Cryogenic to + 93°	
Closed cell content ASTM D-2856	90 % minimum
Water absorption ASTM D-2842	12 gm/1000 cc maximum
Dimension Stability, ASTM D-2126, Procedure B and E	3 %

.4 Protective jacketing for buried piping to be either of the following:

.1 A 1.14 mm thickness of black continuously extruded high density polyethylene over a rubber mastic under-adhesive as manufacture red by Shaw Pipe Protection, "Insul 8" system.

.2 A 1.27 mm thickness, in two (2) layers, of spirally wrapped black high density polyethylene tape, hot applied, counter-wound, overlapping 15% of tape width on each seam, Urecon Ltd. "UIP" system, or Thermal Pipe System Ltd.

.5 Protective jacket for above ground piping to be galvanized steel, 0.889 mm (22 gauge), spirally applied from a continuous steel strip using a lockseam. Protective metal jacket for fittings shall be as detailed on the drawings.

.6 Pre-formed urethane halves shall be to the dimensions shown on the plans, made of urethane to 2.2.3.2.

.7 Heat shrink sleeves shall be "Canusa" cross linked polyethylene heat shrink sleeves, or approved equal.

.8 The insulation shall be cut-back 190 mm to allow for the field joining of the pipe. Care shall be taken, when cutting away insulation from the pipe, do not cut the pipe beneath the insulation. Cut pipe shall be rejected from the work.

.9 Where the drawings call for the use of sealing tape or where the geometry of ends and fittings prevents the installation of heat shrink sleeves over the insulation, then two wrappings of "Raychem Thermaclad" heat shrinkable take in 100 mm widths shall be applied with a 50% overlap.

.10 Urethane halves for field installation shall be field coated with an 0.8 mm coat of "Flintkote - Superior" asphalt mastic No. 110-14. Exposed urethane insulation,

cast on pipe lines, shall be similarly field second coated prior to the application of urethane halves and jacketing.

.11 Shop castings of urethane shall be by firms experienced in the casting of urethane and approved by the Engineer.

2.3 Pipe Bedding Materials

.1 Granular Material, general:

.1 Gradation to be within specified limits when tested to ASTM C136-76 (ASSHTO T11-76 and T27-74) and giving a smooth curve without sharp breaks when plotted on a semi log grading chart.

.2 Pit Run Material:

.1 Natural sand and gravel having a maximum size of 20 mm and no more than 10% passing the No. 200 sieve.

.2 Liquid Limit: ASTM D423-66 (1972) (AASHTO T89-68), maximum 25.

.3 Plasticity Index: ASTM D424-59 (1971) (AASHTO T90-70), max 6.

2.4 Warning Tape

.1 The tape shall be 150 mm wide x 0.15 mm thick polyethylene tape.

.2 The tape for sanitary sewer mains shall be green in colour and have factory appled markings at one meter intervals, i.e., "Caution Buried Sewer Line", Allen Detectatape or approved equal.

2.5 Exterior Pipe Coupling

.1 Pipe couplings adjacent to the access vaults shall be Ford Standard Steel, Style FC3 and minimum 450 mm in length.

.2 Seamless stainless steel inserts shall be installed in all polyethylene lines being connected with couplings specified in 2.5.1.

3. EXECUTION

3.1 Site Preparation

.1 Clean pipe, and appurtenances of accumulated debris and water before installation. Carefully inspect materials for defects. Remove defective material from site.

3.2 Trenching and Backfill

.1 Do trenching and backfill work to Section 02315.

3.3 Granular Bedding

.1 Place granular bedding materials to details indicated or directed.

.2 Shape bed true to grade to provide continuous uniform bearing surface for pipe exterior. Do not use blocks when bedding pipe.

.3 Shape traverse depressions in bedding as required to make joints.

.4 Carry out mechanical tamping of the bedding material in 150 mm loose layers with no more than one man placing to one man tamping.

.5 Place crushed stone instead of pit run bedding material when directed by the Engineer.

3.4 Pipe Installation

.1 On dry ground, assemble by butt-fusion, or socket fusion where specified, or electro fusion couplings lengths of pipe to be laid.

.2 Employ a qualified butt-fusion technician to carry out thermal butt-fusion and socket fusion of pipe as recommended by the manufacturer. Technician shall have a minimum of two (2) years experience in fusion jointing pipe. Affidavit of experience shall be submitted to the Engineer for approval four (4) weeks prior to commencement of construction.

.3 Complete installation of urethane halves after laying the pipe in the trench and after successful pressure testing of the pipe.

.4 Handle pipe by approved methods, without causing damage to the jacket or insulation. Do not use chains or cables passed through pipe bore so that weight of pipe bears on pipe ends.

.5 Do not drag pipe over the ground which would damage the jacket and insulation. Damage to insulation to be repaired with field foam. Damage to jacket to be repaired with heat shrink tape around pipe, overlapped 50%, extended 150 mm each side of the damage.

.6 Lay pipes on prepared bed, true to line and grade as indicated. No deviations shall be made without written approval of the Engineer. Ensure barrel of each pipe is in contact with shaped bed throughout its full length. Take up and replace defective pipe. Correct pipe, which is not in, true alignment or grade or pipe which shows undue settlement after installation. The Contractor shall change his method or equipment for setting grade when requested by the Engineer.

.7 Keep jointing materials and installed pipe free of dirt and water and other foreign materials. Install a removable watertight bulkhead at open end of pipe to prevent entry of foreign materials.

.8 Cut pipes as required for closure pieces, in a neat manner as recommended by the pipe manufacturer, without damaging the pipe, insulation or its coating and to leave a smooth end at right angles to axis of pipe.

.9 Recheck pipe joints assembled above ground after placing in trench to ensure that no movement of joint has taken place.

.10 Do not lay pipe on frozen bedding.

.11 Upon completion of pipe laying and pressure testing, install insulation half shells and heat shrink sleeves at joints. After the Engineer has inspected work in place, surround and cover the pipe with approved granular material placed to dimensions indicated or directed.

.12 Hand place granular bedding material in uniform layers not exceeding 200 mm thick to 300 mm over top of pipe. Dumping of material directly on top of pipe is not permitted.

.13 Place layers uniformly and simultaneously on each side of pipe to prevent lateral displacement of pipe.

.14 Carry out mechanical tamping of each layer with no more than one man placing to one man tamping.

.15 Lay on top of the granular bedding, 300 mm directly above the water and sewer mains, continuous runs of warning tape as specified.

3.5 Connections to Prefabricated Access Vaults

.1 Connect ends of the pipes in trench to the steel pipe ends outside the access vault wall, as indicated on the drawings. The maximum allowable space between pipe ends shall be 10 mm.

.2 After successful pressure testing, install pre-formed mastic coated urethane half shells over the connection assembly as indicated on the drawings.

.3 Apply two (2) wrappings of specified heat shrinkable tape as indicated on the drawings. The first complete wrapping shall be applied and shrunk down before the second wrapping is applied. The tape shall overlap 50% as it is wrapped around the fitting.

3.6 Pressure Testing

.1 Pressure test the complete installed and sewer mains, prior to connection to the existing system.

.2 Pressure testing of water mains and sewer mains shall be required after runs of main, between access vaults, and/or flanged fittings have been joined by thermal fusion, and installed in the trench but before the completion of insulation at the joints.

.3 Provide all necessary labour, materials and equipment for the test, including a suitable pump and measuring tank, pressure hoses and connection plugs, caps, gauges, and all other apparatus necessary for filling the pipe to be tested, pump to the required test pressure and record the pressure and leakage losses.

.4 Water shall be used for testing. Provide temporary heating and additional insulation that may be necessary to keep the water in the pipes from freezing in cold weather.

.5 Seal off the ends of the pipe to be tested using valves, victaulic caps for sewer lines in access vaults or using blind flanges and gaskets where applicable. The flange or cap on the lower end of the pipe shall be tapped to receive the test pump discharge line. The flange or cap on the high end of the pipe shall be tapped to receive a vent cock to discharge air from the line during the filling process. The pipe shall be laid to a continuously rising grade to the vent cock.

.6 Fill the pipe with water at a gauge pressure of 1.5 times the series rating of the pipe and maintain the pressure for four (4) hours. No visible leakage shall be permitted.

.7 Reduce the pressure by 70 kPa thereafter for a period of one (1) hour. If the pressure does not hold steady for the one (1) hour period, locate and repair leakage.

.8 Repair all leaks or replace defective material to the Engineer's requirements. Repeat testing until the defects are rectified.

.9 Under no circumstances shall the total time under test exceed eight (8) hours at 1 ½ times the pressure rating. If the test is not completed because of leakage or equipment failure, the test section should be permitted to "relax" for eight (8) hours prior to the next testing sequence.

.10 All pressure tests must be made in the presence of the Engineer.

3.7 Test of Obstructions

.1 Upon completion of backfilling, sewer mains shall be tested for obstructions. Provide and pay for labour, tools, ropes, pigs, lights and other equipment required to examine all work as required by the Engineer.

.2 The sewer and water mains shall be tested for obstructions using a pig test. The pipes shall be deemed unobstructed if a wood or metal ball, having a diameter 19 mm less than the inside diameter of the pipe can be readily pulled through the line.

.3 Repair and/or replace mains which do not pass the pig test. After completion of repair work, redo the pressure and leakage test and pig test.

3.8 TV Inspection of Sewer Mains

.1 The Owner reserves the right to have a complete TV inspection done, on completion of the project, for the installed mains. The cost of such TV inspection shall be borne by the Owner. Deficiencies noted by means of the TV inspection shall be rectified by the Contractor at his own expense.

END OF SECTION

DIVISION 3
CONCRETE

TABLE OF CONTENTS
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, CSA S269.1, ACI 347 and applicable construction safety regulations.

.2 Design work to conform to CAN/CSA A23.1 and ACI 350 for sewage containment structures.

.3 Design to be sealed by a qualified professional engineer licensed to practice with the Northwest Territories and Nunuvat.

1.4 Quality Assurance

.1 Construct and erect concrete formwork in accordance with CAN/CSA-A23.1, CSA S269.1, ACI 347, ACI 350 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. Plywood used as permanent form under structural slabs maybe unspecified cull material free protuberances that will not detrimentally affect the slab vapour barrier and is strong enough to support rebar chains and embedded hardware.

.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.

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 on extruded polystyrene of thickness shown capable to carry weight of wet concrete during casting to a maximum deformation of 5%.

.5 Vapour barrier, see Section 03250.

3. EXECUTION

3.1 Examination

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

.2 Notify the Owner 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, shoring and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties and parts are secure.

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

.3 Do not tear or displace vapor barrier during work.

3.6 Cleaning

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

.2 During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out completed forms, unless formwork and concrete construction 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 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 and ACI 550 for structures containing fluids and waste.

.2 Perform welding in accordance with CSA W186.

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.

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

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

Item	Coverage (mm)
Clarifier tank walls	50
Clarifier tank base slab top	40

Clarifier tank base slab bot	50
Headworks channels and wires	40
Other interior slabs, beams, walls	40
Exterior slabs, beams	50
Concrete cast against earth	75

.5 Maintain alignment as follows:

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

.6 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 super hardware and hilti hyiso epoxy. Use cold weather grade is below 10°C.

.2 Mechanical inserts: designs aer 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 Hydraulic Cement Compounds

.1 Hydraulic cement grout: fast setting, non shrink, high-bond strength, non soluable crystalline hydraulic cement compound (Xypex Admix approved alternate).

.2 Crystalline cement slurp: non soluble crystalline cementitious compound (Xypex Concentrate or approved alternate).

2.4 Water Stops

.1 HPE water stop: one component hydrophilic polyurethane based extrudable swelling water stop (Sikawell or approved alternate).

.2 PVC water stop: high strength poly vinyl chloride water stop c/w prewelded joints to resist fluid pressures indicated.

2.5 Vapour Barrier

.1 Vapour Barrier: 0.25 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. Apply hydraulic cement components in accordance with manufacturers recommendation for each specific application.

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

.4 When installing seal or hydraulic cement compounds, 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 or pre-wet with clear water as directed.

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

.6 Install HPE water stops over clean prepared surfaces to manufacturer's recommendation.

.7 Install PVC water stops as a single length with minimum splices. Use pre-welded tees, joints and intersections.

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.

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

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

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

.4 Water sealing admixture: water based, high polymer dispersion specifically designed to fortify portland cement compositions, enhance water resistance characteristics and reduce concrete shrinkage (Xypex Admix or approved alternate).

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.

.3 All concrete unless noted otherwise on the Drawings: 30 MPa 28 day compressive strength, slump 70 ±20 mm. Walls: maximum slump 100 ±20.

.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 For all water or fluid retaining structures including walls and base slabs mix water sealing admixture 1:2 with water in accordance with manufacturer's recommendation.

.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, 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. 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.

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