PART 1 - GENERAL

1.1 GENERAL REQUIREMENT

.1 Comply with the applicable requirements of Division 1.

.2 Furnish all labour, materials, equipment, tools and incidentals necessary for the complete design, installation, maintenance and removal of concrete formwork as required by the drawings and/or as herein specified, including: falsework, bracing, supports, forms, ties, templates, blockouts, sleeves, placing only of anchor bolts and all inserts related to the curtain wall details. Supply and placing of all inserts imbedded in the concrete, including water stops.

1.2 RELATED WORK

.1	Concrete Reinforcement	Section 03 20 00
.2	Cast-In-Place Concrete	Section 03 30 00

1.2 REFERENCE STANDARDS

.1 Do concrete formwork in accordance with CAN/CSA-S269.3.

.2 Comply with the requirements of the Ontario Building Code 2012, and The Occupational Health and Safety Act, and Regulations for Construction Projects, latest issue including all amendments and revisions.

.3 Refer to current edition of all Regulations and By-laws.

1.3 APPROVAL

.1 Obtain Consultant's approval of all forms for exposed concrete work prior to placing concrete. Obtain written approval of Consultant for all mechanical and electrical openings in exposed work.

1.4 SHOP DRAWINGS

.1 Prepare formwork shop drawings to clearly illustrate all materials and details of work, complete and to adequate scale. Comply with the requirements of Section 01 33 00.

.2 Drawings shall contain a description of the methods of shoring and reshoring floor slabs and other horizontal members, shoring for vertical walls, locations and methods of forming for expansion, construction and control joints, methods of stripping and all other relevant data.

.3 Drawings shall show all relevant dimensions. Indicate location of construction joints, inserts, openings, sleeves and the like and for all exposed work show location of clean-outs for columns and high walls.

.4 Drawings shall show formwork pattern and material, special details for architectural finishes, pattern and type of formwork ties for exposed work.

.5 All formwork drawings shall bear the stamp and signature of a qualified professional engineer.

.6 Submit copies of formwork shop drawings to the Consultant for approval. No work indicated on such drawings shall be done until these drawings have been approved by engineer.

.7 Formwork shop drawings will be checked for general arrangement only and not for figured dimensions and approval shall in no way relieve the contractor of his responsibility for carrying out the work in accordance with the contract documents and intent.

.8 After review, drawings will be returned to the Contractor stamped to show one of the followings:

Reviewed	-	Released for fabrication
Reviewed as Noted	-	Released for fabrication after revisions noted are made, submit final record print.
Revise and Resubmit	-	Correct and resubmit for review prior to fabrication.

.9 Keep on site at all times a set of shop drawings bearing the review stamps of the Consultant and the Structural Sub-consultant and use only these

drawings and the Structural Drawings to place reinforcing steel.

Neatly mark on the Structural Drawing changes issued during the course of construction.

1.5 EXAMINATION OF DRAWINGS

.1 Check all dimensions and details given on the structural drawings against those on the architectural drawings. Have discrepancies, if any, corrected before starting construction of formwork.

PART 2 - PRODUCTS

2.1 FORMWORK MATERIAL

.1 Quality and strength of formwork material shall comply with the requirements of CAN/CSA-S269.3.

.2 Use formwork materials which are new at start of Work except that, for unexposed locations such as foundations, used materials may be substituted.

.3 Plywood, wood and formwork materials to CAN/CSA-O86.

.4 False material to CAN/CSA-S269.1.

.5 Tubular column forms: round, spirally wound laminated fibre forms, internally treated with release material.

.6 Grooves, reglets and chamfers: White Pine selected for straightness and accurately dressed to size.

.7 If a smooth architectural finish to concrete is required, specify form materials such as high density overlaid plywood to CSA O121 or other special materials to achieve the desired concrete finish.

2.2 ACCESSORIES

.1 Water-stops: Plastic type, 150 mm wide minimum, weighing 1.75 Kg/m for solid sections and 1.5 Kg/m for sections with one split leg, made of continuous extruded virgin polyvinyl, capable of 300% elongation.

.2 Non-slip nosing insert: Fine Aluminium oxide strips, 6 mm wide x 10 mm deep.

.3 Joint Tape: Non-staining, water impermeable, self-release.

2.3 FORM TIES

.1 Snap-ties and ties capable of acting as both tie and spread. Ties for exposed work shall be hot-dip galvanized equipped with snap off metal ties to provide for a break point 40 mm from the concrete surface.

.2 Ties shall have a minimum working strength of 1300 kg. Ties for exposed work shall be equipped with 40 mm high wood or other non-staining removable cones, or as selected by the Consultant. Use of Wire ties is not permitted.

2.4 FORM RELEASE AGENT

.1 Non-staining type, based on chemical reaction between the release agent and alkali content of concrete. Oil based lubricants may not be used without engineer's approval.

2.5 SAMPLES

.1 Submit samples of form ply, boards, plastic, coatings, and release agents, form ties and cones and other relevant material affecting the concrete finish

PART 3 - EXECUTION

3.1 TYPE, STRENGTH, RIGIDITY AND ALIGNMENT OF FORMS

.1 Forms shall be of sufficient strength and rigidity to support all concrete and construction loads and wind, taking into account proposed rate and method of pouring the concrete so that the resultant finished concrete shall conform to the shapes, lines and dimensions of the members shown on drawings.

.2 Forms shall produce straight dense surfaces, free from honeycombs, bulges

and depressions.

.3 Special cambers if any shall be shown on drawings.

.4 Carefully lay out concrete forms from batter boards and fine wire check lines. Check and correct wedging and shoring both horizontally and vertically as required during the placing of concrete. When concrete is being placed in a wall provide at least one readily accessible check wire parallel to the direction of the wall.

Assign at least one competent carpenter to check continually the alignment during the operation of placing concrete. Take special care in the alignment of exterior exposed columns and beams.

.5 Form sides of footings unless otherwise noted on the Structural Drawings.

.6 Do not permit loads from formwork to be transmitted to adjacent existing structure.

.7 Apply a form coating and release agent uniformly to the contact surface of formwork panels before reuse. Seal all lumber in forms for architectural concrete prior to use.

3.2 SHORING AND BRACING

.1 Provide bracing to ensure the stability of the formwork at all times.

.2 Prop or strengthen all previously constructed parts liable to be overstressed by construction loads.

.3 Place shores in successive storeys of a structure directly over those below.

.4 Design forms to allow stripping without removal of the principal shores, where these are required to remain in place.

.5 Keep shoring or re-shoring in position until concrete has reached its 28 day strength.

3.3 JOINTS IN FORMS

.1 Make form joints tight in order to prevent leakage of grout, particularly at corners and at all joints between board and panels used for exposed work. Do not use tape or the like for exposed work.

.2 Clean all edges and contact surfaces before erection.

3.4 HORIZONTAL CONSTRUCTION JOINTS

.1 Make all horizontal construction joints on exposed surfaces straight and level.

3.5 WATERSTOPS

.1 Install water-stops in all expansion, construction and other joints where shown on the drawings.

.2 Set and secure water-stops in forms so that their position is maintained during placing of concrete.

3.6 CORNER BEVELS

.1 Construct corners as detailed on architectural drawings. Unless otherwise shown, exposed columns, walls and beams must have a 20mm chamfer and all other corners shall be square and sharp

3.7 CLEANING FORMS

.1 Clean out forms before pouring concrete. Provide all inaccessible portions of formwork with clean-out and inspection ports. Column forms shall have a 150 x 250 mm port built in at the bottom of the column so arranged that it can be removed and the inside space cleaned of all debris before casting concrete. The port shall have a closure that can be put in place and held under concrete pressure without distortion of members. Provide similar ports in the base of walls and other deep members at about 3 m intervals.

3.8 SLEEVES AND PENETRATIONS

.1 Install sleeves only as shown on drawings or as directed by the Consultant.

.2 Form all multiple services of through-penetrating items to meet manufacturers and other specified fire stopping requirements as per related Sections/Documents and as outlined below.

.3 Bear all extra costs incurred as a result and in the event of oversized joints (larger than specified).

.4 The following regulates the sizing of service penetrations to be fire stopped in an effort to standardize and minimize penetration sizes:

.1 Sleeve single, circular penetrates by Divisions 15 and 16 respectively.
Multiple penetrations of circular penetrates shall be considered such, if the circular penetrates are no further than 100 mm (4") apart. Such multiple penetrations shall be carried out by this Section where erecting the fire separations by forming an open, square or rectangular, box around the multiple penetrates. This box, or frame, shall have a maximum 25 mm (1") clearance around the outer penetrates.

.2 Create penetrations with square penetrates in the same manner as the above mentioned multiple, circular penetrates.

The only difference is that the maximum clearance between penetrant and penetration shall be a maximum of 50 mm (2").

.5 An exception to this is the fire dampers, which require a design specific clearance around them.

3.9 SURFACE TREATMENT OF FORMS

.1 Use untreated forms where concrete is to receive stucco or plaster finish. Soak inside surfaces of these forms subject to shrinkage or absorption of water and keep continuously wet prior to pouring of concrete.

.2 Treat plywood and board forms, where concrete is to be exposed to view, with a non-staining form release agent or with an approved type of lacquer or plastic before each use of forms. Spray apply form release agent prior to placing reinforcing. Wipe off excess with rags leaving the form surface thinly coated. Prevent over-spray on reinforcing steel which will destroy bond. Recoat forms after cleaning for re-use.

3.10 RE-USE OF FORMWORK

.1 Lumber, plywood and steel forms may be re-used after all nails have been withdrawn and surfaces to be in contact with concrete are thoroughly cleaned and repaired before re-use.

.2 Re-use of plywood for exposed work shall be limited to one re-use unless further re-use is approved by consultant.

.3 Board formwork shall not be re-used for exposed work.

3.11 REMOVAL OF FORMWORK

.1 Submit stripping and pouring schedule to the consultant for approval, prior to start of work.

.2 Notify the engineer of intention to strip forms in advance of removal. The minimum strength of concrete in place for safe removal of soffit forms for horizontal or inclined members shall be 70% of the specified 28-day strength, with the added provision that the stripped member shall be of sufficient strength to safely carry its own weight together with superimposed construction loads.

Cantilevers longer than 1.5 m shall obtain 100% of its specified strength before removal of soffit forms.

Strip wall forms before removal of shores beneath slabs or beams and strip slabs prior to removal of shores beneath beams.

.3 Unless otherwise shown on the drawings side forms for vertical members (walls) may be stripped as soon as the concrete is sufficiently strong to stand

unsupported, but not before 3 days after concreting. If such forms are stripped before 7 days after concreting, the member faces must be treated with a curing agent that will seal the surface and prevent loss of moisture of the concrete surface. For supply and application of curing compound, see Section 03 30 00.

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

.5 Notwithstanding the above, under no circumstances shall forms and shoring be removed until concrete has gained sufficient strength to carry load and all possible construction and design loads liable to be imposed upon it. The Contractor shall be fully responsible for the safe removal of the forms and for any damage resulting from early removal of the forms including excessive deflections.

3.12 TOLERANCES, VERTICAL SURFACES

.1 All vertical lines shall be within 6 mm of plumb per storey, and not exceeding 12 mm of drift over the entire structure.

.2 Offset of continuous vertical elements in subsequent floors shall not exceed 6 mm.

.3 Relative position of vertical elements: Errors in any distance among the locations of faces of vertical elements shall not exceed 12 mm for adjacent members, 25 mm for any members.

3.13 TOLERANCES, HORIZONTAL SURFACES

.1 Variation of level (to be measured before removal of shores), shall not exceed:

1. 6 mm in 3 m.

2. 10 mm in 6 m.

3. 1:300 in one bay.

3.14 CONCRETE DIMENSIONS

.1 Errors in concrete dimensions for any member: shall not exceed 5 mm less or 10 mm more than true.

.2 The engineer shall have the right to have discrepancies corrected if they exceed the above limits.

END OF SECTION