

PART 1 - GENERAL

1.1 SECTION
INCLUDES

- .1 This Section covers all cast-in-place concrete related to the construction of the components listed below, including formwork, finishing, expansion and construction joints, anchor bolts and other concrete accessories:
 - .1 Haul Road and East Mound Road bridge structure - footings, abutments, deck, wing walls, approach slabs, and barrier walls.
 - .2 Concrete in retaining wall footing and stem located at the end of the wing walls for the bridge structures.
 - .3 Pumping Stations.

1.2 MEASUREMENT AND
PAYMENT

- .1 Measure cast-in-place concrete in cubic metres calculated from neat dimensions authorized in writing by Departmental Representative. Concrete placed beyond dimensions indicated will not be measured.
 - .1 Concrete in bridge footings.
 - .2 Concrete in bridge abutments and wing walls.
 - .3 Concrete in retaining walls.
 - .4 Concrete in bridge barrier walls.
 - .5 Concrete in bridge deck.
 - .6 Concrete in bridge approach slabs.
 - .2 Measure cast-in-place concrete by Lot Price for pumping stations. Concrete shall be placed to dimensions indicated.
 - .1 Pumping Station No. 1 - Eq. Pond.
 - .2 Pumping Station No. 2 - PGWMF SWM Pond.
 - .3 Pumping Station No. 3 - East Gorge.
 - .4 Pumping Station No. 4 - West Gorge.
 - .5 Pumping Station No. 5 - Leachate Cell 1.
 - .6 Pumping Station No. 6 - Leachate Cell 2.
 - .3 No deductions will be made for volume of concrete displaced by reinforcing steel.
 - .4 No deductions will be made for volume of concrete less than 0.1 m² in cross sectional area displaced by individual drainage openings.
 - .5 Supply and installation of reinforcing steel, joint filler, caulking, and PVC waterstop will not be measured but considered incidental to the work.
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1.2 MEASUREMENT AND PAYMENT (Cont'd)	.6	Supply and installation of anchor bolts, nuts and washers and bolt grouting will not be measured but considered incidental to the work.
	.7	Supply and installation of 20 MPa mass concrete for workings slab below footings will not be measured but considered incidental to the work.
1.3 RELATED SECTIONS	.1	Section 03 10 00: Concrete Forming and Accessories.
	.2	Section 03 20 00: Concrete Reinforcing.
	.3	Section 03 30 51: Concrete for Bridge Decks.
1.4 ABBREVIATIONS AND ACRONYMS	.1	Cement: hydraulic cement or blended hydraulic cement (XXb - where b denotes blended). .1 Type GU or GUb - General use cement. .2 Type MS or MSb - Moderate sulphate-resistant cement. .3 Type MH or MHb - Moderate heat of hydration cement. .4 Type HE or Heb - High early-strength cement. .5 Type LH or LHb - Low heat of hydration cement. .6 Type HS or HSb - High sulphate-resistant cement.
	.2	Fly ash: .1 Type F - with CaO content less than 8%. .2 Type CI - with CaO content ranging from 8 to 20%. .3 Type CH - with CaO greater than 20%.
	.3	GGBFS - Ground, granulated blast-furnace slag.
1.5 REFERENCES	.1	American Society for Testing and Materials (ASTM): .1 ASTM C260/C260M-10a, Standard Specification for Air-Entraining Admixtures for Concrete. .2 ASTM C494/C494M-12, Standard Specification for Chemical Admixtures for Concrete. .3 ASTM C1017/C1017M-07, Standard Specification for Chemical Admixtures for Concrete.

1.5 REFERENCES
(Cont'd)

- .1 (Cont'd)
 - .4 ASTM D1751-04(2008), Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
 - .5 ASTM C1059/C1059M-99(2008), Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete.
 - .6 ASTM C165-07 (2012), Standard Test Method for Measuring Compressive Properties of Thermal Insulations.
 - .7 ASTM E96/E96M-13, Standard Test Method for Water Vapour Transmission of Materials.
 - .8 ASTM C578-14a, Standard Specification for Rigid Cellular Polystyrene Thermal Insulation.
- .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-51.34-M86 Amend, (R1988), Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
 - .2 CAN/CGSB 19.13-M87 Sealing Compound, One-component, Elastomeric Chemical Curing.
 - .3 CGSB 71-GP 24m AMD1-1983, Adhesive, Flexible, for Bonding Cellular Polystyrene Insulation.
 - .4 CAN/CGSB-37.2-M88, Emulsified Asphalt, Mineral-Colloid Type, Unfilled, for Dampproofing and Waterproofing, and for Roof Coatings.
- .3 Canadian Standards Association (CSA):
 - .1 CSA A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
 - .2 CSA A283-06(R2011), Qualification Code for Concrete Testing Laboratories.
 - .3 CSA A3000-08, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - .4 CSA-G30.18-09, Carbon Steel Bars for Concrete Reinforcement.
- .4 CAN/CSA-A3001-08, Cementitious Materials for Use in Concrete.
- .5 OPSS.PROV 904 (Nov 2012) Construction Specification for Concrete Structures.
- .6 CAN/ULC S701-05, Thermal Insulation Polystyrene, Boards and Pipe Covering.

1.5 REFERENCES
(Cont'd)

- .7 CAN/ULC-S702-09, Standard for Thermal
Insulation Mineral Fibre, for Buildings.

1.6 ADMINISTRATIVE
REQUIREMENTS

- .1 Pre-installation Meetings: in accordance with
Section 01 31 19, convene pre-installation
meeting one week prior to beginning concrete
works.

1.7 SUBMITTALS

- .1 Provide submittals in accordance with Section
01 33 00.
- .2 At least 4 weeks prior to beginning Work,
provide Departmental Representative with
samples of materials proposed for use as
follows:
- .1 1 m length of each type of joint filler.
- .2 1 m length of each type of water stops.
- .3 Certificates:
- .1 A minimum of 8 weeks prior to placement
of concrete, submit to the Departmental
Representative manufacturer's test data
and certification by the concrete
producer with material samples verified
by a qualified independent inspection and
testing laboratory that the following
materials will meet the specified
requirements of this Contract.
- .1 Portland cement.
- .2 Blended hydraulic cement.
- .3 Supplementary cementing materials.
- .4 Admixtures.
- .5 Aggregates.
- .2 Submit certification that plant,
equipment, and materials to be used in
concrete Work comply with requirements of
CSA A23.1/A23.2.
- .3 Submit certification that Ready Mix
concrete producer has current
qualification of Ready Mix Concrete
Association of Ontario (RMCAO) Special
Seal of Quality.
- .4 Submit test results and certification
demonstrating that aggregates will not,
nor have the potential to, react with
cement to result in deleterious expansion
in the concrete. Ensure these tests are
current and represent the aggregates
being supplied.

1.7 SUBMITTALS
(Cont'd)

- .3 (Cont'd)
 - .5 Submit test results and certification that deleterious substances in aggregate are within limits specified in CSA A23.1, Table 12 Limits for Deleterious Substances and Physical Properties of Aggregates. Ensure these tests are current and represent the aggregates being supplied.
 - .6 Provide certification that mix proportions selected will produce concrete of quality, yield and strength as specified in concrete mixes, and will comply with CSA-A23.1/A23.2.
- .4 Reports:
 - .1 Submit for the Departmental Representative's review the quality control plans which describe the material, equipment and procedures to be used for the following activities.
 - .1 Uniform and consistent concrete finishing.
 - .2 Cold weather protection.
 - .3 Hot weather protection.
 - .4 Concrete curing.
 - .5 Concrete placing.
 - .2 Mix design:
 - .1 Submit performance based mix design 8 weeks prior to placement of concrete using RMCAO Mix Design Submission Form or equivalent acceptable to the Departmental Representative.
 - .2 Alkali aggregate reactivity problems may occur under certain circumstances. Ensure mix design is adjusted suitably to prevent such problems.
 - .3 Do not place concrete before performance based mix designs have been reviewed by the Departmental Representative.
 - .4 Submit mix design for patching material to the Departmental Representative for written acceptance.

1.8 QUALITY
ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00.
- .2 Provide Departmental Representative, minimum 8 weeks prior to starting concrete work, with valid and recognized certificate from plant delivering concrete.

1.8 QUALITY
ASSURANCE
(Cont'd)

- .2 (Cont'd)
 - .1 Provide test data and certification by qualified independent inspection and testing laboratory that materials and mix designs used in concrete mixture will meet specified requirements.
- .3 Minimum 8 weeks prior to starting concrete work, provide proposed quality control procedures for review by Departmental Representative on following items:
 - .1 Falsework erection.
 - .2 Hot weather concrete.
 - .3 Cold weather concrete.
 - .4 Curing.
 - .5 Finishes.
 - .6 Formwork removal.
 - .7 Joints.
- .4 Quality Control Plan: provide written report to Departmental Representative verifying compliance that concrete in place meets performance requirements of concrete as established in PART 2 - PRODUCTS.
- .5 Manufacturer's qualifications:
 - .1 Ready mix concrete supplier: Member in good standing of Ready Mix Concrete Association of Ontario (RMCAO). Batching plant facilities are required to maintain RMCAO Special Seal of Quality.
 - .2 Batching and delivery facilities: Facilities capable of producing minimum of 75 m³/h, conform to requirements of CSA A23.1/A23.2.
- .6 Tolerances:
 - .1 Make concrete in place plumb, level and true. Have maximum variations (non cumulative) conform to CSA A23.1/A23.2, unless noted otherwise.
 - .2 Do not construe variation permitted by the Departmental Representative in one part of construction or in one Section of Specifications as permitting violation of more stringent requirements for other part of construction, or in other Specification Sections.
- .7 Inspection and tests:
 - .1 Materials: CSA A23.1/A23.2; Inspected and tested for conformance to requirements of this standard and to Specifications by the Departmental Representative.
 - .2 Tests will be made in accordance with CSA A23.2.

1.8 QUALITY
ASSURANCE
(Cont'd)

- .7 (Cont'd)
 - .3 Cooperate with and assist the Departmental Representative during inspections and tests.
 - .4 Remove defective materials and completed work which fails tests and replace as directed by the Departmental Representative.
 - .5 Inspection or testing by the Departmental Representative will not augment or replace Contractor's quality control nor relieve them of their contractual responsibility.
- .8 Defective concrete:
 - .1 Strength acceptance criteria from tests cylinder will be in accordance with CSA A23.1/A23.2 except as follows:
 - .1 Concrete shall be considered defective for concrete placements less than 200 m³ when a cylinder test fails to meet specified strength. In such cases concrete in that section may be checked by the Departmental Representative by core specimens drilled and tested in accordance with CSA A23.2. All concrete core extraction and testing shall be conducted by a third party inspection company with a CSA certified testing laboratory with Category I certification.
 - .2 Strength acceptance criteria from core specimens will be in accordance with CSA A23.1/A23.2.
 - .3 Consider concrete defective if it is structurally unsound, lacks moisture resistance, honeycombed or improperly finished, as determined by the Departmental Representative.
 - .4 The Departmental Representative has the right to require replacement, strengthening or correction of impacted portions of defective concrete structure to acceptance of the Departmental Representative.
 - .1 Bear all costs of rectifying defective concrete including inspections, design, coring, testing, strengthening, demolishing, and replacement. Bear investigation and evaluation costs even if further evaluation of design allows unit to be classed as acceptable concrete.
- .9 Records:

1.8 QUALITY
ASSURANCE
(Cont'd)

.9 (Cont'd)

- .1 Before unloading at Site, have concrete producer submit to the Departmental Representative a delivery ticket (with each batch of concrete) on which is printed, stamped or written the following information:
 - .1 Name and location of batch plant.
 - .2 Date and serial number of ticket.
 - .3 Name of Contractor.
 - .4 Specific designation of job (name and location).
 - .5 Approved mix code, specified strength, and specific class or designation of concrete indicated in Concrete Mixes article specified.
 - .6 Amount of concrete in cubic metres.
 - .7 Truck number, cumulative total, and/or load number.
 - .8 Time loaded or time of first mixing of cement and water/aggregate.
 - .9 If water added show amount and have this information initialled by the Departmental Representative.
- .2 Include the following information, which is to be registered by producer's representative on at least two copies of the delivery ticket, after discharge has been completed:
 - .1 Time that load arrived on Site.
 - .2 Time that discharge of load was started.
 - .3 Time that discharge of load was completed.
 - .4 Type and amount of admixtures, if added at Site.
 - .5 Amount of water, if added at Site.
- .3 Maintain accurate records of cast-in-place concrete elements. Include in records the following information:
 - .1 Date of placing concrete element.
 - .2 Location of concrete element.
 - .3 Specified strength of concrete.
 - .4 Air and form temperature when concrete was placed.
 - .5 Temperature of concrete when placed in the form.
 - .6 Test samples taken and results of test samples.
- .4 Submit additional information designated by the Departmental Representative and required to verify compliance with Specifications upon request.

1.9 DELIVERY,
STORAGE AND
HANDLING

- .1 Delivery and Acceptance Requirements:
 - .1 Concrete hauling time: deliver to site of Work and discharged within 120 minutes maximum after batching.
 - .2 Concrete delivery: ensure concrete delivery from plant meets CSA A23.1/A23.2.
- .2 Concrete, Site-mixed:
 - .1 Site-mixed concrete is not permitted when:
 - .1 A structure contains more than a total of 50 m³ of concrete.
 - .2 Specified compressive strength is higher than 25 MPa at 28 days.
 - .3 Concrete is prestressed.
 - .4 Ready-mix concrete is specified.
 - .2 Transport concrete from mixer to point of delivery as rapidly as practicable. Conform to requirements of Article 3.2 Placing of Concrete, specified for methods and equipment.
- .3 Concrete, mixed off-Site:
 - .1 When truck mixer or agitator is accepted for mixing or delivery of concrete do not add water to batch after initial introduction of mixing. This requirement may be waived at the start of discharge of concrete when measured slump is less than that specified, and when not more than 60 minutes has elapsed from time of batching to start of discharge. In this case, upon approval as verified by the Departmental Representative initialing of the delivery ticket, water may be added by producer when concrete is delivered to maximum amount of 10% of mix design water. Do not add water to batch at later time.
 - .2 Complete the discharge of concrete within 2 hours after introduction of mixing water to cement and aggregates. If acceptable to the Departmental Representative, as verified in writing 14 days prior to placement, the 2 hour time limitation may be waived if concrete is initially proportioned to contain a chemical retarder or hydration stabilizer to delay the initial set.
 - .3 If measured slump or entrained-air content falls outside specified limits, ensure another portion of same sample is tested immediately. If second failure occurs, concrete will be considered to have failed requirements of Specification and will be rejected.

1.9 DELIVERY,
STORAGE AND
HANDLING
(Cont'd)

- .4 Packaging Waste Management: remove for reuse of pallets, crates, padding, and packaging materials in accordance with Section 01 74 20.

1.10 SITE
CONDITIONS

- .1 Conform to CSA A23.1/A23.2.
 - .2 Do not place concrete during or prior to rain. If rain occurs after placing and prior to initial set of concrete, prevent rain water from reaching newly placed concrete.
 - .3 Cold weather protection:
 - .1 Maintain protection equipment, in readiness on Site. Use such equipment when the ambient temperature is at or below 5°C, or when, in the opinion of the Departmental Representative the temperature may fall below 5°C before concrete has cured.
 - .2 Do not place concrete upon or against surface which is at temperature lower than 5°C.
 - .3 Provide temperature-controlled enclosures for areas where concrete is placed whenever ambient air temperature is 5°C or lower.
 - .4 Protect concrete from the adverse effects of space-heated enclosures including local overheating and combustion products.
 - .5 Heat mix water and, if necessary, aggregates when air temperature is at or below, or predicted to go below, 5°C at any time during the next 24 hours.
 - .6 Maintain temperature of reinforcing bars and forms above 10°C prior to placing concrete.
 - .7 Maintain temperature of concrete when deposited in forms not less than 15°C but not higher than 25°C.
 - .8 Maintain temperature of concrete at surfaces at least 10°C for a minimum period of seven days after placing and achieving minimum 75 percent of specified strength. Concrete temperature may then be lowered to ambient air temperature at a rate of 1/2 degrees C per hour or 10°C per day.
 - .9 Use additional protection if full 28 day compressive strength is required at an early age.
 - .10 Keep concrete continuously moist during the curing period.
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1.10 SITE
CONDITIONS
(Cont'd)

- .3 (Cont'd)
 - .11 Obtain the Departmental Representative acceptance of method of maintaining minimum temperatures.
- .4 Hot weather protection:
 - .1 Maintain protection equipment, in readiness on Site. Use such equipment when the ambient temperature is at or above 25°C, or when, in the opinion of the Departmental Representative the temperature may exceed 25°C before concrete has cured.
 - .2 When ambient temperature is at or above 25°C, protect concrete from direct sunlight and keep forms moist by sprinkling with cool water, applying wet burlap, or other accepted methods of cooling which will not affect concrete adversely.
 - .3 Do not place concrete, when concrete temperature exceeds 25°C in the mixer.
 - .4 Concrete, which has a temperature in the mixer between 20°C. and 25°C. must contain a retarder which reduces mixing water requirements and increases strength, not contain high early strength cement.
 - .5 Protect forms and equipment, including both mixing and placing equipment, from the rays of the sun and cool by wetting as necessary to maintain a temperature of not more than 5°C. in excess of ambient temperature nor more than 30°C.
 - .6 Prior to placing concrete, wet down forms and reinforcement and the area surrounding the work. Ensure excess water is swept and drained away immediately before casting the concrete.
 - .7 Keep mixing time to the minimum, consistent with the production of the quality of concrete specified and place mixed concrete immediately.
 - .8 Use sufficient qualified personnel for rapid placing and finishing of concrete.
 - .9 Commence continuous wet curing as soon as the concrete has hardened sufficiently to prevent surface damage.
- .5 Protection from drying:
 - .1 When surface moisture evaporation may exceed 0.75 kg/(m²/h), erect windbreaks around sides of structural element.

1.10 SITE
CONDITIONS
(Cont'd)

- .5 (Cont'd)
 - .2 When surface moisture evaporation may exceed 1.0 kg/(m²/h), take additional measures accepted by the Departmental Representative to prevent rapid loss of moisture from surface of concrete. Such methods are identified in Clause 7.4.2.2 of CSA A23.1/A23.2.
- .6 Frost Protection for Footings and Slabs on Grade:
 - .1 Protect subgrades prior to casting concrete and maintain a minimum temperature at the subgrade surface and below of 5°C.
 - .2 Provide continuous protection for footings and slabs on grade to prevent the subgrade below from freezing during cold weather. Provide heated enclosures and insulation as required.
 - .3 The subgrade below completed tanks may be protected against frost by filling the tank with water to a minimum depth of 2000 mm. Maintain water sufficiently warm to prevent ice formation on water.
- .7 Influence of Ambient Concrete Temperature on Concrete Crack Control:
 - .1 To minimize the formation of thermal cracks during placement and curing, maintain previously cured concrete and concrete that will be placed against it at the same temperature.
 - .2 Failure to minimize temperature differential between adjacent pours may result in temperature induced cracking. Repair such cracks as specified in this Section.

PART 2 - PRODUCTS

2.1 DESIGN CRITERIA

- .1 Alternative 1 - Performance: to CSA A23.1/A23.2, and as described in MIXES of PART 2 - PRODUCTS.
 - .1 Provide concrete mix to meet following hard state requirements:
 - .1 Durability and class of exposure, minimum compressive strength at 28 days shall be in accordance with paragraph 2.4.3 of this specification section.

2.2 PERFORMANCE
CRITERIA

- .1 Quality Control Plan: ensure concrete supplier meets performance criteria of concrete as established by Departmental Representative and provide verification of compliance as described in PART 1 - QUALITY ASSURANCE.

2.3 MATERIALS

- .1 Portland cement with supplementary cementitious materials: to CSA-A3000. Type in accordance with paragraph 2.4.3 of this specification section.
- .2 Water: to CSA A23.1/A23.2.
- .3 Aggregates: to CSA A23.1/A23.2. All aggregate sources as listed on the MTO's Designated Source Materials (DSM) list.
- .4 Admixtures:
 - .1 Air entraining admixture: to CSA A23.1/A23.2 and ASTM C260/C260M-10a.
 - .2 Chemical admixture: to CSA A23.1/A23.2 and ASTM C494/C494M. Departmental Representative to approve accelerating or set retarding admixtures during cold and hot weather placing.
 - .1 Water reducing admixture: ASTM C494/C494M, Type A.
 - .2 Set retarding admixture: ASTM C494/C494M, Type D.
 - .3 Set accelerating admixture: ASTM C494/C494M, Type C.
 - .4 Air entraining admixture: CSA A23.1/A23.2 and ASTM C260.
 - .5 Superplasticizer (for use with silica fume): ASTM C494/C494M, Type A.
 - .6 Superplasticizer (cold weather): ASTM C494/C494M, Type F.
 - .7 Superplasticizer (hot weather): ASTM C494/C494M, Type G.
- .5 Anchor Bolts: refer to Section 05 50 00.
- .6 Pre-moulded joint fillers:
 - .1 Bituminous impregnated fiber board: to ASTM D1751.
 - .2 Eva Foam shall be as supplied by Concrete Chemicals, or approved equal.
- .7 Shrinkage compensating grout: compound consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agents.
 - .1 Compressive strength: 40 MPa at 28 days.

2.3 MATERIALS
(Cont'd)

- .8 Water stops: extruded PVC, 150 mm Type 660B or approved equal.
- .9 Polyethylene film: 6 mil thickness to CAN/CGSB-51.34.
- .10 Joint sealer: to CAN/CGSB-19.13-M87 sealing compound, one component, elastomeric chemical curing. Type I for horizontal joints, Type II for vertical joints.
- .11 Polystyrene Insulation: unfaced (Type E), CAN/ULC S-701 Type 4, expanded, extruded polystyrene board insulation. Minimum compressive strength of 210 kPa (40 psi) (HI-40) at 10% deformation or yield. Square edges.
- .12 Adhesive: type recommended by insulation manufacturer.
- .13 Anchors: self tapping, power-driven masonry type, steel, cadmium coated.
- .14 Waterproofing: emulsified asphalt, mineral colloid-type, unfilled.

2.4 MIXES

- .1 Performance Requirements
 - .1 Proportion concrete for structures to create high performance concrete.
 - .2 Density: Normal density.
- .2 General:
 - .1 Establish proportions of cementing materials, aggregates, water, and admixtures required to produce consistent workable concrete with strength and other properties specified.
 - .2 Comply with clause 4.3.6-CSA A23.1 Volume Stability Considerations.
 - .3 Provide mixes that meet the stringent requirements of each of the exposures specified in CSA A23.1 Clause 4.1.1.1.3.
 - .4 Use same types and brand of cement throughout.
 - .5 Comply with and allow for the supplier's Standard Deviation as specified in CSA A23.1, Clause 4.4.6.7 Compressive Strength Requirements.
 - .6 Use high slump concrete by addition of superplasticizing admixture for walls and columns.
 - .7 Provide mix that meets linear shrinkage requirements.

2.4 MIXES
(Cont'd)

- .3 Mixes for Normal Density High:
- .1 Concrete for footing, foundation walls, retaining Walls and concrete collars:
- .1 Class F exposure.
- .2 35 MPa @ 28 days
- .3 w/c ratio = 0.40 maximum.
- .4 Maximum coarse aggregate size - 20 mm cement.
- .5 65% to 80% Normal Portland Cement type GU.
- .6 20% to 35% Type S Slag cement.
- .7 Air content 5-8%
- .8 Admixtures plant added with the mix water.
- .9 Slump: 75+25 mm.
- .2 Concrete for retaining walls, abutments, wing walls, barrier walls and deck:
- .1 Class C-1 exposure.
- .2 35 MPa @ 28 days.
- .3 W/C ratio - 0.40 maximum.
- .4 Maximum Coarse Aggregate size - 20 mm cement.
- .5 65% to 80% Normal Portland Cement Type GU.
- .6 20% to 35% Type S Slag Cement.
- .7 Mid-Range Water reducer and shrinkage reducing admixture plant added with the mix water.
- .8 Slump: between 100 and 150 mm for at
- .9 Air content 5-8%.
- .3 Mass Concrete below footings:
- .1 Class F exposure.
- .2 20 MPa @ 28 days
- .3 w/c ratio = 0.40 maximum.
- .4 Maximum coarse aggregate size - 20 mm cement.
- .5 65% to 80% Normal Portland Cement type GU.
- .6 20% to 35% Type S Slag cement.
- .7 Air content 5-8%
- .8 Admixtures plant added with the mix water.
- .9 Slump: 75+25 mm.

PART 3 - EXECUTION

3.1 PREPARATION

- .1 Obtain Departmental Representative's written approval before placing concrete.
- .1 Provide 24 hours minimum notice prior to placing of concrete.
- .2 Place concrete reinforcing in accordance with Section 03 20 00.

3.1 PREPARATION
(Cont'd)

- .3 During concreting operations:
 - .1 Development of cold joints not allowed.
 - .2 Ensure concrete delivery and handling facilitates placing with minimum of re-handling, and without damage to existing structure or Work.
- .4 Pumping of concrete is permitted only after approval of equipment and mix.
- .5 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .6 Prior to placing of concrete obtain Departmental Representative's approval of proposed method for protection of concrete during placing and curing.
- .7 Protect previous Work from staining.
- .8 Clean and remove stains prior to application for concrete finishes.
- .9 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.

3.2 INSTALLATION/
APPLICATION

- .1 Do cast-in-place concrete work to CSA A23.1/A23.2.
- .2 Sleeves and inserts:
 - .1 Do not permit penetrations, sleeves, ducts, pipes or other openings to pass through joists, beams, column capitals or columns, except where indicated or approved by Departmental Representative.
 - .2 Where approved by Departmental Representative, set sleeves, ties, pipe hangers and other inserts and openings as indicated or specified elsewhere.
 - .3 Sleeves and openings greater than 100 x 100 mm not indicated, shall be reviewed by Departmental Representative.
 - .4 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain written approval of modifications from Departmental Representative before placing of concrete.
 - .5 Confirm locations and sizes of sleeves and openings shown on drawings.

3.2 INSTALLATION/
APPLICATION
(Cont'd)

- .2 (Cont'd)
 - .6 Set special inserts for strength testing as indicated and as required by non-destructive method of testing concrete.
- .3 Anchor bolts:
 - .1 Set anchor bolts to templates in co-ordination with appropriate trade prior to placing concrete.
 - .2 Grout anchor bolts in preformed holes or holes drilled after concrete has set only after receipt of written approval from Departmental Representative.
 - .1 Formed holes: 100 mm minimum diameter.
 - .2 Drilled holes: 25 mm minimum diameter larger than bolts used or to manufacturers' recommendations.
 - .3 Protect anchor bolt holes from water accumulations, snow and ice build-ups.
 - .4 Set bolts and fill holes with shrinkage compensating grout epoxy grout.
 - .5 Locate anchor bolts used in connection with expansion shoes, rollers and rockers with due regard to ambient temperature at time of erection.
- .4 Drainage holes and weep holes:
 - .1 Form weep holes and drainage holes in accordance with Section 03 10 00. If wood forms are used, remove them after concrete has set.
 - .2 Install weep hole tubes and drains as indicated.
- .5 Grout under base plates and machinery using procedures in accordance with manufacturer's recommendations which result in 100% contact over grouted area.
- .6 Finishing and curing:
 - .1 Finish concrete in accordance with A23.1. CAN/CSA.
 - .2 Use curing compounds compatible with applied finish on concrete surfaces. Provide written declaration that compounds used are compatible.
 - .3 Unformed surface concrete tolerance to conventional classification in accordance with straight edge method.
 - .4 Use wood float finish for unformed surfaces.
 - .5 Use smooth-form finish for formed surfaces.

3.2 INSTALLATION/
APPLICATION
(Cont'd)

- .6 (Cont'd)
- .6 Use procedures as reviewed by Departmental Representative or those noted in CSA A23.1/A23.2 to remove excess bleed water. Ensure surface is not damaged.
 - .7 Curing compounds are not permitted. Moist curing of all concrete shall be achieved with continuously wetted burlap and plastic sheeting.
 - .8 All concrete that retains or is in contact with liquid/water is to be continuously wet cured for 10 days minimum.
 - .9 All other concrete is to be continuously wet cured for 3 days minimum.
 - .10 No concrete is to be placed/poured until provisions for wet curing are arranged and all equipment/material, including water supply, is on site and available for use.
 - .11 With the exception of concrete that retains or is in contact with liquid/water, unformed surfaces: cure with burlap and water. Carefully place two layers of damp burlap on the surface of the concrete. Overlap each strip by at least 75 mm and secure against displacement by wind. Maintain burlap in place and keep thoroughly wet for 7 days after day of placing.
 - .12 With the exception of concrete that retains or is in contact with liquid/water, formed surfaces: if formwork is left in place for 7 days or more no additional curing will be required. If formwork is removed in less than 7 days, cure in manner specified for unformed surfaces for remainder of seven day period.
 - .13 During curing period, uncover only such areas as are immediately needed for finish treatment. Recover and continue curing.
- .7 Joint fillers:
- .1 Furnish filler for each joint in single piece for depth and width required for joint, unless otherwise authorized by Departmental Representative.
 - .2 When more than one piece is required for joint, fasten abutting ends and hold securely to shape by stapling or other positive fastening.
 - .3 Locate and form isolation construction expansion joints as indicated.
 - .4 Install joint filler.

3.2 INSTALLATION/
APPLICATION
(Cont'd)

- .7 (Cont'd)
 - .5 Use 12 mm thick joint filler to separate vertical joints in the retaining walls.
- .8 Insulation to Footings and Underside of Slab on Grade.
 - .1 Install polystyrene insulation adjacent to footings and to the underside of slab on grade as shown on drawings.
 - .2 Use 50 mm thick, rigid, expanded, extruded polystyrene board insulation.
- .9 Waterstop: install waterstop at location as indicated on Contract Drawings.

3.3 SURFACE
TOLERANCE

- .1 Concrete tolerance to CSA A23.1/A23.2.

3.4 FIELD QUALITY
CONTROL

- .1 Site tests: conduct tests as follows in accordance with Section 01 45 00 and submit report as described in 1.7 SUBMITTALS and 1.8 QUALITY ASSURANCE.
 - .1 Concrete pours.
 - .2 Slump.
 - .3 Air content.
 - .4 Compressive strength at 7 and 28 days.
 - .5 Air and concrete temperature.
- .2 Inspection and testing of concrete and concrete materials will be carried out by testing laboratory identified by the Contractor and approved by the Departmental Representative for review to CSA A23.1/A23.2.
 - .1 Ensure testing laboratory is certified to CSA A283.
- .3 Ensure test results are distributed for discussion at pre-pouring concrete meeting between testing laboratory and Departmental Representative.
- .4 Contractor shall perform testing at Contractor's own cost.
- .5 At the cost of the Departmental Representative additional QA testing will be conducted as necessary.
- .6 Non-Destructive Methods for Testing Concrete: to CSA A23.1/A23.2.

3.4 FIELD QUALITY
CONTROL
(Cont'd)

- .7 Inspection or testing by Departmental Representative will not augment or replace Contractor quality control nor relieve Contractor of his contractual responsibility.

3.5 CLEANING

- .1 Clean in accordance with Section 01 74 11.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.