

1.1.1 Part 1 General

1.2 **WORK INCLUDED**

1.2.1 Comply with Division 1, General Requirements and all documents referred to therein.

1.2.2 Provide all labour, materials, plant and equipment necessary to perform structural alterations indicated or noted on the drawings and as specified herein.

1.2.2.1 Verification of field conditions and dimensions.

1.2.2.2 Design of shoring, needling, and associated bracing along with the necessary foundations thereto as required to safely install new structural members.

1.2.2.3 Temporary shoring, needling, and associated bracing and where necessary jacking of existing work and removal thereof as required to safely install new structural members.

1.3 **RELATED WORK SPECIFIED ELSEWHERE**

1.3.1 Demolition of Structure, Section 02 41 19.

1.3.2 Concrete Forming, Section 03 10 00.

1.3.3 Concrete Reinforcement, Section 03 20 00.

1.3.4 Cast-in-Place Concrete, Section 03 30 00.

1.4 **REFERENCE STANDARDS, CODE AND ACTS**

1.4.1 Conform to the requirements of the local building code identified on the Structural General Notes as amended by all subsequent Regulations issued to the date of this Specification and applicable acts of authorities having jurisdiction.

1.4.2 All references to the Standards and publications noted below shall be to the edition referenced in the local building code identified on the Structural General Notes, or to the edition referenced in the latest published editions or revisions of all Standards published by the Canadian Standards Association issued to the date of this Specification, whichever is the later edition or revision.

1.4.3 All references noted below, which are not referenced by the local building code or the Standards published by the Canadian Standards Association, shall be to the latest edition and revision published to the date of this Specification.

1.4.4 Standards and publications referenced by the Standards noted below are to apply even if they are not included in the list. Where such reference is made, it shall be to that latest edition and revision published to the date of this Specification.

1.4.4.1 CSA A23.1 Concrete Materials and Methods of Concrete Construction.

1.4.4.2 CSA A23.2 Test Methods and Standard Practices for Concrete.

1.4.4.3 CSA S16 Design of Steel Structures.

1.4.4.4 Where there are differences between the specifications and drawings and the codes, standards and acts, the most stringent shall govern.

1.5 **GENERAL**

1.5.1 The drawings governing alterations to existing structural work were prepared using the following assumptions:

1.5.1.1 The existing building is built in accordance with the original contract documents, significant details of which have been reproduced on the drawings.

1.5.1.2 The workmanship and materials employed on the existing buildings were of good quality and the building has not deteriorated significantly.

1.5.1.3 Bearing walls, structural steel, and structural concrete framing is reasonably true and plumb.

1.5.1.4 Existing building documents used in preparing the documents for this contract include the following:

1.6 **EXAMINATION**

1.6.1 Examine the site and buildings on it. Establish conditions under which the work is to be done, and accept the premises as found upon taking possession of the property. The Owner will make no allowance for conditions that were apparent at the time of submission of tender. Direct all inquiries to the Consultant.

1.6.2 Before proceeding with alterations to structural members, verify that the existing building information shown on the drawings and the assumptions described above are correct. Should the drawing or the assumptions described above not be correct, notify the Consultant immediately. The Consultant will determine revisions necessary to the work as shown. The Contractor shall provide the necessary assistance to enable the Consultant to determine the extent of the revisions necessary.

- 1.6.3 Investigate the existing building to determine actual field conditions, take field dimensions, ascertain loads and forces to be supported or resisted, probe structural bearing members to determine soundness, and perform other inspection as deemed necessary to carry out design of shoring, needling, bracing, and the like, to schedule the sequence of operations, and prepare shop drawings and details.

1.7 DESIGN

- 1.7.1 Design shoring, bracing, needling, scaffolding, and the like, along with the necessary foundations so that loads applied to them will be safely carried. Superimposed live loads, construction loads, and wind loads shall be taken into account and the lateral stability of the elements supported and the shoring and needling shall be insured.
- 1.7.2 The members requiring shoring or needling, the elements to be altered, the general sequence of operations and in some circumstances the type of needling and shoring are shown. These general requirements shall govern the design.
- 1.7.3 The design of shoring, needling and foundations thereto and the sequence of their installation and sequence of the work shall be prepared by a Professional Engineer licensed in the Province of [Ontario].
- 1.7.4 Prepare design of shoring, and the like, in co-operation with other trades so that new work may be installed as required.

1.8 RESPONSIBILITY

- 1.8.1 The Contractor shall be responsible for all damage arising out of the work of the Contract and for all damage to adjacent private or public property. The Contractor shall make good damages caused in the performance of this contract to the satisfaction of the Consultant.
- 1.8.2 Review of shoring and needling design drawings by the Consultant shall in no way relieve the Contractor of its responsibility for carrying out the work in a manner which ensures the complete safety of the existing work, persons, and adjacent property and also ensures that no damage occurs thereto, during any period of the alterations.

1.9 SUBMITTALS

- 1.9.1 Prepare and submit to the Consultant drawings fully describing the shoring, needling, bracing and scaffolding work, the sequence of their installation and removal and the sequence of alterations.

- 1.9.2 Each drawing submitted shall bear the signature and stamp of a qualified Professional Engineer licensed in the Province of [Ontario]
- 1.9.3 Submit calculations to the Consultant if requested.
- 1.9.4 The Professional Engineer employed to design the shoring, bracing, needling and the like shall also be employed to fully supervise their installation and removal and shall submit weekly reports to the Consultant regarding these phases of the work.
- 2 PART 2 PRODUCTS**
- 2.1 MATERIALS**
- 2.1.1 Concrete, grouting, formwork and reinforcing steel shall conform to the requirements of CSA A23.1.
- 2.1.2 Structural Steel shall conform to the requirements of CSA S16.
- 2.1.3 Structural timber framing shall conform to CSA O86.
- 3 PART 3 EXECUTION**
- 3.1 Carry out shoring and needling by means of jacking, wedging, or by other suitable means so that load is transferred to the shoring and needling without damaging the work supported. Ensure that over wedging does not damage the work.
- 3.2 CUTTING AND CORING OF EXISTING STRUCTURES**
- 3.2.1 All dimensions provided by the Consultants are to be confirmed with the appropriate Contractor prior to cutting/coring.
- 3.2.2 Any revisions to the dimensions provided by the Consultants must be reviewed by the Consultants prior to cutting/coring.
- 3.2.3 Unless noted otherwise, no reinforcement is permitted to be cut when new openings are cut through the existing structure.
- 3.2.4 Do not cut or damage any existing post-tensioned tendons.
- 3.2.5 Prior to cutting the existing structure, all reinforcement (including any post-tensioned tendons) in the affected areas is to be located by a positive means, (i.e. x-raying, local chipping of slab, or use of cover meter) unless otherwise permitted by the Consultant and as shown on the drawings.

- 3.2.6 After reinforcement has been located in these areas, notify Consultant who will review the prior to cutting/coring. Make any necessary adjustments to the holes locations as required by the Consultant.
- 3.2.7 For any openings which are to be sawcut into the existing structure, pre-drill the corners using a 100 mm (4") diameter core drill. Do not overcut corners of opening.
- 3.2.8 For any areas where reinforcement is cut, the Contractor is to indicate the direction and layer of reinforcement on the as built drawings.
- 3.2.9 Where the drawings call for existing reinforcement to be exposed without cutting, take measures to ensure the existing reinforcement is exposed without being damaged.
- 3.3 **QUALITY CONTROL**
- 3.3.1 Implement a system of quality control to ensure that the minimum standards specified herein are attained.
- 3.3.2 Bring to the attention of the [Consultant] any defects in the work or departures from the Contract Documents which may occur during Construction. The [Consultant] will decide upon corrective action and give his recommendations in writing.
- 3.3.3 The [Consultant]'s general review during construction and inspection and testing by independent inspection and testing agencies reporting to the [Consultant] are both undertaken to inform the [Owner] [Client] of the Contractor's performance and shall in no way augment the Contractor's quality control or relieve the Contractor of contractual responsibility.
- 3.4 **NOTIFICATION**
- 3.4.1 Prior to commencing significant segments of the work, give the [Consultant] and independent inspection and testing agencies appropriate notification so as to afford them reasonable opportunity to review the work. Failure to meet this requirement may be cause for the [Consultant] to classify the work as defective.
- 3.5 **INSPECTION AND TESTING**
- 3.5.1 Independent inspection and testing agencies shall be engaged by the Construction Manager for the purpose of inspecting and/or testing portions of the Work. Independent inspection/testing agencies engaged by the Construction Manager shall be acceptable to and approved by the Consultant.
- 3.6 **DEFECTIVE MATERIALS AND WORK**

- 3.6.1 Where evidence exists that defective work has occurred or that work has been carried out incorporating defective materials, the [Consultant] may have tests, concrete coring, inspections or surveys performed, analytical calculations of structural strength made and the like in order to help determine whether the work must be repaired or replaced. Tests, inspections or surveys or calculations carried out under these circumstances will be made at the Contractor's expense, regardless of their results, which may be such that, in the [Consultant]'s opinion, the work may be acceptable.
- 3.6.2 All testing shall be conducted in accordance with the requirements of the [Ontario Building Code], except where this would in the [Consultant]'s opinion cause undue delay or give results not representative of the rejected material in place. In this case, the tests shall be conducted in accordance with the standards given by the [Consultant].
- 3.6.3 Materials or work which fail to meet specified requirements may be rejected by the [Consultant] whenever found at any time prior to final acceptance of the work regardless of previous inspection. If rejected, defective materials or work shall be promptly removed and replaced or repaired to the satisfaction of the [Consultant], at no expense to the Owner.

END OF SECTION 02 20 10

1 PART 1 – GENERAL

1.1 WORK INCLUDED

1.1.1 Comply with Division 1, General Requirements and documents referred to therein.

1.1.2 Provide labour, materials, products, equipment and services required to complete the selective demolition work.

1.1.3 Schedule of Structure to Be Demolished

1.1.4 Also, refer to drawings for location of building and extent of demolition work.

1.2 RELATED WORK SPECIFIED ELSEWHERE

1.2.1 Structural Alterations: Section 02 20 10.

1.3 REFERENCE STANDARDS, CODES AND ACTS

1.3.1 Conform to the requirements of the local building code identified on the Structural General Notes as amended by all subsequent Regulations issued to the date of this Specification and applicable acts of authorities having jurisdiction.

1.4 PERMITS AND REGULATIONS

1.4.1 Arrange and pay for all permits, notices, and inspections necessary for the proper execution and completion of the demolition work, except for the demolition permit which shall be obtained and paid for by the Owner or by his authorized representative.

1.4.2 Engage the services of a Professional Engineer licensed in the Province of Ontario to provide supervision during demolition and to prepare and submit the required documents to the municipal authorities at completion of Work. Submit a copy of the documents to the Owner and the Architect.

2 PART 2 - PRODUCTS

2.1 SALVAGE AND DISPOSAL OF MATERIALS

2.1.1 All materials from the demolition, except as specified below or otherwise directed, shall become the property of the Contractor. Remove all material and debris from the site as quickly as possible and dispose of legally. Burning of debris or selling of materials on the site will not be permitted.

- 2.1.2 Salvage materials and/or equipment to be turned over to the Owner as directed by the Consultant. Remove carefully the following items to be salvaged, protect during demolition, and place in locations designated:

3 **PART 3 - EXECUTION**

3.1 **PROTECTION**

- 3.1.1 Supply, install, and maintain temporary hoardings and sidewalk covers, including lighting if required, in compliance with requirements of authorities having jurisdiction, and to the approval of the Owner, to provide a smooth, continuous exterior surface in one plane, unbroken by supports, perforations or other structural members. Remove hoardings at completion of work of this Section as and when directed by the Owner.
- 3.1.2 Provide barricades and guard rails as required to give full protection to the general public, to workmen employed on the demolition and to adjoining properties.
- 3.1.3 Protect adjacent properties against damages which might occur from falling debris or other causes; do not interfere with use or occupancy of adjacent buildings; maintain free, safe passage to and from same.
- 3.1.4 Take precautions to guard against movement or settlement of existing structures to remain, adjacent land, buildings, and paving. If at any time the safety of such land, buildings, or pavements appears to be in danger, suspend operations and notify the Consultant promptly. Take measures to support such land, buildings, and pavements. Do not resume demolition until the Consultant permits.
- 3.1.5 Do not place nor store material in streets, lanes, or passageways, except as permitted by authorities having jurisdiction.
- 3.1.6 Do not restrict traffic on public streets, lanes, and sidewalks except as permitted by authorities having jurisdiction.
- 3.1.7 Do not commence demolition of buildings until all personnel and Owner's equipment are removed from the buildings.
- 3.1.8 Drain fuel tanks and remove the fuel from the site in an acceptable manner prior to start of demolition work.

3.2 **EXISTING SERVICES**

- 3.2.1 Arrange and pay for the disconnection, capping, and plugging of gas, water, sewer, electric, telephone, and other services to the structures to be demolished. In advance, notify each utility company involved and obtain approval before

commencing that portion of the work. Disconnect and cap services at the property line.

- 3.2.2 Make good to the requirements of the local authorities public roads, walkways and curbs soiled or damaged due to work of this Section.

3.3 **DEMOLITION**

- 3.3.1 Refer to the drawings for extent of demolition work.

- 3.3.2 Do not allow existing drains which are to remain in place, to become blocked.

- 3.3.3 Carry out demolition in strict accordance with requirements of authorities having jurisdiction.

- 3.3.4 At end of each work shift leave work in a safe condition so that no part of the remaining structure is in danger of toppling, collapsing, or falling.

- 3.3.5 During demolition operations, keep work wetted down thoroughly to prevent dust and dirt from rising. Provide waterline for this purpose. Furnish connections that may be required and pay for cost of water used. Upon completion, remove installed temporary waterline.

- 3.3.6 Demolish the portion of building noted including removal of roofs, walls, floors, paving, foundation walls to [300 mm (12") below existing grade], drains and other piping.

- 3.3.7 Leave intact existing foundation walls below [300 mm (12") below grade] at building perimeter and interior walls and/or framing members which provide lateral support for perimeter walls.

- 3.3.8 Collapse enclosed spaces existing below grade, if any.

- 3.3.9 Remove combustible materials, plastics, metal, glass, wood, and other organic material from site.

- 3.3.10 Break up and remove existing slabs on grade.

- 3.3.11 Remove from the site all pieces of concrete weighing more than 900 kg (2000 lbs) or larger than 0.5 m³ (½ yd³) whichever is the more restrictive or break into small pieces.

- 3.3.12 Remove fuel tanks from the site.

- 3.3.13 Fill excavated areas, voids, and depressions below grade at areas of demolished structure (outside new basement walls) with clean rubble containing only whole or

broken masonry units, mortar, stone, small pieces of concrete, gravel, sand, or crushed stone. Remove all combustible materials, metal, glass, and wood or other organic material from backfill material.

- 3.3.14 On completion, grade and level the finished site around remaining structure, sloped to drain away from remaining structure and in manner to prevent puddles, flush with adjacent grades, adding clean granular fill as required.

3.4 **NOTIFICATION**

- 3.4.1 Prior to commencing significant segments of the work, give the [Consultant] and Independent Inspection and Testing Companies appropriate notification so as to afford them reasonable opportunity to review the work. Failure to meet this requirement may be cause for the [Consultant] to classify the work as defective.

END OF SECTION 02 41 19

1 PART 1 - GENERAL

1.1 DEFINITIONS

1.1.1 The following Definitions shall apply in this Specification:

1.1.2 Contract Documents

1.1.2.1 The Contract Documents consist of the Drawings, Specifications and Reports which form part of the agreed Contract.

1.1.3 Consultant

1.1.3.1 The Consultant is the Architect, SEOR, persons or entities engaged by the Owner. The term Consultant means the Consultant or the Consultant's authorized representative.

1.1.4 Contractor

1.1.4.1 The term Contractor is defined to include any of the following: Construction Manager, General Contractor, Structural Steel Erector, Structural Steel Fabricator, Subcontractor or Supplier.

1.1.5 Owner

1.1.5.1 The Owner is the person or entity identified as such in the Contract. The term Owner means the Owner or the Owner's authorized agent or representative but does not include the Consultant.

1.1.6 SEOR

1.1.6.1 The SEOR is defined as the Structural Engineer of Record for the Contract.

1.2 WORK INCLUDED

1.2.1 Comply with Division 1 - General Requirements and all documents referred to therein.

1.2.2 Provide all labour, materials, plant, and equipment to complete the concrete formwork indicated in the Contract Documents, including the installation of cast in inserts and assemblies as therein.

1.3 RELATED WORK SPECIFIED ELSEWHERE

1.3.1 Concrete Reinforcement, Section 03 20 00 – Concrete Reinforcement.

1.3.2 Cast-in-Place Concrete, Section 03 30 00 – Cast-in-Place Concrete.

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- 1.3.3 Concrete Floor Finishes, Section 03 35 10 – Concrete Floor Finishes.
- 1.3.4 Anchor assemblies, bolts, and the like to be cast into concrete, Section 05 12 00- Structural Steel.
- 1.4 **REFERENCE STANDARDS, CODES AND ACTS**
- 1.4.1 Conform to the requirements of the local building code identified on the Structural General Notes as amended by all subsequent Regulations issued to the date of this specification and applicable acts of authorities having jurisdiction.
- 1.4.2 All references to the Standards and publications noted below shall be to the edition referenced in the local building code identified on the Structural General Notes, or to the edition referenced in the latest published editions or revisions of all Standards published by the Canadian Standards Association issued to the date of this Specification, whichever is the later edition or revision.
- 1.4.3 All references noted below, which are not referenced by the local building code, or the Standards published by the Canadian Standards Association, shall be to the latest edition and revision published to the date of this Specification.
- 1.4.4 Standards and publications referenced by the Standards noted below shall apply even if they are not included in the list. Where such reference is made, it shall be to that latest edition and revision published to the date of this Specification.
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| 1.4.4.1 | CSA A23.1/ CSA A23.2 | Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete |
| 1.4.4.2 | CSA S413 | Parking Structures |
| 1.4.4.3 | CSA O86 | Engineering Design in Wood |
| 1.4.4.4 | CSA O121 | Douglas Fir Plywood |
| 1.4.4.5 | CSA O151 | Canadian Softwood Plywood |
| 1.4.4.6 | CSA O153 | Poplar Plywood |
| 1.4.4.7 | CSA O437 Series | OSB and Waferboard |
| 1.4.4.8 | CSA O325.0 | Construction Sheathing |
| 1.4.4.9 | CSA S269.1 | Falsework and formwork |
| 1.4.4.10 | CAN/CSA-S269.3 | Concrete Formwork |

- 1.4.4.11 COFI (Council of Forest Industries of British Columbia) Exterior Plywood for Concrete Formwork
- 1.4.5 Where there are differences between the Contract Documents and the codes, standards, or acts, the most stringent shall govern.
- 1.5 **TOLERANCES**
- 1.5.1 Perform forming operations and place hardware so that finished concrete will be within the tolerances set out in CSA A23.1.
- 1.5.1.1 Variations in building lines which result in extension of the building over lot lines or restriction lines will not be permitted.
- 1.5.2 These tolerances are acceptable with regard to structural requirements. Interfacing tolerances may not be compatible with the above. Review and coordinate interfacing tolerances so that the various elements come together properly.
- 1.6 **QUALIFICATIONS**
- 1.6.1 The formwork and reshoring shall be designed by a qualified professional engineer licensed by the authority having jurisdiction with a minimum of 5 years Canadian experience in the design of such temporary construction Work.
- 1.7 **DESIGN**
- 1.7.1 Formwork and Reshoring.
- 1.7.1.1 The Contractor shall design formwork and reshoring to safely support vertical and lateral loads until they can be supported by the structure.
- 1.7.1.2 The Contractor shall design formwork and reshoring for the effects of post-tensioning and shall ensure the design is coordinated with the post-tensioning designer.
- 1.7.1.3 Design formwork to the requirements of CAN/CSA S269.3.
- 1.7.2 Reshores in the lower storeys shall be capable of safely carrying the full weight of the concrete, formwork and all construction live loads posted to them prior to the removal of the first storey of shores supported by the ground or slab-on-grade.
- 1.7.3 After reshores are removed from the first storey, the design and provision of reshores may be based on the assumption that each shored or reshored flexural member shares load in relation to its achieved strength, provided the flexural member has attained at least 70% of its specified 28 day strength.

1.8 SUBMITTALS

1.8.1 Shop Drawings for Formwork, and Reshoring

1.8.1.1 Reproduction of the structural drawings, to serve as a basis for the preparation of shop drawings, will be permitted and is subject to a separate agreement between the Consultant and the Contractor. Any costs associated with the preparation of the structural Drawings for use by the Contractor shall be paid for by the Contractor.

1.8.1.2 Provide adequate space on all shop drawings immediately above the drawing title block for the Consultant's Shop Drawing review stamp. Where requested by the Consultant, the stamp is to be inserted by this section directly into the shop drawing prior to submission. The stamp shall be positioned in the same location on each shop drawing, and in no case shall the allocated space be less than 63mm x 75mm. Request the details of these requirements from the Consultant no less than 2 weeks before the commencement of shop drawings.

1.8.1.3 Well in advance of construction, submit to the Consultant shop drawings showing the complete design and detailing of the slab formwork and reshoring systems stamped by a qualified professional engineer licensed by the authority having jurisdiction.

1.8.1.4 As a minimum, the shop drawings shall show the following:

1.8.1.4.1 All design assumptions including references to the relevant codes, standards and sets, design loads, assumed concrete placing rate and the like.

1.8.1.4.2 Layout of formwork panels and shores;

1.8.1.4.3 Formwork details related to stripping and reshoring;

1.8.1.4.4 Camber;

1.8.1.4.5 Sequence for installing reshores;

1.8.1.4.6 Stripping schedule;

1.8.1.4.7 Number of slabs reshored at any given time;

1.8.1.4.8 Method, sequence, and schedule of construction, materials, arrangement of joints, form ties, shores, liners and locations of temporary embedded parts in architectural form concrete elements; and

- 1.8.1.4.9 Complete details associated with forming sloped slabs together with placing and compaction procedures for sloping slabs, including details of construction and placing of top forms.
- 1.8.1.5 Include in the shop drawing submission a method statement as to how the cambers specified in the Contract Documents will be achieved in the field.
- 1.8.2 Construction Joints
 - 1.8.2.1 Well in advance of construction, submit to the Consultant shop drawings showing the location of all horizontal and vertical construction joints in the structure. Drawings shall include plans, wall elevations and additional sections and details (as necessary) which clearly indicate the proposed location of the joints. Drawings shall include dimensions for all construction joints to reference grid lines and elevations.
 - 1.8.2.2 Drawings shall include any specific provisions or requirements where the elements are noted to be poured monolithically on the Contract Documents.
- 1.8.3 Honeycombed Concrete
 - 1.8.3.1 Submit a proposed method statement for the repair of honeycombed concrete, including a list of suitable products, for the following depths of honeycombing;
 - 1.8.3.1.1 Less than 20 mm;
 - 1.8.3.1.2 20 mm to 60 mm; and
 - 1.8.3.1.3 Greater than 60 mm.
- 1.8.4 Lift Drawings
 - 1.8.4.1 Submit lift drawings of the structure showing, all cast-in or embedded items, openings, recesses, and sleeving required by the Work of all Specification Sections, for the Consultant's review. Drawings shall be submitted a minimum of 30 days prior to the commencement of the reinforcement detailing of the area outlined on the lift drawings.
 - 1.8.4.2 All embedded items, openings, sleeves, and chases are not necessarily shown on the structural Drawings nor are their sizes or locations shown on the Drawings. Refer to architectural, mechanical, and electrical Drawings and Specifications and the detailed shop drawings prepared for the Work of all Specification Sections for openings and sleeving requirements not shown, located, and dimensioned on the structural Drawings.

- 1.8.4.3 Openings, sleeves, chases embedded items and the like shall be fully dimensioned from grid lines in plan and floor levels in elevation. Information including sizes, dimensions, locations, elevations etc. shall be drawn to scale on a set of structural drawings.
- 1.8.4.4 Openings and embedded items required for all aspects of the Work shall be shown and coordinated on a single set of lift drawings.
- 1.8.4.5 Lift drawings are to be reviewed by the Contractor, prior to submission to the Consultant.
- 1.8.4.6 The Contractor's review stamp shall be affixed to all lift drawings that are submitted for review.
- 1.8.5 Surveys
 - 1.8.5.1 Submit surveys showing position of formwork, cast-in-place inserts and structural elements as noted below.
 - 1.8.5.2 As a minimum include the following:
 - 1.8.5.2.1 Elevation and location of centreline with respect to grids of all footings, pile caps and piles;
 - 1.8.5.2.2 Location of centreline of all columns with respect to grids at each floor level;
 - 1.8.5.2.3 Location with respect to grids and horizontal alignment of all concrete walls at all floor levels;
 - 1.8.5.2.4 Vertical alignment (plumbness) of all columns and walls at all floor levels;
 - 1.8.5.2.5 Elevation of slab formwork and slabs at all columns, walls, centre of bays, midway between columns along gridlines and at cantilever ends, at points of maximum camber on all floor levels at the following times:
 - 1.8.5.2.5.1 Before concrete placement.
 - 1.8.5.2.5.2 After concrete placement, prior to removal of any formwork and reshores from below.
 - 1.8.5.2.5.3 Between 7 and 14 days after removal of all reshores immediately above and below the subject floor.
 - 1.8.5.2.6 Location and alignment of edge of slabs with respect to grids at all floor levels;
 - 1.8.5.2.7 Location and elevation of cast-in-place hardware at all levels; and

- 1.8.5.2.8 Regular elevation checks of formwork adjacent to separation strips.
- 1.8.5.3 All surveys submitted must clearly indicate the date when the survey was carried out.
- 1.8.6 Underpinning Details
 - 1.8.6.1 Well in advance of construction, submit for the Consultant's review complete details of the design and installation of shoring and bracing prepared, sealed, and signed by a qualified professional engineer licensed in by the authority having jurisdiction.
- 1.8.7 As-Built Drawings
 - 1.8.7.1 Mark on a complete set of final drawings any changes, additions or deletions that occur during construction as a result of the Contractor's Work, change orders, or for any other reason.
 - 1.8.7.2 For all shop drawings marked "Reviewed as Noted" or "Revise and Resubmit", update and submit a record set of these drawings at the completion of the structural Work. Ensure that these drawings reflect the changes and are coordinated with the final drawings noted above.
- 2 **PART 2 - PRODUCTS**
 - 2.1 **MATERIALS**
 - 2.1.1 Formwork
 - 2.1.1.1 Formwork lumber: Conform to O86.1 and CSA - O325.0.
 - 2.1.1.2 Sheathings for exposed surfaces: New, Douglas Fir plywood not less than 19 mm thick, concrete form grade, sanded one side, conforming to CSA-O325.0.
 - 2.1.1.3 Preformed Steel Forms: Minimum 1.6 mm or 16 gauge matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
 - 2.1.1.4 Void Forms: Moisture resistant treated paper faces, biodegradable, structurally sufficient to support weight of the wet concrete mix until initial set.
 - 2.1.1.5 Corners: Chamfered as required architecturally, in maximum lengths possible.
 - 2.1.2 Waterstops

- 2.1.2.1 Construction and Control Joints: Provide polyvinyl Chloride (PVC) waterstop Type 7 (internal type) or Base Seal Type 61 (external type) as manufactured by CPD Construction Products or an equivalent approved by the Consultant.
- 2.1.2.1.1 Construction Joints: Provide polyvinyl Chloride (PVC) waterstop Type GSK580 (internal type) as manufactured by Sika or Base Seal Type GSK776 (external type) as manufactured by Sika or an active bentonite/butyl-rubber based waterstop Type RX-101 by Cetco or an equivalent approved by the Consultant.
- 2.1.2.1.2 Control Joints: Provide polyvinyl Chloride (PVC) waterstop Type 5 (internal type_ as manufactured by CPD Construction Products or polyvinyl Chloride (PVC) waterstop Base Seal Type GSK923 (external type) as manufactured by Sika or an equivalent approved by the Consultant.
- 2.1.2.2 Construction and Control Joints: Provide bentonite waterstop RX-101 as manufactured by ETCO.
- 2.1.2.3 Movement Joints: Provide polyvinyl Chloride (PVC) waterstop Type 7C (internal type) or Baseal Type 62 (external type) as manufactured by CPD Construction Products or an equivalent approved by the Consultant.
- 2.1.3 Dovetail anchor slots: Minimum 0.8 mm thick (22 gauge) galvanized steel with insulation filled slots.
- 2.1.4 Flashing Reglets: Minimum 0.8mm (22 gauge) thick galvanized steel with alignment splines for joints.
- 2.1.5 Form Spacers: (Stay-in-place form spacers exposed to weather, earth, or moisture shall not be made of wood, and shall be corrosion and decay resistant.)
- 3 **PART 3 - EXECUTION**
- 3.1 **PRE-CONSTRUCTION CONFERENCE**
- 3.1.1 At least 60 days prior to the commencing of concrete construction, the Contractor shall hold a pre-construction meeting to review the requirements of the project.
- 3.1.1.1 The Contractor shall ensure responsible representatives of every party that is involved in the concrete Work attend the conference, including but not limited to the following:
 - 3.1.1.1.1 The Contractor
 - 3.1.1.1.2 Subcontractor responsible for Concrete Forming
 - 3.1.1.1.3 Concrete Supplier

3.1.1.1.4 Reinforcement Fabricator/Placer

3.1.1.1.5 All Inspection and Testing Agencies

3.1.1.1.6 Consultant

3.1.1.1.7 The Owner's Representative

3.1.1.2 Minutes of the meeting shall be recorded and distributed to all parties within 5 days of the meeting.

3.2 **CONCRETE WORK AT EXISTING STRUCTURE**

3.2.1 Prior to undertaking any Work in or adjacent to the existing structure, verify that conditions are as indicated on the Contract Documents. If they are not, do not proceed until the Consultant has given instructions.

3.2.2 Protect and support existing services that may interfere with Work in the existing structure.

3.3 **FORMWORK**

3.3.1 General

3.3.1.1 Erect, support, brace, and maintain formwork to safely support vertical and lateral loads until they can be supported by the structure.

3.3.1.2 All falsework erection shall be supervised by the professional engineer responsible for its design.

3.3.1.3 All formwork shall be inspected by the Contractor and the professional engineer responsible for its design, prior to the concrete pour to ensure that they have been erected in conformance with the formwork shop drawings.

3.3.1.4 Align joints in formwork and make water-tight. Keep form joints to a minimum.

3.3.2 Construction

3.3.2.1 Form footing sides unless footings are shown to be placed against undisturbed soil in the Contract Documents or unless excavation is left with vertical sides against which the concrete can be directly cast.

3.3.2.2 Mark building, grid or other lines on forms to permit the accurate positioning of dowels into concrete elements above and all other reinforcing steel.

- 3.3.2.3 Construct templates and supports to rigidly fix reinforcing dowels in the forms prior to concreting.
- 3.3.2.4 Set anchor rods, templates, steel connection units, hardware, and/or other inserts into the forms and secure them rigidly so that they do not become displaced during concreting.
- 3.3.2.5 Application of Form Release Agent
 - 3.3.2.5.1 Apply form release agent in accordance with the manufacturer's recommendations.
 - 3.3.2.5.2 Apply prior to placement of reinforcement, anchoring devices, and embedded items.
 - 3.3.2.5.3 Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings, which are affected by the agent. Soak inside surface of untreated forms with clean water and keep surfaces covered prior to placement of concrete.
- 3.3.3 Sleeves, Recesses and Formed Openings
 - 3.3.3.1 Form sleeves, recesses and openings in accordance with reviewed sleeving drawings, except where such items are specified to be formed or sleeved by the appropriate Section in the Contract Documents.
 - 3.3.3.2 No sleeves, recesses, or openings through structural members shall be formed without the Consultant's approval.
 - 3.3.3.3 During cold weather, protect members from damage due to water freezing in confined areas, recesses, sleeves or formed 'openings'.
- 3.3.4 Exposed Concrete Forms
 - 3.3.4.1 Make joints of forms sufficiently tight to prevent leakage of concrete fines at corners of exposed beams, walls and columns or at the corners of exposed edges of slabs, and other concrete exposed to view in the finished building.
 - 3.3.4.2 Provide 25 mm chamfer strips at all exposed edges of concrete and 19 mm v-joints at control joints.
 - 3.3.4.3 Form panels for exposed concrete may be reused 3 times, providing the tie holes are reused and panels are not damaged in a way that will cause visual defects.
- 3.3.5 Cambers

3.3.5.1 Where indicated in the Contract Documents, camber formwork such that hardened concrete, prior to stripping of forms, is cambered as indicated. Maintain beam depth and slab thickness indicated on the Contract Documents.

3.4 **STRIPPING OF FORMS AND RESHORING**

3.4.1 Where forms are stripped from horizontal or sloping members before concrete has reached its specified strength, reshore the members so that they can safely support their own load plus construction loads. In addition, ensure that the stripped member is of sufficient strength to safely carry its own weight over the area stripped out at any instant, together with any superimposed construction loads.

3.4.1.1 Install reshores so that they are supported on members which can safely support the reshore load.

3.4.1.2 As a guide, under the curing conditions specified in the Contract Documents, 70% of the 28 day strength should be attained 7 days after concreting in normal weather and 14 days after concreting in "Cold Weather".

3.4.1.3 Base decision to strip forms upon satisfactory results of 7 day concrete cylinder tests and on Site curing conditions or on in situ tests.

3.4.1.4 Stripping and reshoring shall proceed simultaneously so as not to leave an area greater than 80 sq. m. unsupported by either formwork or reshoring at any instant. Install reshores tight to construction above and below so that they will not significantly shorten under load but take care not to preload the construction below or raise the construction above by over-tightening.

3.4.1.5 Maintain reshoring or formwork in place for a minimum of 28 days or for such longer time as may be required to ensure that the concrete has reached its specified 28-day strength.

3.4.1.6 Do not strip within one and a half bays of a construction joint until new concrete beyond the construction joint has reached 70% of its specified 28 day strength.

3.4.1.7 Side forms for vertical members may be stripped as soon as the concrete is sufficiently strong to stand unsupported and safely resist imposed loads.

3.4.1.8 Prior to pouring the concrete elements directly supported above, remove sonotube forms to such an extent to allow the Consultant to review the quality of any exposed column surface. Provide necessary protection to the exposed surfaces upon completion of review.

3.5 **CONSTRUCTION JOINTS**

- 3.5.1 Obtain approval from the Consultant for location and details of construction joints not shown on the Contract Documents.

3.6 **MOVEMENT JOINTS**

- 3.6.1 Construct movement joints at the locations indicated in the Documents and in accordance with the details shown in the Contract Documents.
- 3.6.2 Construct clean movement joints free of foreign material, likely to impair the proper operation of the joint.
- 3.6.3 Provide a non-extruding joint filler in movement joints for the full area between adjacent concrete members. Anchor the filler material to one of the adjacent members or between concrete members and adjacent members of other materials.
- 3.6.4 Where shown in the Documents, provide waterstops in movement joints.

3.7 **WATERSTOPS**

- 3.7.1 Install waterstops in accordance with the manufacturer's requirements, to provide continuous water seal. Do not distort or pierce waterstop. Do not displace reinforcement when installing waterstops. Tie waterstops rigidly in place.
- 3.7.2 Splice waterstops in accordance with the manufacturer's requirements.
- 3.7.3 Where waterstops are noted to be installed adjacent to existing Work, prepare existing surfaces to receive waterstop in accordance with manufacturer's recommendations.

3.8 **QUALITY CONTROL**

- 3.8.1 Implement a system of quality control to ensure that the minimum standards specified in the Contract Documents are attained.
- 3.8.2 Bring to the attention of the Consultant any defects in the Work or departures from the Contract Documents which may occur during construction. The Consultant will decide upon corrective action and give recommendations in writing.
- 3.8.3 The Consultant's general review during construction and inspection and testing by independent inspection and testing companies reporting to the Consultant are both undertaken to inform the Owner of the Contractor's performance and shall in no way augment the Contractor's quality control or relieve the Contractor of its contractual responsibility.

3.9 **NOTIFICATION**

- 3.9.1 Prior to commencing significant segments of the Work, give the Consultant and independent inspection and testing companies appropriate notification so as to afford them reasonable opportunity to review the Work. Failure to meet this requirement may be cause for the Consultant to classify the Work as defective.

3.10 INSPECTION AND TESTING

- 3.10.1 The Owner or Consultant will appoint an independent inspection and testing companies to make inspections or perform tests as the Consultant directs. The independent inspection and testing companies shall be responsible only to the Consultant and shall make only such inspections or tests as the Consultant may direct.

3.11 DEFECTIVE MATERIALS AND WORK

- 3.11.1 Where evidence exists, that defective Work has occurred or that Work has been carried out incorporating defective materials, the Consultant may have tests, inspections or surveys performed, analytical calculations of structural strength, made and the like, in order to help determine whether the Work must be corrected or replaced. Tests, inspections or surveys or calculations carried out under these circumstances will be made at the Contractor's expense, regardless of their results, which may be such that, in the Consultant's opinion, the Work may be acceptable.
- 3.11.2 All testing shall be conducted in accordance with the requirements of the Building Code, except where this would, in the Consultant's opinion, cause undue delay or give results not representative of the rejected material in place. In this case, the tests shall be conducted in accordance with the standards given by the Consultant.
- 3.11.3 Materials or Work which fail to meet the requirements Specified in the Contract Documents may be rejected by the Consultant whenever found at any time prior to the Total Performance of the Work regardless of previous inspection. If rejected, defective materials or Work shall be promptly removed and replaced or repaired to the satisfaction of the Consultant, at no expense to the Owner.

END OF SECTION 03 10 00

1 PART 1 – GENERAL

1.1 DEFINITIONS

1.1.1 The following Definitions shall apply in this Specification

1.1.2 Contract Documents

1.1.2.1 The Contract Documents consist of the Drawings, Specifications and Reports which form part of the agreed Contract.

1.1.3 Consultant

1.1.3.1 The Consultant is the Architect, SER, persons or entities engaged by the Owner. The term Consultant means the Consultant or the Consultant's authorized representative.

1.1.4 Contractor

1.1.4.1 The term Contractor is defined to include any of the following: Construction Manager, General Contractor, Structural Steel Erector, Structural Steel Fabricator, Subcontractor or Supplier.

1.1.5 Owner

1.1.5.1 The Owner is the person or entity identified as such in the Contract. The term Owner means the Owner or the Owner's authorized agent or representative, but does not include the Consultant.

1.2 WORK INCLUDED

1.2.1 Comply with Division 1 - General Requirements and all documents referred to therein.

1.2.2 Provide all labour, materials, plant and equipment to complete the steel reinforcement Work indicated in the Contract Documents and specified in this Section.

1.3 REFERENCE STANDARDS, CODES AND ACTS

1.3.1 Conform to the requirements of the local building code identified on the Structural General Notes as amended by all subsequent Regulations issued to the date of this Specification and applicable acts of authorities having jurisdiction.

1.3.2 All references to the Standards and publications noted below shall be to the edition referenced in the local building code identified on the Structural General Notes, or

to the edition referenced in the latest published editions or revisions of all Standards published by the Canadian Standards Association issued to the date of this Specification, whichever is the later edition or revision.

1.3.3 All references noted below, which are not referenced by the local building code or the Standards published by the Canadian Standards Association, shall be to the latest edition and revision published to the date of this Specification.

1.3.4 Standards and publications referenced by the Standards noted below are to apply even if they are not included in the list. Where such reference is made, it shall be to that latest edition and revision published to the date of this Specification.

1.3.4.1 ASTM A82/A82M Steel Wire, Plain, for Concrete Reinforcement.

1.3.4.2 ASTM A184/A184M Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.

1.3.4.3 ASTM A185/A185M Steel Welded Wire Reinforcement, Plain, for Concrete.

1.3.4.4 ASTM A496/A496M Steel Wire, Deformed, for Concrete Reinforcement.

1.3.4.5 ASTM A497/A497M Steel Welded Wire Reinforcement, Deformed, for Concrete.

1.3.4.6 ASTM A704/A704M Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement.

1.3.4.7 ASTM D3963/D3963M Fabrication and Jobsite Handling of Epoxy-Coated Steel Reinforcing Bars.

1.3.4.8 CSA A23.1/ CSA A23.2 Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete

1.3.4.9 CSA A23.3 Design of Concrete Structures.

1.3.4.10 CSA S304.1 Design of Masonry Structures

1.3.4.11 CSA A371 Masonry Construction for Buildings

1.3.4.12 CAN/CSA G30.18 Carbon Steel Bars for Concrete Reinforcement.

1.3.4.13 CAN/CSA G40.20/G40.21 General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

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| 1.3.4.14 | CSA S413 | Parking Structures |
| 1.3.4.15 | CSA W186 | Welding of Reinforcing Bars in Reinforced Concrete Construction. |
| 1.3.4.16 | RSIC (Reinforcing Steel Institute of Canada) – Manual of Standard Practice. | |
| 1.3.4.16.1 | Where there are differences between the Contract Documents and the codes, standards, or acts, the most stringent shall govern. | |
| 1.4 | QUALIFICATIONS | |
| 1.4.1 | The Contractor shall ensure that those responsible for welding reinforcement shall be certified by the Canadian Welding Bureau under the requirements of W186. | |
| 1.5 | SAMPLES AND ASSISTANCE | |
| 1.5.1 | Supply samples of the following materials, the cost of which shall be paid for by the Contractor: | |
| 1.5.3 | Replace samples removed from the Site as necessary | |
| 1.5.4 | Inform the Consultant when fabrication will be undertaken. Allow Consultant to access the fabricator's plant during fabrication process. | |
| 1.6 | SUBMITTALS | |
| 1.6.1 | Shop Drawings for Reinforcement | |
| 1.6.1.1 | The structural Drawings shall not be reproduced, in whole or in part, for use as shop drawings. | |
| 1.6.1.2 | Prepare reinforcement shop drawings and bar lists taking into account all openings and recesses shown on the architectural, structural, mechanical and electrical Drawings, and on the sleeving shop drawings prepared by all other Sections. | |
| 1.6.1.3 | Prepare shop drawings to a minimum scale of [1:50] or larger as deemed necessary by the Contractor. Shop drawings shall be clear and complete and shall allow placement of reinforcement without reference to the Contract Documents. | |
| 1.6.1.4 | Provide adequate space on all shop drawings immediately above the drawings title block for the Consultant's shop drawing review stamp. Where requested by the Consultant, the stamp is to be inserted by this section directly into the shop drawing prior to submission. The stamp shall be positioned in the same location on each shop drawing, and in no case shall the allocated space be less than | |

63 mm x 75 mm. Request the details of these requirements from the Consultant no less than 2 weeks before the commencement of shop drawings.

- 1.6.1.5 Detail reinforcement in accordance with the Contract Documents, CSA A23.1, CSA S413, CSA S304.1 and detailing standards in RSIC Manual of Standard Practice.
- 1.6.1.6 As a minimum, the shop drawings shall show the following:
 - 1.6.1.6.1 Bar sizes, spacing, lap lengths, location and quantities of reinforcement and welded wire fabric.
 - 1.6.1.6.2 Bar spacing requirements and provisions for spacers where required.
 - 1.6.1.6.3 Locations where reinforcement is considered to be bundled, as defined by CSA A23.1.
 - 1.6.1.6.4 Identification of each bar with a code mark corresponding to the bar lists.
 - 1.6.1.6.5 Detail sections to fully illustrate placement of concrete reinforcement at areas such as openings, change of levels, spandrel elements, and wherever else required.
 - 1.6.1.6.6 Large scale detail concrete sections at areas of steel concentrations such as at intersections of beams and columns, column splices or wherever else required.
 - 1.6.1.6.7 Placing sequence for areas with multiple layers of reinforcement.
 - 1.6.1.6.8 Minimum clearances between reinforcement and minimum concrete cover.
 - 1.6.1.6.9 Location, number, and type of support accessories, including support bars suitably sized and spaced to rigidly support the weight of reinforcement and imposed loads during construction. Where 10M top bars and welded wire fabric are shown in the Contract Documents, provide adequate supports to ensure that these bars are not bent or displaced prior to or during the concreting operation.
 - 1.6.1.6.10 Location and embedment of dowels.
- 1.6.1.7 Provide dowels for reinforced masonry walls (load bearing or non-load bearing) from slabs and walls. Coordinate location of walls with architectural Drawings.
- 1.6.1.8 Submit code marks or symbols used on reinforcement of each manufacturer so that the Consultant may identify grades and sizes of reinforcement.
- 1.6.2 Certificates

- 1.6.2.1 Reinforcement from Canadian Manufacture: Provide the Consultant with a certified copy of the mill test reports for reinforcing steel showing physical and chemical analysis. For weldable reinforcement, include verification of its weldability. Reports to be submitted a minimum of 4 weeks prior to commencing fabrication.
- 1.6.3 As-Built Drawings
 - 1.6.3.1 Mark on a complete set of final drawings any changes, additions, or deletions that occur during construction as a result of the Contractor's Work, change orders, or for any other reason.
 - 1.6.3.2 For all shop drawings marked "Reviewed as Noted" or "Revise and Resubmit", update and submit a record set of these drawings at the completion of the structural Work. Ensure that these drawings reflect the changes and are coordinated with the final drawings noted above.
- 1.7 **TOLERANCES**
 - 1.7.1 Perform fabrication and setting so that completed Work will be within the tolerances set out in CSA A23.1.
 - 1.7.2 These tolerances are acceptable with regard to structural requirements. Interfacing tolerances may not be compatible with the above. Review and coordinate interfacing tolerances so that the various elements come together properly.
- 2 **PART 2 – MATERIALS**
 - 2.1 **REINFORCEMENT**
 - 2.1.1 Reinforcing Steel, Deformed: Canadian manufacture to CAN/CSA-G30.18, billet steel, Grade 400R, regular bars, unfinished.
 - 2.1.2 Welded Steel Wire Reinforcement, Plain: ASTM A185/A185M, in flat sheets unfinished
 - 2.2 **ACCESSORIES**
 - 2.2.1 Minimum gauge as required for support of stability of steel reinforcement during reinforcement placement and concreting operation.
 - 2.2.2 Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions including load bearing pad on bottom to prevent vapour barrier puncture.

- 2.2.3 Special Chairs, Bolsters, Bar Supports, Spacers Adjacent to Weather Exposed Concrete Surfaces: Plastic coated steel type; size, and shape as required.
- 2.2.4 Special Bar Supports for Reinforced Soil/Rock: Use precast concrete supports for exposed concrete beams and soffits and concrete cast against soil/rock. Precast concrete supports shall be made of concrete quality, class and strength at least equal to that specified in the Contract Documents for the member in which they are used.
- 2.2.5 Special Chairs, Bolsters, Bar Supports, Parking Structures and other structures containing Class 'C1' concrete: Support Accessories to be an approved plastic or non-corroding type of chair, bolster or spacer of sufficient strengths to rigidly support the weight of reinforcement and construction loads. Do not use plastic coated tipped steel chairs.
- 3 **PART 3 – EXECUTION**
 - 3.1 **FABRICATION**
 - 3.1.1 Fabricate reinforcement in accordance with:
 - 3.1.1.1 CSA A23.1.
 - 3.1.1.2 RSIC - Reinforcing Steel Manual of Standard Practice.
 - 3.1.2 Locate reinforcement splices not indicated on the Drawings, at point of minimum stress. Review location of splices with the Consultant. Stagger splices to minimize cross sectional area at any one point in beams and walls.
 - 3.1.3 Unless noted otherwise in the Contract Documents, bend reinforcement once only and at room temperature of 18°C, do not straighten or rebend reinforcement and do not field bend reinforcement. Do not use bars with kinks or bends not shown on the Drawings. Replace bars which develop cracks or splits.
 - 3.2 **PLACEMENT**
 - 3.2.1 Prior to placing concrete, place support and secure reinforcement against displacement to CSA 23.1 and as indicated on reviewed placing drawings.
 - 3.2.2 Do not displace or damage vapour barrier during reinforcement placement.
 - 3.2.3 Accommodate placement of formed openings.
 - 3.2.4 Maintain concrete cover as noted on the Contract Documents.

- 3.2.5 Where continuous drop panels or slabs thickenings are noted on the Drawings, place bottom slab reinforcement in the bottom of the continuous drop panel or slab thickening, unless noted otherwise on the Drawings.
- 3.2.6 Provide splices only where shown on the Contract Documents or reviewed shop drawings. No other splices will be permitted without approval of the Consultant.
- 3.2.7 Lap ends and sides of welded wire fabric as noted on the Drawings, but in no case less than 300 mm.
- 3.2.8 Take particular care not to damage form sheathing surfaces during installation of reinforcement.
- 3.3 **QUALITY CONTROL**
- 3.3.1 Provide a system of quality control to ensure that the minimum standards specified in the Contract Documents are attained.
- 3.3.2 Bring to the attention of the Consultant any defects in the Work or departures from the Contract Documents which may occur during Construction. The Consultant will decide upon corrective action and give recommendations in writing.
- 3.3.3 The Consultant's general review during construction and inspection and testing by the independent inspection and testing companies are both undertaken to inform the Owner of the Contractor's performance and shall in no way augment the Contractor's quality control or relieve the Contractor of its contractual responsibilities with respect to quality control.
- 3.3.4 Prior to commencing significant segments of the Work, give the Consultant and independent inspection and testing companies appropriate notification so as to afford them reasonable opportunity to review the Work. Failure to meet this requirement may be cause for the Consultant to classify the Work as defective.
- 3.4 **INSPECTION AND TESTING**
- 3.4.1 The Owner or Consultant will appoint the independent inspection and testing companies to make inspections or perform tests as the Consultant directs. The independent inspection and testing companies shall be responsible only to the Consultant and shall make only such inspections or tests as the Consultant may direct.
- 3.4.2 When defects are revealed, the Consultant may request, at the Contractor's expense, additional inspection or testing to ascertain the full extent of the defect.

3.5 DEFECTIVE MATERIALS AND WORK

- 3.5.1 Where evidence exists, that defective Work exists or that Work has been carried out incorporating defective materials, the Consultant may have tests, inspections or surveys performed, analytical calculations of structural strength made, and the like, in order to help determine whether the Work must be replaced. Tests, inspections or surveys or calculations carried out under these circumstances will be made at the Contractor's expense, regardless of their results, which may be such that, in the Consultant's opinion, the Work may be acceptable.
- 3.5.2 All testing shall be conducted in accordance with the requirements of the Building Code, except where this would, in the Consultant's opinion, cause undue delay or give results not representative of the rejected material in place. In this case, the tests shall be conducted in accordance with the standards given by the Consultant.
- 3.5.3 Materials or Work which fails to meet the requirements specified in the Contract Documents may be rejected by the Consultant whenever found at any time prior to the Total Performance of the Work regardless of previous inspection. If rejected, defective materials or Work shall be promptly removed and replaced or repaired to the satisfaction of the Consultant, at no expense to the Owner.

END OF SECTION 03 20 00

1 PART 1 – GENERAL

1.1 DEFINITIONS

1.1.1 The following Definitions shall apply in this Specification:

1.1.2 Contract Documents

1.1.2.1 The Contract Documents consist of the Drawings, Specifications and Reports which form part of the agreed Contract.

1.1.3 Consultant

1.1.3.1 The Consultant is the Architect, SER, persons or entities engaged by the Owner. The term Consultant means the Consultant or the Consultant's authorized representative.

1.1.4 Contractor

1.1.4.1 The term Contractor is defined to include any of the following: Construction Manager, General Contractor, Structural Steel Erector, Structural Steel Fabricator, Subcontractor or Supplier.

1.1.5 Owner

1.1.5.1 The Owner is the person or entity identified as such in the Contract. The term Owner means the Owner or the Owner's authorized agent or representative but does not include the Consultant.

1.2 WORK INCLUDED

1.2.1 Comply with Division 1 - General Requirements and all documents referred to therein.

1.2.2 Provide all labour, materials, plant, and equipment to complete the cast-in-place concrete Work indicated on the Drawings and specified in this Section.

1.3 RELATED WORK SPECIFIED ELSEWHERE

1.3.1 Concrete Forming, Section 03 10 00 – Concrete Forming.

1.3.2 Concrete Reinforcement, Section 03 20 00 – Concrete Reinforcement.

1.4 REFERENCE STANDARDS, CODES AND ACTS

- 1.4.1 Conform to the requirements of the local building code identified on the Structural General Notes as amended by all subsequent Regulations issued to the date of this Specification and applicable acts of authorities having jurisdiction.
- 1.4.2 All references to the Standards and publications noted below shall be to the edition referenced in the local building code identified on the Structural General Notes, or to the edition referenced in the latest published editions or revisions of all Standards published by the Canadian Standards Association issued to the date of this Specification, whichever is the later edition or revision.
- 1.4.3 All references noted below, which are not referenced by the local building code, or the Standards published by the Canadian Standards Association, shall be to the latest edition and revision published to the date of this Specification.
- 1.4.4 Standards and publications referenced by the Standards noted below are to apply even if they are not included in the list. Where such reference is made, it shall be to that latest edition and revision published to the date of this Specification.
- 1.4.4.1 CSA A23.1/ CSA A23.2 Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete
- 1.4.4.2 CSA A23.3 Design of Concrete Structures
- 1.4.4.3 CSA A3000 Cementitious Materials Compendium.
- 1.4.5 Where there are differences between the Specifications and Drawings and the codes, standards, or acts, the most stringent shall govern.
- 1.5 **TOLERANCES**
- 1.5.1 Perform placing operations so that completed Work will be within the tolerances set out in CSA A23.1.
- 1.5.2 Variations in building lines which result in extension of the building over lot lines or restriction lines will not be permitted.
- 1.5.3 These tolerances are acceptable with regard to structural requirements. Interfacing tolerances may not be compatible with the above. Review and coordinate interfacing tolerances so that the various elements come together properly.
- 1.6 **QUALIFICATIONS**
- 1.6.1 The 'foreperson' or 'lead hand' supervising the placement, consolidation, finishing and curing of the concrete shall be certified under an industry recognized concrete

finishing program, such as the ACI Concrete Flatwork Finisher/Technician Certification Program.

1.6.2 The concrete supplier shall be certified by the Ready Mixed Concrete Association of Ontario (RMCAO) and shall hold a current “Certificate of Ready Mixed (or Mobile Mix) Concrete Production Facilities” as issued by the RMCAO.

1.6.3 Where concrete toppings are specified in the Contract Documents, the Contractor shall ensure that the concrete flooring contractor assumes responsibility for all aspects of the topping construction. This will include, but is not limited to the base course or substrate preparation, review of concrete mix design, concrete supply, bonding agents, placing, finishing, and curing etc.

1.7 **CONCRETE MIX DESIGN**

1.7.1 Design of Concrete Mixes

1.7.1.1 Concrete mixes are to be designed in accordance with the Performance Alternative outlined in CSA A23.1. The mixes shall be designed such that they will be homogeneous, uniformly workable, readily placeable into corners and angles of forms and around reinforcement by the methods of placing and consolidation employed on the Work, but without permitting materials to segregate or without permitting excessive free water to collect on the surface. The concrete, when hardened, shall have the qualities specified in the Contract Documents and in the concrete mix design.

1.7.1.2 When designing the concrete mixes, the Contractor shall ensure that the supplier is cognizant of the curing requirements outlined in the Contract Documents and CSA A23.1. If a particular concrete mix requires curing in addition to that specified, the Contractor shall be responsible for providing this additional curing.

1.7.1.3 Specified Strength: As called for on Drawings. Where walls are integral with columns of different specified strengths, cast walls and columns with concrete of the higher specified strength.

1.7.1.4 Modulus of Elasticity (E): For each concrete mix design, the Modulus of Elasticity, shall not to be less than $(3300\sqrt{f'c} + 6900) \times (\gamma_c/2300)^{1.5}$ MPa.

1.7.1.5 Fly Ash: The use of fly ash in concrete that will be exposed to view or in concrete that will be exposed to freeze-thaw cycles or de-icing chemicals is subject to review and acceptance by the Consultant.

1.7.1.6 Use of calcium chloride shall not be permitted.

- 1.7.1.7 The Contractor shall coordinate the mix designs for suitability with concrete pumping.
- 1.7.1.8 The Contractor shall design concrete mixes, so they maintain their workability based on assumed minimum discharge and placing rates.
- 1.8 **SAMPLES AND ASSISTANCE**
- 1.8.1 Concrete Test Cylinders
- 1.8.1.1 Supply materials for concrete test cylinders, the cost of which shall be paid for by the Contractor.
- 1.8.1.2 Cooperate in the execution of the concrete quality testing program. Furnish concrete required, protect specimens against injury and loss, and assist in the sampling and storage of specimens, as required.
- 1.8.1.3 Sample concrete, cast cylinders and store in accordance with CSA A23.1 where directed by the Consultant.
- 1.8.1.4 For all concrete compressive strength tests, 100mm x 200mm cylinders shall be used.
- 1.8.1.5 In accordance with requirements of CSA A23.1, provide storage facilities with continuous power supply for a Site storage container for test cylinders.
- 1.8.1.6 Provide sufficient field curing storage facilities so that cylinders representing the various areas can be safely stored in locations representing the curing conditions for those areas. Move the field cured cylinder storage facilities from area to area as the Work progresses.
- 1.8.2 Pullout Tests
- 1.8.2.1 If requested by the Consultant, install pullouts to the requirements of the inspection and testing company.
- 1.8.2.2 Installation of pullouts shall comply with the requirements of ASTM C900 and ACI 228.1.
- 1.8.3 Maturity Tests
- 1.8.3.1 If pull-out tests are required, maturity meters shall be used to determine when pullout tests can be made.
- 1.8.3.2 Installation, equipment, and procedures shall comply with ACI 228R.

1.8.4 Substrate (Soil/Rock) Inspection

1.8.4.1 Assist the geotechnical Consultant in making their inspections or tests.

1.9 **SUBMITTALS**

1.9.1 Surveys

1.9.1.1 Submit surveys in accordance with Section 03 10 00 - Concrete Forming

1.9.2 Certificates

1.9.2.1 The Contractor shall ensure that the concrete supplier submits a current
"Certificate of Ready Mixed (or Mobile Mix) Concrete Production Facilities," as
issued by the RMCAO.

1.9.2.2 Prior to beginning Work and when any change in materials or source of supply is
proposed, provide the following certificates prepared by an independent inspection
company;

1.9.2.2.1 Certification that all raw materials used in the production of concrete proposed for
the Work comply with the requirements of the Specifications and CSA A23.1.

1.9.2.2.2 Certification that compressive strength, slump, entrained air content, and other
specified properties will be met, using the proposed mixes.

1.9.2.2.3 Certification that classes of exposure C-1, A-1 and C-XL will meet the 56-day limits
specified in CSA A23.1 for the rapid chloride permeability test, using the proposed
mixes.

1.9.2.2.4 Certification that the chloride ion content in the concrete, before exposure, shall
not exceed 0.06% by mass of the cementing materials.

1.9.2.3 The Contractor shall ensure that the concrete supplier submits representative
chloride permeability test data distributed over a period of 56 days for concrete
exposure classes C-1, A-1 and C-XL with and without calcium nitrite corrosion
inhibitor or any other admixture containing ionic salts.

1.9.2.4 The Contractor shall ensure that the concrete supplier submits their most current
"Concrete Mix Design Statistical Analysis" records for the proposed concrete plant.
These records shall indicate the concrete supplier's average strength, standard
deviation, coefficient of variation and target strength, as per the requirements of
CSA-A23.1 and the RMCAO.

1.9.3 Concrete Mix Designs

- 1.9.3.1 Well in advance of the supply of concrete to the project submit, using the standard RMCAO form for Concrete Mix Design Submissions, all concrete mix designs for review. The mix designs shall include, as a minimum the following information:
 - 1.9.3.1.1 Concrete strength;
 - 1.9.3.1.2 Exposure class;
 - 1.9.3.1.3 Water-cement ratio;
 - 1.9.3.1.4 Maximum aggregate size;
 - 1.9.3.1.5 Maximum SCM replacement;
 - 1.9.3.1.6 Additional durability and architectural requirements;
 - 1.9.3.1.7 Slump range;
 - 1.9.3.1.8 Plastic air range;
 - 1.9.3.1.9 Method of placement;
 - 1.9.3.1.10 Dosage of corrosion inhibitor;
 - 1.9.3.1.11 Class of HVSCM (1 or 2);
 - 1.9.3.1.12 Other specific information regarding the source and type of all materials being proposed;
 - 1.9.3.1.13 Source of Supplementary Cementing Materials (SCM's).
 - 1.9.3.1.14 Assumed minimum discharge and placing rates.
- 1.9.3.2 Describe in detail on the mix design summary, the location(s) where each mix is to be placed in the structure.
- 1.9.4 Concrete Quality Plan
 - 1.9.4.1 At least four weeks prior to the supply of concrete to the project, submit a complete "Concrete Quality Plan", in the format provided by the Ready Mixed Concrete Association of Ontario.
- 1.9.5 Sloped Concrete Slabs
 - 1.9.5.1 Well in advance of construction, submit complete details of placing and compaction procedures for sloping roofs, including details of construction, and placing of top forms and top form panel.

1.9.6 Curing Procedures

1.9.6.1 At least four weeks prior to implementation in the field, submit a detailed description of the procedures which will be employed to cure the structure.

1.9.6.2 As a minimum, the procedures shall indicate:

1.9.6.2.1 The method for protecting the concrete from evaporation of surface moisture from the fresh concrete;

1.9.6.2.2 The type of curing method to be used;

1.9.6.2.3 Details of how various surfaces will be cured (slabs, walls, columns, ramps etc.)

1.9.6.2.4 How the surface will be kept moist, and the quality control requirements for keeping the surface moist;

1.9.6.2.5 The time of initiation and duration of curing;

1.9.6.2.6 Provisions to address potential problems such as high winds and hot and cold weather;

1.9.6.2.7 The limitations of access, if any, to the surfaces being cured; and

1.9.6.2.8 A Quality assurance/Quality control program detailing how the curing program will be implemented, monitored, and documented.

1.9.6.3 Submit a 300mm x 300mm sample of each type of material (absorptive mat, fabric, plastic film, waterproof paper etc.) which will be used to cure the concrete.

2 **PART 2 - PRODUCTS**

2.1 **MATERIALS**

2.1.1 Concrete: Normal density concrete with an air-dry density between 2350 and 2450 kg/m³. Conform to CSA A23.1.

2.1.2 Cement Type: GU General Use Portland Cement.

2.1.3 Supplementary Cementing Materials: Conform to CSA.A3001 Fly Ash, Type F, CI, CH, Ground Blast Furnace Slag, Type S, Silica Fume, Type SF.

2.1.4 Water: Clean, potable, and not detrimental to concrete.

2.1.5 Nominal Size of Coarse Aggregate: 20 mm, except as noted below.

- | | | | |
|----------|--|---|----------|
| 2.1.5.1 | Use pea gravel (5 mm to 10 mm) where concentration of reinforcement requires the use of a smaller diameter aggregate. | | |
| 2.1.5.2 | Use 10 mm (maximum) aggregate in toppings that are less than or equal to 75 mm in thickness, and 20 mm aggregate in toppings greater than 75 mm in thickness. | | |
| 2.1.6 | Admixtures: Conform to CSA A23.1. | | |
| 2.1.6.1 | Corrosion Inhibitor Admixture: Calcium nitrite-based corrosion inhibitor, such as "DCI" or "DCI(S)" by W.R. Grace & Co. (or approved equivalent), shall be added at the rate of 10.1 litres per cubic metre of concrete, to all concrete designated Exposure Class 'C-1', unless noted otherwise in the Contract Documents. The corrosion inhibitor shall contain 30 ± 3 percent of calcium nitrite by weight. The selection of "DCI" or "DCI(S)" (or approved equivalent) shall be as directed by the admixture supplier, based on anticipated placing and curing conditions and the specific concrete mix design selected. | | |
| 2.1.7 | Shrinkage Control Fibres: "Dramix" steel fibres by Bekaert or approved equivalent, 60/1.05. | | |
| 2.1.8 | Bonding Agent: Use Sika Sikdur 32 epoxy bonding agent for all bonded topping installations. | | |
| 2.1.9 | Curing Compound: Conform to CSA A23.1. | | |
| 2.1.10 | Grout Beneath Base Plates: Non-shrink flowable grout in-Pakt by King Construction Products or approved equivalent, having a compressive strength at 28 days of at least 35 MPa. Where grout is exposed to view or weather, use non-ferrous grout. | | |
| 2.1.11 | Water Storage Tanks/Water Tight Construction | | |
| 2.1.11.1 | Cement: Type LH low heat of hydration Portland Cement in accordance with CSA A3000. Alternative use of supplementary cementing materials and chemical admixtures is subject to review by the Consultant. | | |
| 2.1.11.2 | Air Entrainment: 6% plus or minus 1% | | |
| 2.1.11.3 | Compressive Strength: 28 MPa minimum at 28 days. | | |
| 2.1.12 | Unshrinkable Fill | | |
| 2.1.12.1 | Cement type-General Use GU Portland | | |
| 2.1.12.2 | Minimum 24 hour strength | - | 0.07 MPa |
| 2.1.12.3 | Maximum 28 day strength | - | 0.4 MPa |

2.1.12.4	Class of exposure	-	Not Applicable
2.1.12.5	Size of coarse aggregate	-	20 mm to 40 mm
2.1.12.6	Slump at point of discharge	-	150 mm to 200 mm
2.1.12.7	Calcium chloride or pozzolanic mineral admixtures shall not be used. Air entraining admixtures may be added if desired by the Contractor.		
2.1.13	Sealant for Exposed Separation Strips, Construction Joints, and Temporary Opening Joints: Multi-Component Polyurethane 'Sikaflex 2C-SL' by Sika, or an equivalent approved by the Consultant.		
3	PART 3 - EXECUTION		
3.1	GENERAL		
3.1.1	Ensure minimum concrete discharge and placing rates are maintained to avoid unexpected cold joints from forming in the structure.		
3.2	PRE POUR MEETING		
3.2.1	Prior to the initial supply of concrete to the project, the Contractor must schedule a "pre-pour meeting" as outlined in the concrete supplier's concrete quality plan.		
3.3	FOOTINGS		
3.3.1	During cold weather conditions, carefully protect footing bases from freezing.		
3.3.2	Founding elevations shown in the Contract Documents are based upon the geotechnical investigation.		
3.3.3	Founding elevations and allowable bearing capacities must be verified by the geotechnical Consultant before footing concrete is placed.		
3.3.4	If, upon excavating to the elevations shown in the Contract Documents, the required bearing capacities are not achieved, or if they are achieved at a higher elevation, inform the Consultant who will provide instructions as to how to proceed.		
3.3.5	Record actual footing founding elevations.		
3.3.6	Construct footings in a particular area commencing from the lowest footing elevation and proceeding to the higher elevations.		

- 3.3.7 Remove water, disturbed soil and foreign matter from footing excavations before placing concrete. Do not permit the soil at founding elevations to soften due to the presence of water in the excavations or construction activity.
- 3.3.8 During cold weather, prevent soil adjacent to and beneath all footings from freezing. Do not pour footings on frozen soil or soil which has been allowed to freeze. If the soil at founding elevations is frozen or was frozen and thawed, remove affected material and found footings on unaffected soil with the required characteristics at no extra cost to the Owner.
- 3.3.9 Record actual pile cap founding elevations.
- 3.3.10 Where excavations for mechanical or electrical services, pits, adjacent foundations, and the like encroach upon a 7 in 10 slope noted above between corners of footings and bottom corners of excavations, lower footings a suitable amount so as not to exceed the slope noted above at no extra cost to the Owner.

3.4 **CONSTRUCTION JOINTS**

- 3.4.1 Obtain approval from the Consultant for location and details of construction joints not shown on the structural Drawings.
- 3.4.2 Provided proper placing, curing and protection means and methods are employed by the Contractor, the maximum length/height of concrete pours shall be as follows.
- 3.4.2.1 The maximum length of a suspended concrete slab pour shall be 40 m.
- 3.4.2.2 The maximum length of a concrete slab on steel deck pour shall be 30 m.
- 3.4.2.3 The maximum length of a slab-on-grade pour shall be 30 m.
- 3.4.2.4 The maximum length of a concrete foundation wall pour shall be 15 m.
- 3.4.2.5 The maximum height of a concrete pour shall be 4.5 m.
- 3.4.3 If the construction joints (including joints around temporary openings) will be exposed in its permanent condition, such as in a Parking Garage, the joints must be caulked as outlined in this Specification.

3.5 **SLABS-ON-GRADE**

- 3.5.1 General
- 3.5.1.1 Do not place concrete slab-on-grade until the specified sub-floor material has been placed, inspected and approved.

- 3.5.1.2 Do not place concrete on a frozen sub-grade, or on one that contains frozen materials.
 - 3.5.1.3 Do not place concrete on a sub-grade that has been frozen and thawed until the sub-grade has been reviewed by the geotechnical Consultant and approved. If, in the geotechnical consultant's opinion, the safe bearing capacity of the sub-grade has been reduced to below 25 kPa, remove the affected materials and replace with compacted granular fill at no additional cost to the Owner.
 - 3.5.1.4 Place clear crushed stone over the sub-base, to depths indicated in the Contract Documents. Thoroughly roll and consolidate to the lines and levels required, with a maximum surface variation of +/- 10mm.
 - 3.5.1.5 Upon approval of the placement of the sub-floor material and setting of reinforcement, place and consolidate concrete and finish and cure as specified in this Section.
 - 3.5.1.6 Place a bond breaker, minimum 1 layer of building paper between edges of slab-on-grade and abutting surfaces. Where slab-on-grade is exposed to de-icing chemicals, provide an approved sealant at the joint between the slab-on-grade and abutting surfaces.
 - 3.5.1.7 Saw-cut slabs-on-grade as shown in the Contract Document, or to the Consultant's approval.
 - 3.5.1.8 Carry out cutting in accordance with recommendations contained in CSA A23.1.
 - 3.5.1.9 Mask edges of saw-cuts as required to prevent concrete floors from becoming stained.
 - 3.5.1.10 Construction joints may be provided in slabs-on-grade so that pours on any one day may be kept to reasonable sizes. Locate construction joints to the Consultant's approval.
- 3.6 **SEPARATION STRIPS**
- 3.6.1 Place concrete in the separation strips after concrete in adjacent areas has aged for the duration noted on the Drawings.
 - 3.6.2 If the separation strip will be exposed in its permanent condition, the joints must be caulked as outlined in this Specification.

3.7 UNSHRINKABLE FILL

3.7.1 Unshrinkable fill is intended for use locally in place of granular backfill below slabs-on-grade or within excavations where compaction of granular material is difficult to achieve. It is not intended for use below footings or around foundation walls, tunnels, laterally loaded caissons, etc., where vertical and/or lateral structural bearing capacities are required. Obtain written approval from the Consultant prior to using unshrinkable fill.

3.7.2 The unshrinkable fill material shall flow into the excavation so that it fills the entire space. Care shall be taken to ensure that no air is entrapped beneath horizontal projections or in other locations within the excavation.

3.7.3 Where bracing, shoring and/or sheeting is used to support the sides of the excavation or to prevent movements that could damage other services or adjacent pavements, this support system shall be removed as backfilling proceeds.

3.8 CONCRETE WORK AT EXISTING STRUCTURE

3.8.1 Before proceeding with any Work in or adjacent to the existing structure, verify that conditions are as indicated on the Drawings. If they are not, advise the Consultant of discrepancies and do not proceed until the Consultant has given instructions.

3.8.2 Prior to proceeding with the Work, determine the exact founding elevations of existing footings adjacent to the new Work. Report these findings to the Consultant before proceeding further.

3.8.3 Where openings are shown to be cut into the existing structure in the Contract Documents, drill at corners and saw cut remainder such that saw cuts do not extend into structure to be retained. Overcutting may require major structural strengthening, the cost of which shall be borne by the Contractor.

3.9 SLOPING SLABS

3.9.1 In the case of sloping slabs, employ suitable concrete placing and compaction procedures to ensure that completed concrete has the specified design characteristics, and in particular, to prevent movement of plastic concrete resulting in cracking, loss of bond, etc.

3.10 PLACING CONCRETE

3.10.1 Place all concrete in accordance with CSA A23.1, the concrete supplier's requirements and as specified in this Section.

- 3.10.2 Immediately before placing concrete, clean forms and reinforcement of foreign matter.
- 3.10.3 Discharge concrete into forms in accordance with the time frames specified in CSA A23.1.
- 3.10.4 Prior to pouring the concrete elements directly supported above, remove sonotube forms to such an extent to allow the Consultant to review the quality of any exposed column surface. Provide necessary protection to the exposed surfaces upon completion of review.
- 3.10.5 Place concrete on steel deck floors in a manner that avoids piling up of concrete. Do not drop concrete directly from buckets but employ suitable means of distribution. Wet down deck during hot weather prior to concreting.
- 3.10.6 Remove concrete spilled onto forms around hoisting equipment before depositing concrete in these areas.
- 3.10.7 Pumping Concrete
 - 3.10.7.1 Pumping or pneumatic placing of concrete shall only be used if the velocity of discharge is reduced to a point where no separation or scattering of the concrete occurs, and the consistency of the mix has been designed to allow such a system with no adverse effects on the quality of concrete.
 - 3.10.7.2 The shotcrete process shall be deemed as being in contravention of the above clause.
 - 3.10.7.3 Excess grout or mortar used to lubricate pipelines, or washout water, must not be discharged into the forms.
- 3.10.8 Shotcrete
 - 3.10.8.1 The use of shotcrete to construct any part of the Work shall be at the sole discretion of the Consultant.
- 3.11 **CURING CONCRETE**
 - 3.11.1 Cure all concrete in accordance with CSA A23.1, the concrete supplier's requirements and as specified in this Section.
 - 3.11.2 HVSCM Concrete
 - 3.11.2.1 Cure all HVSCM concrete in accordance with the requirements of CSA A23.1. Wet curing shall commence immediately after placement and finishing of concrete.

3.11.3 Wet Curing

3.11.3.1 The following provisions apply to the Slabs.

3.11.3.2 Basic Curing Period - the concrete shall be protected from premature drying and extremes of temperatures and shall be wet cured at a temperature of at least 10°C for a period of three (3) consecutive days. Wet curing shall commence immediately after placement and finishing of the concrete.

3.11.3.3 Additional Curing for Durability - Immediately following the Basic Curing Period, continue to wet cure the concrete (at a minimum temperature of 10°C for an additional four (4) consecutive days or until the concrete reaches 70% of its 28 day compressive strength, whichever is greater.

3.11.3.4 Wet curing is to be achieved using one or more of the techniques outlined in CSA A23.1.

3.11.3.5 If an absorptive mat or fabric material is used, it is imperative that it be kept continuously wet, by means of sprinklers, soaker hoses, a layer of polyethylene sheeting above, or another acceptable means.

3.11.3.6 The use of curing compounds shall not be permitted in these areas.

3.11.4 C-XL Concrete

3.11.4.1 All C-XL (extended service life concrete) shall be wet cured at a temperature of at least 10°C for a period of seven consecutive days and for a time necessary to attain 70% of the specified compressive strength, whichever is greater. Wet curing shall commence immediately after placement and finishing of concrete.

3.12 **PROTECTION**

3.12.1 Protect all concrete in accordance with CSA A23.1, the concrete supplier's requirements and as specified in this Section; to prevent freshly deposited concrete from adverse conditions such as high winds, precipitation, freezing, being exposed to abnormally high temperatures or temperature differentials, premature drying, and moisture loss, for a period of time necessary to develop the specified properties of the concrete.

3.12.2 Take care in concrete mix design and sequencing of concrete Work to avoid damage, to concrete that is aged between early and final concrete setting time, due to external vibrations from blasting, pile drilling, or other similar sources.

3.12.3 Cold Weather Concreting

- 3.12.3.1 Between the 15th of October of any year and the 15th of April of the following year, or when the temperature is at or below 5°C or anticipated to fall below 5°C within 24 hours of placing concrete, provide on hand and ready for use all equipment necessary for adequate cold weather protection and curing before concrete placement is begun.
- 3.12.3.2 When fresh concrete is to be cast against existing concrete, prevent the loss of heat by extending the protection for the fresh concrete over the existing concrete.
- 3.12.3.3 Insulate, or enclose within the protective housing, tie rods, reinforcement or metal which projects from the concrete being protected.
- 3.12.3.4 Construct enclosures tight and safe for wind and snow loadings.
- 3.12.3.5 Maintain housing, enclosures and supplementary heat in place for entire period of protection, except that sections may be temporarily removed as required to permit placing additional forms or concrete provided the uncovered concrete is not permitted to freeze. Make up time lost from the required period of protection at the required temperature before protection is discontinued and removed. Protection is not to be completely removed until the concrete has cooled to within the temperature differential limits specified in CSA A23.1.
- 3.12.3.6 Locate heating units to avoid heating concrete locally or drying it excessively. Avoid high temperature and dry heating within enclosures.
- 3.12.3.7 Take particular care to maintain edges and corners of concrete at the required temperature owing to their greater vulnerability to freezing.
- 3.12.3.8 Provide sufficient insulation, and heat as necessary, to prevent freezing of frost susceptible soil which lies against structural elements; in particular protect soil beneath footings and behind foundation walls until the building is completed.
- 3.12.4 Hot Weather Concreting
 - 3.12.4.1 When the rate of moisture evaporation exceeds 0.5kg/m² per hour or when the temperature is greater than or equal to 27°C, employ the following measures in addition to the requirements of CSA A23.1:
 - 3.12.4.1.1 Use ice as mixing water, or an approved equivalent temperature reducing or set retarding admixture to lower the concrete temperature.
 - 3.12.4.1.2 Dispatch ready-mix trucks and organize Work to keep mixing time to a minimum. Minimize exposure of mixing trucks to the hot sun while waiting. Water shall be made available to spray the exterior of the drum while the truck is waiting to discharge its concrete.

- 3.12.4.1.3 Provide adequate personnel and organize Work to keep placing time to a minimum.
- 3.12.4.1.4 Place concrete in layers thin enough and areas small enough so that the time interval for placing is reduced and compaction will ensure complete union of adjacent portions.
- 3.12.4.1.5 With formed concrete, reliance shall not be placed on the forms alone to provide curing. Spray formwork with water to keep it tight and free from cracking.
- 3.12.5 Protection of Completed Work
- 3.12.5.1 At all times during the Work, protect exposed concrete, exposed masonry and other exposed members from staining or becoming coated with concrete leakage due to continuing concreting operations. Members which become coated may be classed as defective by the Consultant.
- 3.12.5.2 Protect exposed members from staining due to rusting of reinforcement projecting beyond construction joints.
- 3.12.5.3 Take suitable measures to prevent spalling and cracking damage occurring to the structure due to water freezing in expansion joints, small holes, slots, depressions and take suitable measures to prevent damage occurring to foundations and the like due to frost action in the soil or backfill.
- 3.12.5.4 The application of de-icing salts on completed Work is not permitted.
- 3.13 **OPENINGS THROUGH COMPLETED MEMBERS**
- 3.13.1 Do not cut openings through completed members without the Consultant's approval.
- 3.13.2 Where the location of openings is approved, locate the reinforcement by x-ray, cover meter or other positive means as required by the Consultant and adjust the location of the opening so that no reinforcement is cut unless specifically approved otherwise in writing by the Consultant.
- 3.13.3 In the case of precast concrete slabs, holes shall be cut or drilled only by the precast concrete Contractor.
- 3.14 **MAKING GOOD**
- 3.14.1 Make good temporary openings left in concrete construction around pipes, ducts and the like using a mortar of the same proportions as the surrounding Work. Reinforce mortar with welded wire fabric where openings exceed 75 mm. Roughen

existing surfaces to receive mortar or apply suitable bonding agent such that mortar will be securely bonded to existing concrete.

3.15 GROUTING BENEATH BASE PLATES

3.15.1 Grout beneath plates bearing on concrete with an approved non-shrink flowable grout. Comply with the manufacturer's directions for mixing and placing grout. Completely fill voids below plates. Fill voids left by shims after shims are removed.

3.15.2 During cold weather, preheat base plates and footings and maintain temperature at minimum 12°C for 6 days after grouting.

3.15.3 Refer to Section 05 12 00 – Structural Steel for lifting of base plates to determine adequacy of grouting. If defects are found, more base plates will be raised.

3.16 TREATMENT OF FORMED SURFACES

3.16.1 Do Work in accordance with CSA A23.1 and as follows:

3.16.1.1 Remove traces of form lining compound from concrete surfaces which may affect the bonding of following surface application.

3.17 QUALITY CONTROL

3.17.1 Implement a system of quality control to ensure that the minimum standards specified in this Section are attained.

3.17.2 Adhere to the requirements of the project “Concrete Quality Plan” prepared and submitted as required by this Specification.

3.17.3 Bring to the attention of the Consultant any defects in the Work or departures from the Contract Documents which may occur during Construction. The Consultant will decide upon corrective action and will provide recommendations in writing.

3.17.4 The Consultant's general review during construction and inspection and testing by independent inspection and testing agencies reporting to the Consultant are both undertaken to inform the Owner of the Contractor's performance and shall in no way augment the Contractor's quality control or relieve the Contractor of its contractual responsibility.

3.18 NOTIFICATION

3.18.1 Prior to commencing significant segments of the Work, give the Consultant and independent inspection and testing companies appropriate notification so as to

afford them reasonable opportunity to review the Work. Failure to meet this requirement may be cause for the Consultant to classify the Work as defective.

3.19 **INSPECTION AND TESTING**

3.19.1 Appointment of Independent Inspection and Testing Companies

3.19.1.1 The Owner or Consultant will appoint the independent inspection and testing companies to make inspections or perform tests as the Consultant directs. The independent inspection and testing companies shall be responsible only to the Consultant and shall make only such inspections or tests as the Consultant may direct.

3.19.1.2 When defects are revealed, the Owner may request, at the Contractor's expense, additional inspection or testing to ascertain the full extent of the defect.

3.19.2 Concrete Quality Tests

3.19.2.1 Concrete quality tests shall be carried out in accordance with CSA A23.1 and shall include the following:

3.19.2.1.1 Slump

3.19.2.1.2 Air content of fresh concrete

3.19.2.1.3 Temperature of fresh concrete

3.19.2.1.4 Compressive strength

3.19.2.1.5 Density (for low-density and semi-low-density concrete only)

3.19.2.1.6 Flexural strength

3.19.2.1.7 Splitting tensile strength

3.19.2.1.8 Chloride permeability

3.19.2.2 Cement and Aggregates: The Consultant may make tests on these materials as deemed necessary during the Work.

3.19.2.3 Compressive Strength Tests: Compressive cylinder testing will be carried out in accordance with CSA A23.1 and as follows: Three companion laboratory cured concrete standard compression test cylinders; one tested at 7 days and two tested at 28 days, constitute a strength test. During the placing of concrete in cold weather one additional field cured test cylinder will be made and tested at 7 days.

3.19.2.4 High Strength Concrete and HVSCM Concrete: Compressive cylinder testing will be carried out in accordance with CSA A23.1 and as follows: Four companion laboratory cured concrete standard compression test cylinders; one tested at 7 days, one tested at 28 days and two tested at 56 or 91 days, whichever is the specified test age. In addition, two accelerated test cylinders shall be made and tested in accordance with Standard CSA A23.2.

3.19.3 Grout under Baseplates: At least one strength test may be made each day that grout is placed under baseplates.

3.19.4 Inspection of Substrate (Soil/Rock)

3.19.4.1 Substrate (Soil/Rock) at footing founding elevations will be inspected.

3.20 **DEFECTIVE MATERIALS AND WORK**

3.20.1 Where evidence exists that defective Work has occurred or that Work has been carried out incorporating defective materials, the Consultant may have tests, concrete coring, inspections or surveys performed, analytical calculations of structural strength made and the like in order to help determine whether the Work must be repaired or replaced. Tests, inspections or surveys or calculations carried out under these circumstances will be made at the Contractor's expense, regardless of their results, which may be such that, in the Consultant's opinion, the Work may be acceptable.

3.20.2 All testing shall be conducted in accordance with the requirements of the local building code identified on the Structural General Notes, except where this would in the Consultant's opinion cause undue delay or give results not representative of the rejected material in place. In this case, the tests shall be conducted in accordance with the standards given by the Consultant.

3.20.3 Materials or Work which fails to meet the requirements specified in the Contract Documents may be rejected by the Consultant whenever found at any time prior to the Total Performance of the Work regardless of previous inspection. If rejected, defective materials or Work shall be promptly removed and replaced or repaired to the satisfaction of the Consultant, at no expense to the Owner.

END OF SECTION 03 30 00

1 PART 1 – GENERAL

1.1 WORK INCLUDED

1.1.1 Comply with Division 1, General Requirements and all documents referred to therein.

1.1.2 Provide all labour, materials, plant, and equipment to complete the fastening into cast-in-place concrete indicated on the drawings and specified herein.

1.1.3 This specification applies to both normally reinforced concrete and to post-tensioned concrete.

1.2 RELATED WORK SPECIFIED ELSEWHERE

1.2.1 Concrete Reinforcement, Section 03 20 00.

1.2.2 Cast in Place Concrete, Section 03 30 00.

1.3 REFERENCE STANDARDS, CODES AND ACTS.

1.3.1 Conform to Ontario Regulation 332/12 (The Building Code) as amended by all subsequent Ontario Regulations issued to the date of this specification and applicable acts of authorities having jurisdiction.

1.3.1.1 CSA A23.1-09 Concrete Materials and Methods of Concrete Construction

1.3.1.2 CSA A23.2-09 Method of Test and Standard Practices for Concrete

1.3.1.3 CSA A23.3-04 Design of Concrete Structures

1.3.2 Where there are differences between the specifications and drawings and the codes, standards, or acts, the most stringent shall govern.

1.3.3 Standards and publications referenced by the Standards noted above are to apply even if they are not included in the list. Where such references are made, they shall be to the latest edition and revision published.

1.4 TOLERANCES

1.4.1 Perform anchorage installation so that completed work is within the tolerances set out in CSA A23.1 and as listed below:

1.4.1.1 Anchorages are to be drilled to within 10 mm ($\frac{3}{8}$ ") from the $\frac{3}{8}$ " locations determined in accordance with the criteria set herein.

- 1.4.1.2 In no case shall clear over to drilled anchor be less than 75 mm (3") unless explicitly noted on the drawings.
- 1.4.2 The specifications for the items being fastened to the concrete may require more stringent tolerances in establishing anchor locations. In all cases, follow the more stringent requirements.
- 1.4.3 These tolerances are acceptable with regard to structural requirements. Interfacing tolerances may not be compatible with the above. Review and coordinate interfacing tolerances so that the various elements come together properly.
- 1.5 **SAMPLES AND ASSISTANCE**
- 1.5.1 General
 - 1.5.1.1 Supply three samples of all anchor types and sizes proposed to be used, the cost of which shall be paid for by this trade.
- 1.6 **SUBMITTALS**
- 1.6.1 Product Technical Data Sheets
 - 1.6.1.1 Submit manufacturer's technical data sheets for all anchor types and sizes proposed along with their complete installation specifications.
 - 1.6.1.2 It is the contractor's responsibility to verify the availability of the anchors shown on the structural drawings at time of tender, and to immediately notify the engineer of record if any of the anchors are not readily available and need to be substituted.
 - 1.6.1.3 If the Contractor wishes to make other substitutions for anchors indicated, submit proposals with the tender with calculations for review by the Consultant.
 - 1.6.1.4 Substitutions are subject to review and acceptance by the Consultant.
- 1.6.2 Shop Drawings
 - 1.6.2.1 Prepare interference and co-ordination drawings taking into consideration the already existing work of other trades.
 - 1.6.2.2 As a minimum, show on the shop drawings, and on the interference and coordination drawings the following:
 - 1.6.2.2.1 Locations of all anchors dimensioned to grid lines,
 - 1.6.2.2.2 Elevation of all anchors,

- 1.6.2.2.3 Design loads (service, unfactored) to be imposed to the structure,
- 1.6.2.2.4 As-built location of conduits in concrete elements.
- 1.6.2.2.5 As-built location of reinforcing steel in vicinity of proposed anchors. Where as-built locations are not known, locate tendons, anchors, conduits, and reinforcement by positive means (x-ray, ferroskan, radar, cover meter, or the like).
- 1.6.2.3 Shop drawings are to be reviewed by the electrical and mechanical subcontractors prior to being submitted for the consultant's review.
- 1.6.3 Manufacturers Training Certificates
- 1.6.3.1 Copies of Manufacturer's Training Certificate for all workers that will be installing anchors.
- 2 **PART 2 – PRODUCTS**
- 2.1 **MATERIALS**
- 2.1.1 Anchors: Anchors, including all washers, threaded rods, nuts, and the like shall be of stainless steel. They shall be produced by a manufacturer with at least five (5) years of experience in manufacturing anchors.
- 2.1.2 Hardware and/or plates, and all connecting hardware used to distribute a load of several anchors shall be of stainless steel.
- 3 **PART 3 – EXECUTION**
- 3.1 **LAYOUT**
- 3.1.1 Locate anchors as per the shop drawings reviewed by the Consultant.
- 3.1.2 Advise Consultant's site representative at least 24 hours prior to drilling to allow review of anchor locations marked on structure.
- 3.1.3 Upon drilling and cleaning of holes, allow the Consultant 24 hours to review holes prior to installing anchors.
- 3.2 **REQUIREMENTS AND RESTRICTIONS**
- 3.2.1 Install anchors per all manufacturer's instructions.
- 3.2.2 Anchors to be installed only by workers that have received training certification by the anchor manufacturer.
- 3.2.3 Install anchors as per the shop drawings reviewed by consultants.

- 3.2.4 Anchors shall be located at least 100 mm (4") away from conduits, sleeves, drains bodies at their largest point measured on top of a slab above the anchor, and the like embedded in the concrete.
- 3.3 **QUALITY OF CONTROL**
- 3.3.1 Implement a system of quality control to ensure that the minimum standards specified herein are attained.
- 3.3.2 Bring to the attention of the Consultant any defects in the work or departures from the Contract Documents which may occur during Construction. The Consultant will decide upon corrective action and give his recommendations in writing.
- 3.3.3 The Consultant's general review during construction and inspection and testing by independent inspection and testing agencies reporting to the Consultant are both undertaken to inform the Owner/Client of the Contractor's performance and shall in no way augment the Contractor's quality control or relieve the Contractor of contractual responsibility.
- 3.4 **NOTIFICATION**
- 3.4.1 Prior to commencing significant segments of the work, give the Consultant and independent inspection and testing agencies appropriate notification so as to afford them a reasonable opportunity to review the work. Failure to meet this requirement may be cause for the Consultant to classify the work as defective.
- 3.5 **INSPECTION AND TESTING**
- 3.5.1 Appointment of independent Inspection and Testing Companies.
- 3.5.1.1 The Owner will appoint the Independent Inspection and Testing Companies to make inspections or perform tests as the Consultant directs. The Independent Inspection and Testing Companies shall be responsible only to the Consultant and shall make only such inspections or tests as the Consultant may direct.
- 3.5.2 When defects are revealed, the Owner may, request, at the Contractor's expense, additional inspection or testing to ascertain the full extent of the defect.
- 3.5.3 Tests on Installed Anchors
- 3.5.3.1 The Inspection and Testing Company may test some of the installed anchors. Should defective anchors or under-capacity installations be found a higher percentage will be tested. The sampling of anchors tested will be at the Inspection and Testing Company's discretion.

3.6 DEFECTIVE MATERIALS AND WORK

- 3.6.1 Where evidence exists, that defective work has occurred or that work has been carried out incorporating defective materials, the Consultant may have tests, Inspections or surveys performed, analytical calculations of structural strength made and the like in order to help determine whether the work must be repaired or replaced. Tests, inspections or surveys or calculations carried out under these circumstances will be made at the Contractor's expense, regardless of their results, which may be such that, in the Consultant's opinion, the work may be acceptable.
- 3.6.2 All testing shall be conducted in accordance with the requirements of the Ontario Building Code, except where this would in the Consultant's opinion cause undue delay or give results not representative of the rejected material in place. In this case, the tests shall be conducted in accordance with the standards given by the Consultant.
- 3.6.3 Materials or work which fail to meet specified requirements may be rejected by the Consultant whenever found at any time prior to final acceptance of the work regardless of previous inspection. If rejected, defective materials or work shall be promptly removed and replaced or repaired to the satisfaction of the Consultant, at no expense to the Owner.

END OF SECTION 03 90 00