on drawings.

.2 Handling equipment shall be kept free from hardened concrete or foreign material, and cleaned at frequent intervals.

.3 Notify Engineer and Inspection and Testing Firm minimum 24 hours prior to commencement of concrete operations.

.4 Ensure all anchors, seats, plates and other items to be cast into concrete are securely placed, and will not interfere with concrete placement.

.5 Maintain accurate records of cast-in-place concrete items. Record date, location of pour, quantity, air temperature and test samples taken.

.6 Ensure reinforcement, inserts, embedded parts, formed expansion and control joints are not disturbed during concrete placement.

.7 Prepare set concrete by removing all laitance and loose materials and applying bonding agent. Apply bonding agent in accordance with manufacturer's recommendations.

.8 Place concrete continuously between present construction and control joints.

.9 Vibrate concrete using the appropriate size equipment as placing proceeds in strict accordance with CAN/CSA-A23.1-LATEST. Check frequency and amplitude of vibrations prior to use. Provide additional standby vibrators in the event of equipment failure.

.10 Do not place concrete if carbon dioxide producing equipment has been in operation in the building during the 12 hours preceding the pour. This equipment shall not be used during placing or for 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.

.11 Honeycomb or embedded debris in concrete is not acceptable.

.12 Remove and replace defective concrete.

3.3 Cold and Hot Weather Concreting

.1 Conform to requirements of CAN/CSA-A23.1-LATEST.

.2 Refer to Section 01500 for temporary enclosure and heating requirements.

3.4 Concrete Protection for Reinforcement

.1 Ensure reinforcement is placed to provide minimum concrete cover in accordance with CAN/CSA-A23.1-LATEST.

.2 Conduits and Pipes

.3 Conduit and pipe embedded in concrete shall be of a material not harmful to the concrete and shall:

.4 Not displace more than 4% of the area of the cross section of a column on which stress is calculated, including the area of concrete displaced by the bending of the conduit or exit path of the conduit out of the column.

.5 Not be spaced closer than three diametres on centre.

.6 Have a concrete covering of not less than 25 mm.

.7 Be so installed that it will not require cutting, bending or displacement of the reinforcement or impair the structural strength of the system.

3.5 Install Items Specified Under Other Sections

.1 Install hangers, sleeves, anchors, etc. specified under other Sections.

.2 Pour concrete after other trades have satisfactorily installed their materials.

.3 Do not eliminate or displace reinforcement to accommodate hardware. If hangers, inserts, anchors, etc. cannot be located as specified obtain approval of all modifications from Engineer before placing concrete.

3.6 Equipment Pads

.1 Provide concrete pads for equipment where and as indicated on drawings. Adjust dimensions of pads to suit final equipment sizes as per reviewed shop drawings.

.2 Steel trowel top surface smooth.

3.7 Curing and Protection

.1 Cure and protect freshly placed concrete in accordance with CAN/CSA-A23.1-LATEST using moist curing methods only.

.2 All concrete shall receive moist curing for a period of at least seventy two hours. 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 wet.

.2 Surface sealed with polyethylene sheeting at least 6 mils thick and the concrete kept thoroughly wet.

.3 LIQUID MEMBRANE, CURING COMPOUNDS MAY NOT BE USED.

.3 The Contractor shall protect and heat, where necessary, all concrete which has been placed when the air temperature is 5°C. or below. In the opinion of the Engineer, when the air temperature is likely to fall below 5°C. at any time during the twenty four hours after the concrete is placed, the concrete shall then also be protected and heated, when necessary, from the time the concrete is placed. When the air temperature falls below 5°C. during the seven days after the concrete is placed, the Engineer may instruct the Contractor to institute protection and heating where necessary to prevent damage to the concrete by freezing or to allow the concrete to develop sufficient strength to carry the dead and live loads which will be imposed on it by further construction work or general traffic in the near future.

.4 The system of protection, surface or enclosed with heating, where necessary, (or fully insulated forms), must be adequate and designed in relation to ambient conditions and the type of construction to satisfactorily achieve these curing conditions in the concrete.

.5 For proper curing of concrete the temperature of all surfaces of the concrete shall be maintained at not less than 20°C. for five days or at not less than 10°C. for seven days after placing. Further, the concrete shall be kept above freezing temperature for a period of at least nine days and shall be kept from alternate freezing and thawing for at least fourteen days after placement.

.6 No salt or other chemicals shall be used to lower the freezing point of the concrete as a substitute for the specified curing and protection

.7 At the end of the specified 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.

.8 The Contractor shall keep a full record of the temperature of concrete upon placing and a daily record of the curing temperature of the concrete for the full protection period.

.9 Concrete which is allowed to freeze or which obtains insufficient curing conditions shall be subject to all necessary investigations and testing as deemed necessary by the Engineer. If found unsatisfactory, all such concrete shall be removed and the portion reconstructed as directed by the Engineer.

.10 The cost incurred by the Engineer for such investigation, testing or inspection of reconstruction and the cost of reconstruction shall be borne by the Contractor.

3.8 Formed Concrete

.1 Inspect concrete surfaces immediately upon removal of forms.

.2 Treat imperfections in formed surfaces in accordance with CAN/CSA-A23.1-LATEST and to Engineer's approval – all required patches shall be completed using the specified patching mortar.

.3 Modify or replace concrete not conforming to qualities, lines, details and elevations specified herein or indicated on drawings.

3.9 Surfacing and Finishing

.1 Class 1 - Ordinary Surface Finish:

.1 Immediately following the removal of forms, all fins and irregular projections shall be removed from all surfaces except those which are not to be exposed or not to be waterproofed. On all surfaces the cavities produced by form ties, if specified to be filled, and all other holes, honeycomb spots, broken corners or edges and other defects shall be thoroughly cleaned and after having been kept saturated with water for a period of not less than three hours, shall be carefully pointed and trued with the specified mortar. The mortar patches shall be cured as specified under "Curing". All construction and expansion joints in the completed work shall be left carefully tooled and free from all mortar and concrete. The joint filler shall be left exposed for its full length and with clean and true edges. Pointing and patching of concrete surfaces which are to receive a Class 3 finish must be of uniform texture and match the texture of the surrounding formed finishes. An approved acrylic polymer bonding agent shall be used in all repair mortar.

.2 The resulting surfaces shall be true and uniform; all surfaces which cannot be repaired to the satisfaction of the Engineer shall be "rubbed" as specified for Class 2 - Rubbed Finish.

.2 Floated Surface Finish:

.1 After the concrete has been compacted, the surface shall be carefully rodded and struck off with a stroke board to conform to the cross-section and grade shown on the Drawings. Proper allowance shall be made for camber, if required. The strike board may be operated longitudinally or transversely and shall be moved forward with a combined longitudinal and transverse motion, the manipulation being such that neither end is raised from the site forms. A slight excess of concrete shall be kept in front of the cutting edge at all times.

3.10 Defective Concrete

.1 Concrete not meeting the requirements of the Specifications and Drawings shall be considered defective concrete.

.2 Concrete not conforming to the lines, detail and grade specified herein or as shown on the Drawings shall be modified or replaced at the Contractor's expense and to the satisfaction of the Engineer. Finished lines, dimensions and surfaces shall be correct and true within tolerances specified herein and in the Formwork Section of these Specifications.

.3 Concrete not properly placed resulting in excessive honeycombing, and all honey-combing and other defects in critical areas of stress shall be repaired or replaced at the Contractor's expense and to the satisfaction of the Engineer.

.4 To conform to the strength requirements, the average of all tests shall exceed thespecified strength. When five or more tests of the same class of concrete are available, the average of any five 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 above clause are not met, the Engineer 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 Engineer and in accordance with CAN/CSA-A23.2-M90. The test results shall be indicative of the strength of the in-place concrete.

.3 Load testing of the structural elements. The changes in the mix proportions and the testing shall be at the Contractor's expense.

.4 Concrete failing to meet the strength requirements of this specification shall be strengthened or replaced at the Contractor's expense and the satisfaction of the Engineer.

3.11 Patching

.1 Allow Engineer to inspect concrete surfaces immediately upon removal of all formwork.

.2 Patch imperfections when concrete is green.

.3 Remove all exposed metal form ties, nails and wires, break off fins and remove all loose concrete.

.4 Thoroughly wet all form tie pockets and patch with patching mortar followed by proper curing.

.5 Chip away honeycombed and other defective surfaces to depth of not less than 25mm with the edges perpendicular to the surface. Thoroughly wet and patch with patching mortar followed by proper curing.

3.12 Clean-Up

.1 As work progresses, remove from site all debris and excess materials.

.2 At completion of work, remove from site all debris, excess materials and equipment.

END OF SECTION