

PART 1 – GENERAL

1.1 GENERAL CONDITIONS

- .1 The General Conditions of the Contract and any Supplements and/or Addenda thereto form an integral part of this Specification and must be read in conjunction herewith.

1.2 RELATION TO OTHER TRADES

- .1 Read the Specifications and examine the drawings covering the work of other Trades and consult those responsible for the work of others in order to be acquainted with other Trades' requirements as they affect this work.
- .2 Give timely instructions and information in writing (or schedules) to other Trades of the requirements necessary for surfaces, materials or inserts prepared and/or placed by other Trades which will affect the work of this Section.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- .1 Section 03 11 00 – Concrete Floor Finishing
- .2 Section 03 20 00 – Concrete Reinforcement and Accessories
- .3 Section 03 30 00 – Cast-In-Place Concrete
- .4 Section 03 39 00 – Concrete Curing
- .5 Section 03 40 00 – Architectural Precast
- .6 Section 03 41 00 – Precast Concrete Stairs
- .7 Section 07 10 00 – Foundation Waterproofing
- .8 Section 13 08 00 – Floating Floor Slabs
- .9 Section 31 23 00 – Excavation and Backfilling

1.4 HANDLING AND STORAGE OF MATERIALS

- .1 Store material carefully, clear from ground in sufficient quantity to maintain the schedule of the work.
- .2 Prevent damage to materials during handling and storage.

1.5 REFERENCE STANDARDS

- .1 Conform to the Ontario Building Code 0. Reg.332/12, And all local By-Laws and Regulations.
- .2 Meet the requirements of CSA Standard A23.1-14 CSA Standard S269.1-16, S413-14, and S269.3-M92 (R2013), unless otherwise specified.

1.6 WORKMANSHIP

- .1 Use only workmen skilled in the work of this Section. Do work to best standard practice and in accordance with all applicable Laws and Regulations.

1.7 WORK INCLUDED

- .1 Provide all labour, materials, equipment and services necessary to construct all concrete formwork for foundations, walls, piers, slabs, curbs, openings, pits, mechanical bases, etc. as indicated on the design Drawings, and specified herein including but not limited to the following:
 - .1 Forms, shoring and bracing with all necessary hardware.
 - .2 Installation of inserts, anchors, mechanical openings, expansion and control joints, waterstops, masonry lintel anchors, dovetail anchor slots, etc.
 - .3 Recesses for watertight joints, all P.V.C. and/or metal waterstops.
 - .4 Build in items shown or noted to be built into the concrete work which are supplied by others.

1.8 SHOP DRAWINGS

- .1 Prepare and submit shop and erection drawings in conformity with the general conditions and the governing CSA Standards.
- .2 Show all formwork and shoring details and proposed reshoring system.
- .3 Formwork, shoring and reshoring drawings shall be sealed by the Professional Engineer, who is responsible for same and who shall be registered to practice in the Province of Ontario.

1.9 UNIT PRICES

- .1 Provide Unit Prices as called for in the Tender/Bid Form for each individual Trade Contract.

1.10 VARIANCES

- .1 Where there is a variance between this Section of the Specifications and the Structural drawings, the more stringent requirement shall apply unless otherwise approved by the Consultant.

PART 2 – PRODUCTS

2.1 MATERIALS

- .1 Forms shall conform to Chapter 6, CSA-A23.1-14 and to ACI 347.
- .2 For smooth finished exposed concrete surfaces use 18mm weatherproof fir plywood conforming to CSA O121-17, supplied new for this project, and replaced periodically as the surfaces become worn as evaluated by Consultant.

- .3 Elsewhere form lumber free from warp, loose knots, or other defects, or plywood, or approved metal, or plastic forms may be used.
- .4 Use internal and external hardware as manufactured by Acrow-Richmond or approved equal.
- .5 Shores adjustable so that shore heights may be altered before or during a casting and of such a type that they may be removed without producing undue strains or shock in concrete.
- .6 Waterstop – Sika Greenstreak 777 by Sika Canada Inc., or equal.

Note: Verify compatibility of waterbar with any other waterproofing products specified elsewhere.
- .7 Biodegradable form board as manufactured by Stramit Corporation Limited or approved equal.
- .8 Rigid insulation shall be Envirosheet EN-30 as manufactured by Canamould or approved equal.

PART 3 – EXECUTION

3.1 FABRICATION

- .1 All formwork shall conform to CSA Standard A23.1-14, ACI 347, and CAN/CSA-S269.3-M92 (R2013).
- .2 Design, erect, brace, and maintain all forms to support construction loads safely and without noticeable deflection. Brace forms so that finished concrete will conform to lines and dimensions shown on drawings. Use removable separators and ties except where directed otherwise. Any permanent separators or ties shall be of approved metal or plastic types. Wood separators must be removed at time of casting, or cut out later.
- .3 Remove forms without damage to structure.
- .4 Make form joints tight so that there is no leakage of concrete.
- .5 Do not use form oils for exposed concrete surfaces and those surfaces to receive paint or similar finishes. Unless plastic coated, thoroughly soak forms with water before casting. An approved, non-injurious form oil or compound may be used elsewhere. Apply form oil before reinforcing is placed. In cold weather use an approved form coating in lieu of water. Obtain Consultant's approval in writing for this coating before using.
- .6 Arrange internal ties so that when forms are removed, ties are at least 25mm back from any exposed surface.
- .7 Place suitable moldings or fillets at the angles of forms to round or bevel the edges and re-entrant corners of concrete which is to remain exposed. Be responsible for safety of structure before and after form removal. Before removing any forms, notify Consultant well in advance and obtain his approval. Take care when removing forms that concrete is not chipped or cracked.

- .8 Thoroughly clean and repair all forms before reusing. Do not reuse forms which have become damaged.
- .9 Where Contractor intends to use high frequency mechanical vibrators, forms for such concrete shall be specially designed to withstand action of such equipment.

3.2 TOLERANCES

- .1 Erect, adjust and maintain all formwork to such accuracy as to ensure finished work within the following tolerance limits, which shall not be cumulative.
 - .1 In lines and surfaces of columns, piers, walls and in arrises -
 - in any 3 metres.....6mm
 - in any storey up to 6 metres.....8mm
 - in 12 metres or more.....12mm
 - .2 For exposed corners or other conspicuous lines one half of above.
- .2 Variation from level or from grades indicated on drawings.
 - .1 In floors, beam soffits and in arrises -
 - in any 3 metres.....6mm
 - in any bay of 6 metres.....8mm
 - in any 12 metres or more.....12mm
 - .2 For exposed lintels, sills or other conspicuous lines - one half of above.
 - .3 Variation in size and location of sleeves, pits, floor and wall openings.....6mm
 - .4 Variation in location of bolts, inserts and fastenings:
 - .1 If single items.....6mm
 - .2 If in a group.....3mm
 - .5 Variation in cross section and in thickness of slabs and walls -
 - .1 Minus.....0mm
 - .2 Plus.....12mm
 - .6 Variation in cap or footing -
 - .1 In width minus.....12mm
plus.....50mm
 - .2 In thickness minus 5% of specified thickness.
 - .3 Misplacement or eccentricity - 2% of footing width in direction of misplacement with a 50mm maximum.

3.3 CONSTRUCTION JOINTS

- .1 Make only vertical keyed construction joints in walls except where floor slabs rest on the walls. Locate joints as shown on structural drawings or in consultation with the Consultant.

- .2 Make only vertical keyed construction joints in floors as indicated on drawings where it is necessary to end a casting. Run reinforcing continuously through joint.
- .3 Obtain Consultant's approval for locations and details of construction joints required but not shown.
- .4 Provide a key in all construction joints.

3.4 ARCHITECTURAL CONCRETE

- .1 Where Architectural concrete is shown on Architectural drawings provide special forms to produce the required Architectural features, pattern and finishes including all reglets, joints, special ties and plugs for same etc.
- .2 All joints in formwork for Architectural concrete shall be tight to avoid bleeding of cement paste at the joints and to produce uniformly smooth or textured finishes suitable for future bush hammering or sandblasting as indicated on Architectural finish schedules.
- .3 Quality of Finish:
 - .1 The quality of finish shall be such that when the forms are stripped, it meets the standards set out below, without further finishing work other than clean-up.
 - .2 Dense, even concrete, free of major defects such as deep or extreme honeycombing, inconsistencies in plane, severe cold joint lines and major loss of fines. Minor imperfections may be acceptable. Major defects will necessitate replacement. The judgement as to what constitutes major and minor defects will be the Consultant's alone. Patching is not permitted and if used will constitute a major defect. Repairs, i.e.: removal of sections of a member, may be carried out if approved by the Consultant, but the repair shall match the colour and texture of the surrounding concrete.
 - .3 Concrete members of generally uniform colour.
 - .4 Concrete members with sharp, accurate definition at corners, arises and reglets generally free of chipped or spalled areas and within dimensional tolerances set out in CSA-A23.1-14 and as outlined in ACI 347. Members shall be visually straight.
 - .5 Plane surfaces without protuberances, indentations, ridges or bulges.
 - .6 Under no circumstances shall repair to any Architectural concrete be undertaken without the Consultant's written consent. Concrete members which are repaired without the Consultant's consent will be classified as defective Work and the Consultant may require their removal and replacement.
- .4 Sample Panels/Areas: Well in advance of constructing Architectural concrete, to prove out the materials and procedures proposed, construct a sample section of each type of Architectural concrete utilizing portions of the concrete structure not exposed to view in the finished building. Panel or area to be sized 900mm x 900mm.

3.5 REMOVAL OF FORMS

- .1 Be responsible for structure before and after form removal. Give Consultant ample time, when it is proposed to remove forms, and obtain his approval.
- .2 Take care that concrete is not chipped or cracked while forms are removed.
- .3 All slabs and beams shall be reshored immediately after stripping of forms.
- .4 Do not place loads on slabs before reshoring

3.6 CURBS, BASES AND PITS

- .1 Examine Architectural, Mechanical and Electrical drawings to determine size and location of curbs, bases and pits, which shall be formed by this Section.

3.7 CLEAN UP

- .1 Keep building and site free at all times from accumulations of debris from this work and on completion remove promptly all rubbish, equipment, surplus material and mess resulting from this work, and leave site in a clean, orderly and acceptable condition. Remove wood particles, sawdust, etc. from forms prior to casting of concrete.

END OF SECTION

PART 1 – GENERAL

1.1 GENERAL CONDITIONS

- .1 The General Conditions of the Contract any Supplements and/or Addenda thereto form an integral part of this specification and must be read in conjunction herewith.

1.2 RELATED WORK SHOWN ELSEWHERE

- .1 Section 03 10 00 – Concrete Formwork
- .2 Section 03 30 00 – Cast-In-Place Concrete
- .3 Section 31 23 00 – Excavation and Backfilling

1.3 PREPARATION RELATED TO OTHER TRADES

- .1 Read the specifications and examine the drawings covering the work of other Trades and consult those responsible for the work of others in order to be acquainted with other Trades' requirements as they affect this work.

1.4 WORK INCLUDED

- .1 Supply, fabrication, and placing of all reinforcing with all necessary accessories, i.e., chairs, ties, waterbars, bearings, etc.

1.5 WORKMANSHIP

- .1 Use only workmen skilled in work of this Section. Do work to best standard practice in accordance with all applicable Laws and Regulations.

1.6 REFERENCE STANDARDS

- .1 Meet requirements of CSA Standard A23.1-14, A23.3-14, and S413-14.

1.7 UNIT PRICES

- .1 Provide Unit Prices as called for in the Tender/Bid Form for each individual Trade Contract.

1.8 SHOP DRAWINGS

- .1 Placing drawings and bar lists in conformity with the General Conditions and the governing CSA Standards, Reinforcing Steel Institute of Canada standards and ACI Standard 315-99 and ACI Detailing Manual – 2004.
- .2 Conform to reviewed Shop Drawings.
- .3 Shop drawings shall be complete such that all reinforcing steel work can be carried out without recourse to the structural drawings.
- .4 The shop drawings shall have been checked and verified by the Consultant before submission for fabrication by the Supplier.

1.9 INSPECTION AND TESTING

.1 General

- .1 Owner will appoint and pay for an Inspection and Testing Company representing and responsible to the Consultant.
- .2 Qualified Inspectors are to be employed for this work.

.2 Instructions to Contractor

- .1 In advance of construction, provide inspection and testing company with the following:
 - .1 Mill test reports appropriate for each major shipment of reinforcing steel.
 - .2 If mill test reports are not provided, Contractor shall pay for physical tests to certify the grade of reinforcing. Provide Inspection and Testing Company with required samples at no extra cost to Owner.
- .2 Provide free access for Inspectors to all places where work is being done.
- .3 Materials and workmanship not conforming to this Specification shall be rejected. Remove and replace defective material without delay and without extra cost.

.3 Instructions to Inspection and Testing Company

- .1 Inspectors are to ensure that materials conform to the requirements of this specification.
- .2 Forward mill test reports provided by Contractor after ensuring that they are correlated to material on site.
- .3 Above reports will be accepted in lieu of physical tests. However, if reports are not provided, perform physical tests to certify the material at Contractor's expense.

1.10 EXAMINATION

- .1 Examine work upon which work of this Section depends. Commencement of work of this Section implies acceptance of work which is to receive it and that site conditions are satisfactory.

1.11 VARIANCES

- .1 Where there is a variance between this Section of the Specifications and the Structural Drawings, the more stringent requirement shall apply unless otherwise approved by the Consultant.

PART 2 – PRODUCTS

2.1 MATERIALS

- .1 Reinforcing steel shall be deformed (hi-bond) bars of high strength new billet steel conforming to CAN/CSA-G30.18-09 (R2014) with yield strength of 400MPa, or as noted on drawings.
- .2 Chairs, wire ties, etc. by Acrow-Richmond or approved equal. Where rebar placed above Canamould EnviroSheet, plastic chairs to be used.
- .3 The epoxy coated bars shall conform to ASTM A775.
- .4 In all slabs which could be subject to salt application bar support chairs shall be plastic, plastic coated, or precast concrete blocks, which shall be equal in quality to the structural concrete specified for the slab.
- .5 Tie wire employed with epoxy coated steel shall be epoxy or plastic coated.
- .6 Waterbars shall be Sika Greenstreak 777 as manufactured by Sika Canada Inc., or approved equal.

Note: Verify compatibility of waterbar with any other waterproofing products specified elsewhere.
- .7 Expansion bearing strips shall be PTFE reinforced fabric elastomeric pad by Fabreeka International Inc., or approved equal.

2.2 HANDLING AND STORAGE OF MATERIALS

- .1 Store steel reinforcement and wire chairs carefully, clear from ground and protect from rust, soiling, distortion and other damage.

PART 3 – EXECUTION

3.1 FABRICATION AND PLACING

- .1 Bend reinforcement in accordance with CSA Standard A23.1-14 and the Reinforcing Steel Institute of Canada standards using equipment approved by Consultant. Do not rebend reinforcement or heat same for bending.
- .2 Immediately prior to placing, clean reinforcement of loose mill scale, loose rust, oil, grease, mortar, or other foreign matter or coatings that would destroy bond of concrete. Do not use reinforcement having kinks or bends not called for on drawings.
- .3 Place reinforcement accurately in position indicated on drawings, to tolerances set out in ACI 318-02 article 7.5.2, and wire securely or support in position in such a manner that no movement will take place before concrete has set. Use spacing blocks, metal chairs or metal hangers of approved material, size and shape or precast concrete chairs. Securely tie reinforcing in place with 18 gauge wire. Use continuous high chairs to support top bars. Use plastic coated chairs in areas with concrete slabs exposed on underside.

- .4 Splice reinforcement at locations indicated on drawings; where not indicated, obtain instructions.
- .5 Reinforce curbs with 10M @ 300mm dowels and 1-10M continuous top, unless otherwise noted on drawings

3.2 CLEAN UP

- .1 Keep building and site free from accumulation of debris from this work. Promptly remove all rubbish tags, wires, accessories, surplus materials and debris resulting from this work, before the casting of the concrete.

END OF SECTION

PART 1 – GENERAL

1.1 GENERAL CONDITIONS

- .1 The General Conditions of the Contract and any Supplements and/or Addenda thereto form an integral part of this Specification and must be read in conjunction herewith.

1.2 RELATION TO OTHER TRADES

- .1 Read the Specifications and examine the drawings covering the work of other Trades and consult those responsible for the work of others in order to be acquainted with other Trades' requirements as they affect this work. In particular, make special provisions, as may be required, for noise and vibration attenuation.
- .2 Give timely instructions and information in writing (or schedules) to other Trades of the requirements necessary for surfaces, materials or inserts prepared and/or placed by other trades which will affect the work of this Section.
- .3 Do all cutting and patching of this work as may be required due to failure to properly carry out such work or to take cognizance of work to be built in. Make good to the satisfaction of the Consultant any errors in the work and fill around openings, around pipes, or other work as directed, without additional cost to the Owner.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- .1 Section 03 10 00 – Concrete Formwork
- .2 Section 03 20 00 – Concrete Reinforcement and Accessories
- .3 Section 03 34 50 – Concrete Floor Finishes
- .4 Section 03 39 00 – Concrete Curing
- .5 Section 03 40 00 – Architectural Precast
- .6 Section 03 41 00 – Precast Concrete Stairs
- .7 Section 05 12 00 – Structural Steel
- .8 Section 13 08 00 – Floating Floor Slabs
- .9 Section 31 23 00 – Excavation and Backfilling

1.4 WORK INCLUDED

- .1 Provide all labour, material, equipment and services necessary to do and complete all concrete work such as foundations, walls, piers, columns, slabs, beams, curbs, walks, pits, mechanical bases, etc., as indicated, on the design drawings, and specified herein including, but not limited to following:
 - .1 All plain and reinforced concrete.
 - .2 Leveling, compaction and floating to slopes or levels.

- .3 Build in items shown or noted to be built into the concrete work which are supplied by others.

1.5 REFERENCE STANDARDS

- .1 Conform to the Ontario Building Code 0. Reg. 332/12 and all local By-Laws and Regulations.
- .2 Meet the requirements of CSA Standard A23.1-14, A23.2-14, A23.3-14, and S413-14 unless otherwise specified.

1.6 WORKMANSHIP

- .1 Use only workmen skilled in the work of this Section. Do work to best standard practice and in accordance with all applicable Laws and Regulations.

1.7 HANDLING AND STORAGE OF MATERIALS

- .1 Store aggregates on wood platforms free from ground to prevent intrusion of foreign matter and provide cover.
- .2 Prevent contamination of materials during handling and storage.

1.8 UNIT PRICES

- .1 Provide Unit Prices as called for in Tender/Bid Form for each individual Trade Contract.

1.9 INSPECTION AND TESTING

- .1 General
 - .1 Owner will appoint and pay for an Independent Inspection and Testing Company representing and responsible to the Consultant.
 - .2 Tests shall be in accordance with and satisfy the following Standards:
 - .1 Stone Concrete and Reinforced Stone Concrete – CSA Standard A23.2-14.
 - .2 Portland Cement – CSA Standard A3000 – 13.
 - .3 Supplementary Cementing Materials – CSA Standard A3000 – 13.
 - .4 Cementitious Hydraulic Slag – CSA Standard A3000 – 13.
- .2 Instructions to Contractor
 - .1 In advance of construction and prior to any change in brand or source of supply, provide Inspection and Testing Company for this project with certificates prepared by an approved Independent Inspection Company certifying the following:
 - .1 Coarse and fine stone aggregate proposed for this work comply with Specification requirements.

- .2 Strength and slump requirements can be met for each class of concrete required. The compression test results, based on a minimum of 3 test specimens, shall provide average strength not less than 15% greater than specified.
- .2 Before concrete is placed, obtain Consultant's approval of type of formwork, reinforcing, inserts and other materials to be embedded in concrete.
- .3 Notify Inspection and Testing Company and ensure that their representative is on site each day concrete is placed.
- .4 Provide free access for Inspectors to all places where work is being done.
- .5 Materials and workmanship not conforming to this specification shall be rejected. Remove and replace defective material without delay and without extra cost.
- .3 Instructions to Inspection and Testing Company
 - .1 Strength Requirements – satisfy CSA-A23.1-14, article 4.4.6.
 - .2 Inspectors are to ensure that materials conform to requirements of this Specification.
 - .3 Forward certificates provided by Contractor after ensuring that quality of materials as certified meets requirements of this Specification.
 - .4 Above certificates will be accepted in lieu of physical tests. However, if certificates are not provided, perform physical tests to certify same at Contractor's expense.
 - 5 Three laboratory cured specimens (standard 150 mm test cylinders) shall constitute a strength test for footing, slab, and wall concrete. Make one test for each 100 cubic metres of each class of concrete and in any event not less than one strength test for each class of concrete each day it is used. Store specimens at site for first 24 hours in an enclosure specifically provided for this purpose. Maintain curing conditions (temperature and moisture loss) similar to that of the concrete placed. Move all cylinders to laboratory and cure under standard moisture and temperature conditions. Test one specimen at 7 days and two at 28 days unless otherwise directed. Slump shall be determined for each set of specimens.
 - .6 Where 90 days strengths are specified make four standard strength cylinders, and test one at 7 days, one at 28 days and two at 90 days.
 - .7 When concrete is placed under the conditions of ACold Weather Requirements@, make one additional cylinder with each test; store it in a heated enclosure for 24 hours and then store it on the job site in a place protected from disturbance and off ground. Compressive test this cylinder 7 days, after sampling.
 - .8 Where air entrained concrete is specified, make one air content determination test of each 200 cubic metres of concrete placed or at least one test per each day's casting of concrete.
 - .9 By telephoning Consultant, report any errors and omissions before corrective measures are taken.

.10 Provide following information in concrete cylinder test reports:

.1 Specific location of concrete represented by sample, design strength, aggregate size, admixtures used, date, hour and temperature at time of sampling, percentage air content, unit weight, slump, and test strength of cylinder. If possible explain any lack of strength or high slump test.

.11 Circulate certificates, mill test reports and reports of inspections and tests as follows:

Owner	-	1 copy
Architect	-	2 copies
Consulting Structural Engineer	-	1 copy
Construction Manager	-	1 copy
Concrete Supplier	-	1 copy

.12 Strength Requirements - to conform to requirements of this specification average of all sets of three consecutive strength tests for each class of concrete shall exceed specified strength. No individual strength test shall fall below 3.5MPa, of the specified strength.

1.10 JOB RECORDS

.1 Keep Records of the Following:

- .1 Date and time of concrete placing in each part of structure.
- .2 Daily record of temperature during placing and curing.
- .3 During hot weather, records of concrete temperature as delivered and after placing in forms.
- .4 During hot weather, records of relative humidity.
- .5 General weather conditions such as calm or windy, clear or cloudy.

Make these records available to Consultant at all times. Keep records permanently.

1.11 EXAMINATION

.1 Examine work upon which work of this Section depends. Commencement of work of this Section implies acceptance of work which is to receive it and that site conditions are satisfactory.

1.12 VARIANCES

.1 Where there is a variance between this Section of the Specifications and the Structural Drawings, the more stringent requirement shall apply, unless otherwise approved by the Consultant.

PART 2 – PRODUCTS

2.1 MATERIALS

.1 Use only new materials which in physical and chemical properties comply with the Specification in every respect.

- .2 Cement – to CSA-A3000 – 13, Canadian made and obtained from an approved source.
- .3 Supplementary Cementing Materials – to CSA-A3000 – 13 Canadian made and obtained from an approved source.
- .4 Cementitious Hydraulic Slag – to CSA-A3000 – 13, Canadian made and obtained from an approved source.
- .5 Aggregates for stone concrete – clean, uncoated sand and stone from an approved source and conforming to Chapter 4 of CSA-A23.1-14. Provide uniformly graded aggregate which when proportioned with cement and water will produce concrete of the required strength and workability. Maximum size of aggregate shall be 20 mm.
- .6 Water – Clean and potable taken from municipal mains.
- .7 Air Entraining Agent – Darex AEA as manufactured by GCP Applied Technologies Inc., conforming to ASTM C260-86 or approved equal in all concrete permanently exposed to weather or the action of salts in solution.
- .8 Water Reducing Admixture – Master Pozzoloth as manufactured by Master Builders Solutions by BASF or approved equal. Pozzoloth 82N or approved equal shall be used in slabs.
- .9 Curing and Sealing Compound – Masterseal as manufactured by Master Builders Solutions by BASF or approved equal.
- .10 Pre-Mixed Patching Compound – SikaRepair 223 as manufactured by Sika Canada Inc., or approved equal.
- .11 Grout – Masterflow 713 grout as manufactured by Master Builders Solutions by BASF or approved equal.
- .12 Polypropylene fibres – Fibremesh Canada Limited, fibrillated polypropylene MD fibres, added at the batching plant at 0.9 kg/cubic metre, meeting ASTM Standard C1116-91, Section 4.1.3.
- .13 Corrosion inhibitors – DCI corrosion inhibitor as manufactured by GCP Applied Technologies Inc., or approved equal.
- .14 Rigid insulation shall be EnviroSheet EN-30 as manufactured by Canamould or approved equal.

2.2 PROPORTIONS OF CONCRETE

- .1 The concrete production facilities shall be certified in accordance with the standards of the Ready Mixed Concrete Association of Ontario.
- .2 Proportion concrete according to the current CSA-A23.1-14 and S413-14 for ordinary and controlled concrete. Make concrete of strength and workability as noted herein or on the drawings. Measure materials by weight. Use separate scales for cement. Meter water and make allowance for moisture content of the aggregate used for the batch.

- .3 Use no other admixture in any concrete unless specified herein or approved by the Consultant.
- .4 Slump shall be used as a measure of consistency. Maximum slump shall be 75mm for all work, except for walls and columns, where slump may be increased to 100mm. In situations where the congestion of reinforcing makes the placing of 75mm slump concrete, composed of 20mm aggregate, difficult, the Contractor shall provide, at no additional cost to the Owner, concrete of 75mm slump using pea gravel (10mm) aggregate to facilitate placing.
- .5 Admixtures containing chlorides shall not be used.
- .6 Use no other admixture in any concrete unless specified herein or approved by Consultant.
- .7 All concrete slabs, beams, curbs, columns and walls in parking garage, planters, and the like, exposed to weather, or the application of de-icing chemicals, shall satisfy the requirements of exposure classification AC-1@ concrete in accordance with CSA-A23.1-14. All exposed portions of foundation walls and retaining walls shall be cast with concrete satisfying the requirements for exposure classification AF-2@ concrete in accordance with CSA-A23.1-14.

All concrete slabs and roofs in parking garages subject to vehicular access shall be proportioned to include corrosion inhibitors at a rate of 10 litres/cubic metre.

2.3 MIXING

- .1 Use only transit-mixed concrete from a member in good standing of the Ready Mixed Concrete Association of Ontario. Do all work in connection with the measuring of ingredients, batching, mixing and delivering, inspecting, sampling, testing slump and air content, providing material certificate, testing strength and arbitrating disputes in accordance with ASTM C94-92, AReady Mixed Concrete@ and as hereinafter specified and the standards of the Ready Mixed Concrete Association of Ontario.
- .2 Ensure that vehicles carrying the transit-mixed concrete are adequately equipped to handle concrete according to this Specification.
- .3 Control the addition of water to the dry ingredients of the concrete as required by the Consultant. Under no circumstances add additional water to that designed for the W/C ratio, without the written consent of the Consultant. Re-tempering concrete that has partially hardened is not permitted.
- .4 Assure that the mixing and agitating speed is maintained as recommended by mixer manufacturer and is uniform from batch to batch of same mix design. Proportions of materials may be subject to change under direction of Consultant when necessary to produce proper workability or required strength.
- .5 Concrete shall be delivered and discharged within 2 hours after the introduction of the mixing water. Concrete not so used shall be discarded.
- .6 Carry out the discharging operation with the mixer operating at full speed and full discharge opening. Where discharge is intermittent, as into wheel barrows, buggies, etc., control the rate of discharge by drum speed. Under these circumstances, whenever possible revolve drum in the mixing direction for at least 5 revolutions between discharging operations.

- .7 Control temperature of delivered concrete so that it is not less than 10 degrees C., nor greater than 32 degrees C.
- .8 Co-ordinate work so as to minimize any delays in handling concrete at site. Co-operate with batching plant to fullest possible extent and advise plant of any delays at site, or of any changes to mix design required due to contingencies at site. All trucks shall have delivery slips stamped with time of departure from mixing plant. Concrete delivered without timed slips shall be discarded. All concrete deliveries shall satisfy the standards of the Ready Mixed Concrete Association of Ontario.

2.4 CONCRETE STRENGTH

- .1 The compressive strength of concrete in general shall be 25MPa, at 28 days except as otherwise noted on drawings, or in this Specification to satisfy applicable exposure classifications, for the elements under consideration.
- .2 Maximum slump shall not exceed 75mm, except for columns and walls where it may be increased to 100mm maximum, upper limit, with a tolerance of 10mm.
- .3 Should the strength of concrete already cast as shown by job cured test cylinders, fall below the required strength at 28 days, or should a 7 day test fail to reach a minimum of 75% of the 28 day specified strength, the Consultant shall have the right to require changes in mixing proportions for the remainder of the work, so as to attain these strengths. He shall also have the right to require additional curing of those portions of the work represented by test specimens not meeting the herein quoted strength criteria.
- .4 Should additional curing not produce the required strength, the Consultant shall have the right to require strengthening or replacement of the portions of the work in question.
- .5 In determining extent of strengthening or replacement of concrete which fails to meet requirements of Drawings and Specifications, Consultant shall have the right to order (at cost of Contractor) tests to determine actual strength of concrete in place and sufficiency of structure as constructed using one or more of the following methods:
 - .1 Schmidt percussion hammer.
 - .2 Determination of cement proportion.
 - .3 Specimens cut out and tested, or pullout type (Lok-Test) methods.
 - .4 Load tests according to the requirements of CSA Standard A23.3-14, Chapter 20, AStrength Evaluation Procedures@.

PART 3 – EXECUTION

3.1 PLACING CONCRETE

- .1 Before depositing concrete check dimensions and alignment of all forms, bending and placement of the reinforcement, cleanliness of forms and reinforcement, form coatings or wetting, and conveying and placing equipment.

- .2 Transport concrete from mixer to the place of final deposit by methods which will prevent the separation or loss of material. Use equipment for chuting, pumping, pneumatical conveying of concrete of such size and design as to ensure a continuous flow at the delivery end without separation of materials. Clean conveying equipment with water before and after each run and discharge this water outside the forms.
- .3 Aluminum pipelines shall not be used.
- .4 Deposit concrete in forms as nearly as possible to its final position to avoid rehandling, in approximately uniform, horizontal layers. Do not allow concrete to flow laterally more than 0.6 of a metre. Vertical height of free fall shall not exceed 1.2 metres, except in walls and columns where it may be increased to 3.0 metres. Deposit continuously until each unit of operation is completed and as rapidly as possible and not more than 30 minutes after mixing to ensure bonding of successive layers.
- .5 Remove separators only when concrete has reached their level, if separators are not removed at the time of casting, they shall be cut out of the hardened concrete.
- .6 Compact all concrete by internal mechanical vibration. Operate internal vibrators at a speed of not less than 7,000 vibrations per minute. Apply at point of deposit and in area of freshly placed concrete. Use sufficient number of identical high frequency vibrators to permit rapid and uniform consolidation of layers throughout formwork, without overlapping. Do not disturb recently placed concrete which has begun to set.
- .7 Let internal vibrators sink of their own weight in concrete until they penetrate previous layer of concrete. Withdraw immediately at the same speed at which they sank. Move approximately 300mm to a new location and repeat process. To secure even, dense surfaces, supplement vibration by hand spading in the corners of forms.
- .8 Before concrete is placed, thoroughly clean forms, re-tighten as is necessary and saturate the surface of construction joints and form sides with water. Apply a neat cement paste to all construction joints just prior to the second casting, at a joint.
- .9 For depositing concrete in walls, provide suitably sized tapered pouring box to funnel the concrete into the forms. Provide sufficient boxes for each casting such that they can be placed on centres for the entire length of the casting.
- .10 Arrange operations so that once a casting is started, concreting is carried on continuously and the concrete at the surface of the casting is maintained plastic until the completion of the section.
- .11 Shortly after concrete is placed and compacted to the top of walls or columns or to the top of construction joints, rework the concrete with wooden paddles at the exposed faces to a depth of at least 0.6m and then revibrate.

3.2 COLD WEATHER REQUIREMENTS

- .1 Between October 15th and April 15th of the following year and/or when the air temperature is below 4 degrees C., place all concrete in accordance with the requirements of CSA Standard A23.1-14, Chapter 7 APlacing, Finishing and Curing Concrete@ and ACI 306.

3.3 HOT WEATHER REQUIREMENTS

- .1 Conform to recommendations of CSA Standard A23.1-14, Chapter 7 APlacing, Finishing and Curing@ and ACI 605.
- .2 Maintain temperature of concrete at time of placement as close as possible to 15 degrees C. And not in excess of 32 degrees C.

3.4 GROUTING

- .1 Grout base plates for structural steel using a premixed non-shrink material.
- .2 Clean all surfaces to be contacted by the grout free of all laitance, grease, dirt and other foreign material. Thoroughly saturate the concrete surfaces to be grouted with clean water.
- .3 Mix and apply the material in strict accordance with the manufacturer's directions and recommendations. Use the minimum amount of water to produce a grout of such a consistency that it will completely fill the space to be grouted.
- .4 Place grout quickly and continuously and compact thoroughly, so that the space to be grouted is completely filled with grout leaving no voids or air pockets.
- .5 Do not disturb shims sooner than 72 hours after placing grout. Then remove shims and grout shim spaces. Finish grout, at 45 degrees to the edge of the baseplate on all sides.

3.5 CONDUITS

- .1 Permit conduit which is 30mm O.D. or less to be placed in mid third of slab thickness. Maintain a minimum of 75mm of concrete between all adjacent conduit runs. Larger diameter conduit shall be approved for location by Consultant. Use of aluminum conduits or, bare non ferrous wires, is not permitted.
- .2 Conduit, which is over 30mm O.D. shall be placed below slabs on grade. Encase such conduit with a minimum of 100mm of concrete. Maintain a minimum of 100mm of concrete between adjacent conduit runs.

3.6 SLABS-ON-EARTH

- .1 Provide 100mm thick interior floor slabs on earth of 25MPa (50mm slump) concrete, unless otherwise noted. Proportion concrete mix with a maximum stone content and the minimum amount of water. Final mix design shall be approved by Consultant.
- .2 Reinforce slab-on-earth with polypropylene fibres added at the batching plant in accordance with the manufacturer's recommendations.
- .3 Screeds shall be provided for leveling surface of floor slabs and shall be set to an engineer's level.
- .4 Place slab in continuous strips providing construction joints between strips. Limit width of strips to one bay so that each strip will be placed rapidly without creating cold joints. Locate construction joints on column lines. Make construction joints as indicated on typical detail drawings.

- .5 As soon as possible during slab curing, saw cut slab into rectangular panels with a maximum size of 3 metres x 3 metres saw cut to a depth of 35mm. Where possible, make saw cuts on column lines, and saw cut a diamond shape centred on the column centre lines.
- .6 Fill saw cuts with a mix of epoxy and Portland cement. Mix and install saw cut filler in accordance with manufacturer's recommendations, and Section 03 11 00.

3.7 FINISHING

- .1 Conform to Chapter 7 of CSA-A23.1-14 as modified hereinafter, and provide a three (3) year written guarantee from the date of Certificate of Substantial Performance agreeing to make good any deficiencies at no extra cost to Owner.
- .2 Finish exposed concrete surfaces as required by Drawings and Schedules.
- .3 Immediately after removal of forms, cut off bolts, ties, nails, or other metal, back to a depth of 25mm from surface of concrete.
- .4 Have Consultant inspect concrete which is to be exposed and all serious honeycomb and make good as he directs.
- .5 Unless directed to do otherwise, repair defective areas and areas where ties, bolts and nails have been cut off as follows:
 - .1 Remove fins and projections. Carefully prepare all cavities and honeycomb by cutting out all defective material. Cut to a minimum depth of 25mm and leave edges of depressions perpendicular to surface.
 - .2 Apply a premixed patching compound in strict accordance with manufacturer's recommendations.
 - .3 Wet areas to be patched and an area of 150mm width surrounding area.
 - .4 Screed off patches to a level slightly higher than surrounding surface.
 - .5 Finish patches to match adjoining surface.

3.8 TREATMENT OF ARCHITECTURAL FORMED SURFACES

- .1 After forms are stripped, go over the surface carefully, removing loose concrete, styrofoam and/or lumber in reglets, minor fins and the like, leaving the surface clean. After the surfaces are cleaned, the Consultant will make an examination of them to determine their acceptability. If unacceptable, the Contractor shall remove the members and replace them at no extra cost to the Owner.
- .2 As previously noted, patching will only be permitted where it is required to an insignificant extent. If the Consultant permits patching, demonstrate to the Consultant's satisfaction that the patch will accurately match the colour and texture of the surrounding concrete and will have satisfactory tenacity.

3.9 FILLING FORM TIE HOLES

- .1 On surfaces exposed to view, seal the form tie holes with Mills Grout Plugs in accordance with manufacturer's instructions.
- .2 Where tie holes are not exposed, they shall be filled with non-shrink high strength grout to satisfy fire rating separation requirements.

3.10 CLEANING SURFACES

- .1 As late as possible, prior to turning the building over to the Owner, clean down concrete to remove surface discolourations, efflorescents and the like. Use a suitable cleaning agent which will not itself stain the surfaces or mar the texture through chemical reaction.

3.11 CLEAN UP

- .1 Keep the site free at all times from accumulation of debris from this work and on completion remove promptly all rubbish, equipment, surplus material, and debris resulting from this work.

END OF SECTION

PART 1 – GENERAL

1.1 GENERAL CONDITIONS

- .1 The General Conditions of the Contract and any Supplements and/or Addenda thereto form an integral part of this Specification and must be read in conjunction herewith.

1.2 RELATION TO OTHER TRADES

- .1 Read the Specifications and examine the drawings covering the work of other Trades and consult those responsible for the work of others in order to be acquainted with other Trades' requirements as they affect this work.
- .2 Give timely instructions and information in writing (or schedules) to other trades of the requirements which will affect the work of this Section.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- .1 Section 03 10 00 – Concrete Formwork
- .2 Section 03 20 00 – Concrete Reinforcement and Accessories
- .3 Section 03 30 00 – Cast-In-Place Concrete
- .4 Section 03 34 50 – Concrete Floor Finishing

1.4 WORK INCLUDED

- .1 Curing of all cast-in-place concrete.

1.5 HANDLING AND STORAGE OF MATERIALS

- .1 Handle and store materials in original packaging or containers and prevent damage to same.

1.6 REFERENCES STANDARDS

- .1 Conform to the Ontario Building Code O Reg.332/12 and all local By-Laws and Regulations.
- .2 Meet the requirements of CSA Standard A23.1-14, and S413-14, unless otherwise specified.

PART 2 – PRODUCTS

2.1 MATERIALS

- .1 Use only new materials which in physical and chemical properties comply with the Specification in every respect.
- .2 Water: clean and potable taken from municipal mains.
- .3 Chlorinated rubber based curing compound: Florseal WB 18 & 25 by Sika Canada Inc., or approved equal conforming to ASTM C309 and CGSB 90-GP-1.

- .4 Heat reflecting plastic membrane: 6 mils polyethylene sheet as manufactured by Union Carbide Canada Limited.

PART 3 – EXECUTION

3.1 CURING AND PROTECTION

- .1 All unformed surfaces shall be cured. Curing shall be applied to each area of surface as soon after the finishing operation, as can be achieved, without damaging or marring the surface.
- .2 The curing procedure shall be one or both of the following:
 - .1 Moisture vapour barrier
 - .2 White pigmented membrane compound
 - .3 The contractor shall provide an effective vapour barrier and prevent any flow of air between it and the concrete surface. To achieve this, the vapour barrier shall be held down at the edges and at all laps (100mm minimum) to prevent displacement. The material shall be kept in place for a minimum period of four days.
- .3 The membrane curing compound shall be applied to the concrete surface by means of approved spraying equipment that includes provisions for agitating the materials so that it shall be homogeneous at the time of application.
- .4 As soon as the surface is free of any bleed-water, the compound shall be applied to completely cover the surface such that the membrane formed on it is of satisfactory uniformity, thickness and colour, free of breaks or pin holes. This surface shall be maintained in this condition (reapplication may be necessary) for a minimum period of seven days, with the application rate being 1 litre per 6 square metres.
- .5 Where excessive shrinkage stresses may occur in a large expanse of concrete, the contractor may be required to use more than one curing method or to apply temporary curing at an interim stage of placing or finishing.
- .6 During and after curing, protect finished floor slabs from damage by other trades by covering floor with tarpaulin or plywood.
- .7 Wheeling, handling, piling or storing of any materials on slabs is prohibited during first seven days following placement. Consultant may delay work on a Agreen@ slab, if in his opinion, slab surface will be marred.

3.2 COLD WEATHER REQUIREMENTS

- .1 Between October 15th and April 15th of following year or when air temperature is below 4 degrees Celsius, place all concrete in accordance with requirements of CSA Standard A23.1-14 Chapter 7, APlacing, Finishing and Curing Concrete@.
- .2 In cold weather, provide equipment ready to put into operation, for adequate heating of freshly placed concrete and maintenance of temperature and humidity during curing. Obtain approval from Building Commissioner for temporary heating equipment.

- .3 The protection shall be designed for the worst conditions that can be reasonably anticipated from local weather records, forecasts and site conditions. The protective systems shall retain the initial heat of the concrete mix and shall produce the specified curing conditions in the concrete by the retention of heat generated during hardening of the concrete, plus where necessary, the supply of additional heat.
- .4 Loose or absorbent insulation material to be used in any protective system shall be completely contained within waterproof liners. Straw is not an acceptable insulation material but may be allowed for footings providing the footing is not exposed in the completed work. The Contractor shall submit his concrete protection proposals in writing, including any drawings or samples of insulating materials as may be necessary to substantiate his proposal, sufficiently in advance of the need for protection to permit the proper assessment of the proposal and the possible testing of insulating materials. The details shall be in accordance with the requirements of this section. The finished surface of concrete, such as slabs, walls, sidewalks and the like shall not be marred by the protection method. The Contractor shall be responsible for the adequacy of the protection provided.
- .5 Any concrete damaged by freezing or by inadequate protection or curing shall be removed and replaced at no cost to the Owner.
- .6 During cold weather, the Contractor shall provide protection so that one of the following moist curing conditions are met:
 - .1 The relative humidity of the atmosphere surrounding the concrete and formwork shall not be less than 95%.
 - .2 Any exposed surface of the concrete and the containing formwork within a housing shall be kept moist by one of the normal curing methods already specified.
 - .3 The concrete shall sufficiently retain its original moisture while within insulated formwork or under protective curing.
- .7 Maintain temperature of concrete approximately 26 degrees Celsius, but not over 37 degrees Celsius, nor less than 10 degrees Celsius, when deposited in forms. Maintain surface of concrete at a temperature of not less than 10 degrees Celsius and not over 26 degrees Celsius, for at least 72 hours after placing and at least 1 degree Celsius for the following 72 hours.
- .8 Concrete shall not be placed in insulated formwork when the air temperature is below the range for which it was designed.
- .9 Insulating material shall be fastened tightly and securely against the forms without gaps. All joints and any tears in the liners shall be sealed to keep the heat in, and wind and moisture out.
- .10 Parking garage slabs and roofs proportioned for exposure class AC-1@ concrete shall be cured for 7 days at a temperature not less than 10E C. Curing compounds shall not be used in parking garages.

3.3 HOT WEATHER REQUIREMENTS

- .1 Conform to recommendation of CSA Standard A23.1-14, Chapter 7, APlacing, Finishing and Curing Concrete@.
- .2 Special measures shall be taken by the Contractor for concreting operations in hot weather. When necessary, formwork, reinforcing steel and the grade shall be wetted down immediately prior to placing concrete.
- .3 Maintain temperature of concrete at time of placement as close as possible to 15 degrees Celsius and not exceeding 32 degrees Celsius.
- .4 Keep placing and finishing time to a minimum to avoid forming of cold joints.
- .5 The curing operation shall be carried out on the placed and finished concrete as soon as damage to the surface texture or finish can be avoided. Protect its exposed surfaces from drying, by continuous water curing for at least 7 days and preferably longer. After water curing is discontinued, cover surface, while still damp, with a heat reflecting plastic membrane or spray with curing compound type 2 conforming to ASTM C309. Keep vertical surfaces completely and continuously moist by applying water between form and concrete.
- .6 Take particular care to maintain temperature and moisture conditions for concrete strength test specimens as required in standard test methods.

END OF SECTION