PART 1 - GENERAL

1.1 GENERAL

.1 Work of this Section shall conform to requirements of Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections.

1.2 SCOPE

.1 Provide all labor, materials, equipment, services and transportation for formwork and related accessories required to complete all cast-in-place concrete work as shown on Drawings, as specified herein, and as required by the job conditions.

1.3 RELATED REQUIREMENTS

.1 Section 03 20 00: Concrete Reinforcing.

.2 Section 03 30 00: Cast-in-Place Concrete.

1.4 REFERENCES

.1 All referenced standards shall be the current edition, or the edition referenced by the applicable Building Code in force at the time of building permit application, as noted on Structural Drawings.

.2 Canadian Standards Association (CSA International):

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

.2 CSA O86, Engineering Design in Wood.

.3 CSA O121, Douglas Fir Plywood.

.4 CSA 0141, Softwood Lumber.

.5 CSA O151, Canadian Softwood Plywood.

.6 CSA O153, Poplar Plywood.

.7 CSA O325.0, Construction Sheathing.

.8 CSA O437 Series, Standards for OSB and Waferboard.

.9 CSA S269.1, Falsework for Construction Purposes.

.10 CSA S269.3, Concrete Formwork.

.3 American Concrete Institute (ACI):

.1 ACI 347, Guide to Formwork for Concrete.

1.5 QUALITY ASSURANCE

.1 In accordance with Section 01 43 00 – Quality Assurance.

.2 Qualifications

.1 Engage a Professional Engineer licensed in the place where the project is located to be responsible for design and installation of all formwork, falsework and re-shoring.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Shop Drawings:

.1 Provide shop drawings for formwork and falsework stamped and signed by the Professional Engineer responsible for their design.

.2 Show on drawings:

.1 Formwork design data: permissible rate of concrete placement and temperature of concrete in forms.

.2 Erection sequence.

.3 Stripping and re-shoring procedure.

.4 Camber.

.5 Locations of all construction joints in slabs and walls.

.6 For Architectural concrete, types of liners and ties, and tie layout.

.7 Equipment and procedure details when slip forming and / or flying forms are used.

.8 Shoring of existing construction where required to carry construction loads.

.3 Samples: At request of Architect, submit for record samples of form ties and spreaders.

.4 Hazardous Materials Notification: Submit for record where applicable.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Comply with General Conditions and Division 1, including the following:

.1 Store forms and form materials clear of ground and protect from damage.

PART 2 - PRODUCTS

2.1 FORMWORK DESIGN

.1 Design of Formwork, Shoring/Reshoring, and its removal is the Contractor’s responsibility.

.2 Design, erect, support, brace and maintain formwork so that it will safely support vertical and lateral loads per OBC that might be applied, until such loads can be supported by the concrete structure.

.3 Design Requirements:

.1 Forms shall be designed for fabrication and erection in accordance with Design Professionals' requirements and recommendations of CSA S269.1 and CSA S269.3.

.2 Design formwork in a manner such that the total construction load does not at any time exceed the total design load of new or existing construction and accounts for concrete age and relative strength at time of loading. See Part 3 for shoring/reshoring requirements.

.3 Design formwork for loads and lateral pressures, and wind and seismic loads as specified by OBC unless otherwise controlled by local building code.

.4 Design formwork to include loads imposed during construction, including weight of construction equipment, concrete mix, height of concrete drop, rate of filling of formwork, vibrator frequency, ambient temperature, foundation pressures, lateral stability, temporary imbalance or discontinuity of building components, and other factors pertinent to safety of structure during construction.

2.2 MATERIALS

.1 Formwork materials: Conform to CSA S269.1.

.1 For concrete without special architectural features, use wood and wood product formwork materials to CSA O121, CSA 0141, CSA O437 or CSA-O153.

.2 For concrete with special architectural features, use formwork materials to CSA A23.1/A23.2.

.3 Form ties:

.1 For concrete not designated 'Architectural', use removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm diameter in concrete surface.

.2 For Architectural concrete, use snap ties complete with plastic cones and light grey concrete plugs.

.3 Form ties to be designed to act as ties and spreaders and to have a minimum working strength of 13 kN (3000 pounds).

.4 Snap ties to snap cleanly at least 25mm (1") from concrete surface without damage to the concrete.

.5 Cone ties to be internal disconnecting type which snaps cleanly at least 38mm (1½") from concrete surface without damage to the concrete.

.4 Plate dowels: diamond shaped steel plates, min. fy=300 MPa, in prefabricated plastic pockets with internal collapsible fins allowing min. 10mm (¾") movements in the direction of the joint.

.5 Form liner: high density overlay plywood to CSA O121 or other special materials to achieve the required concrete finish.

.6 Form release agent: non-toxic, low VOC, chemically active agent containing compounds that react with free lime in concrete resulting in water insoluble soaps.

.7 Form stripping agent: colourless mineral oil, non-toxic, low VOC, free of kerosene, with viscosity between 15 to 24 mm²/s (70 and 110s Saybolt Universal) at 40°C, flashpoint minimum 150°C, open cup.

.8 Grooves, reglets and chamfers: White pine selected for straightness and accurately dressed to size.

.2 Falsework materials: to CSA S269.1.

.3 Void Form: Cellular cardboard with minimum compressive strength of 62 kPa (9 psi) designed to carry weight of wet concrete and loads associated with placing concrete and also designed to disintegrate and create an air space below the fully hardened concrete.

2.3 ACCESSORIES

.1 PVC Waterstops: flexible, extruded, heat weldable, ribbed to CGSB 41-GP-35M and as follows:

.1 Tensile strength: to ASTM D638, minimum 13 MPa.

.2 Ultimate elongation: to ASTM D638, minimum 350%.

.3 Water absorption: to ASTM D570, 0.15%max.

.4 Tear resistance: to ASTM D624, minimum 50 kN/m.

.5 Low temperature brittleness: to ASTM D746, no failure at -37°C.

.6 Width in construction joints: 100mm (4").

.7 Width in expansion joints: 225mm (9"), with 31mm (1-1/4") O.D. centre bulb.

.2 Swellable waterstops

.1 Bentonite Waterstops - composed of 75% sodium bentonite and 25% butyl rubber, rectangular, flexible, min 200% expansion after 21 day aging. To use bentonite, walls must be at least 200 thick. Do not use bentonite at expansion joints.

.2 Extrudable waterstops - one part polyurethane, bentonite free, 100% expansion after 7 days.

.3 Dovetail anchor slots: minimum 0.6 mm thick galvanized steel with insulation filled slots.

.4 Weep hole tubes: plastic.

.5 Bentonite Geotextile Waterproofing: two interlocked polypropylene geotextile sheets encapsulating a layer of bentonite.

.6 Non-slip tread insert: 76.2mm x 6.4mm extruded aluminum, with aluminum oxide grit in epoxy base. “CT-20/3A” as manufactured by K.N. Crowder Manufacturing Inc. or equivalent, with hidden strap anchors for cast-in installation. Provide at locations poured in placed concrete stairs as specified in arch drawings.

PART 3 - EXECUTION

3.1 FABRICATION AND ERECTION

.1 Confirm to CSA A23.1.

.2 Fabricate and erect falsework in accordance with CSA S269.1.

.3 Do not place shores and mud sills on frozen ground.

.4 Provide site drainage to prevent washout of soil supporting mud sills and shores.

.5 Fabricate and erect formwork in accordance with CSA S269.3 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA A23.1/A23.2.

.6 Make formwork tight and flush faced to prevent the leakage of mortar and the creation of unspecified fins or panel outlines.

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

.8 See drawings for any camber required in hardened concrete. Measure cambers relative to member supports.

.9 Obtain Consultant's approval for formed openings not indicated on Structural Drawings.

.10 Provide water stops and keys around temporary openings in basement and retaining walls for shoring rakers or similar purposes.

.11 Use internal form ties.

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

.13 Apply a form coating and release agent uniformly to the contact surface of formwork panels before reuse.

.14 Use 25 mm (1”) chamfer strips on external corners and 25 mm (1”) fillets at interior corners, unless specified otherwise.

.15 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated on Architectural and Structural drawings.

.16 Build in anchors, sleeves, and other inserts required to accommodate Work specified in other sections.

.17 Anchors and inserts not to protrude beyond surfaces designated to receive applied finishes, including painting.

.18 Clean formwork in accordance with CSA A23.1/A23.2, before placing concrete.

.19 Provide vertical dovetail anchor slots at 600mm (2”-0”) on centre where masonry veneer covers face of concrete.

.20 Build top form on sloping concrete where required to prevent concrete from flowing out of the form. Provide vents to allow air and bleed water to escape.

.21 Do not close wall forms before reinforcing steel has been reviewed.

.22 Void form:

.1 Conform to manufacturer’s recommendations.

.2 Place on sand leveling bed.

.3 Protect from moisture until concrete is about to be placed.

.4 Protect from excessive construction loads. Overlay with max. 3mm (1/8”) thick fibreboard if required to protect it from damage during construction.

.5 If void form collapses during construction, remove and replace affected area.

3.2 JOINTS

.1 Refer to Typical Details and Drawings Notes for locations, detailing and maximum spacing requirements of all concrete joints.

.2 Provide construction joints in formed slab and slab on deck.

.3 Provide evenly spaced vertical control joints in walls.

.4 Provide expansion joints where shown on Structural Drawings. Remove all forming and filler material used during construction and provide clear space between structural elements equal to width specified.

.5 Provide construction gaps (closure strips) where shown on Structural Drawings.

.6 Refer to Structural Drawings and Section 03 30 00 for construction joints, sawcut joints and isolation joints in slab on grade and concrete toppings.

3.3 WATERSTOPS

.1 PVC Waterstops

.1 Provide PVC waterstops for expansion, construction and control joints in exterior walls, basement walls, retaining walls, slabs supporting earth, and at other locations shown.

.2 Do not use surface mounted waterstops at control joints which will be protected by hot applied waterproofing.

.3 Use equipment to manufacturer's requirements to field splice waterstops for continuity over the full length of runs.

.4 Use only straight heat sealed butt joints in the field.

.5 Use factory welded corners and intersections.

.6 Securely tie waterstops to reinforcing bars at 1m (3 feet) maximum centres to keep them in alignment when concrete is placed.

.2 Swellable Waterstops

.1 Provide swellable waterstops for construction and temporary joints in exterior walls, basement walls, retaining walls, slabs supporting earth and at other locations shown where minimum required distance to concrete edge can be achieved. Do not use for expansion joints.

.2 Bentonite waterstops

.1 Locate bentonite waterstops 75 mm (3") from outside face of concrete to avoid spalling of concrete due to swelling pressure of bentonite.

.2 Butt strips together. Do not overlap.

.3 Fasten to concrete at 600mm (2'-0") maximum.

.3 Extrudable waterstops

.1 Locate extrudable waterstops 100mm (4") from outside face of concrete to avoid spalling of concrete due to swelling pressure.

.2 Refer to manufacturer's specifications for application temperature range.

.3 Refer to manufacturers specifications for recommended profile size and number of profiles suitable for particular concrete thickness.

3.4 CONCRETE EXPOSED TO VIEW

.1 Minimize formwork joints. Locate joints and ties in a uniform pattern with no ties within 300mm (12") of an edge or joint.

.2 Make panels forming slab soffits and wall / beam faces as large as possible, and arrange symmetrically.

.3 Make form joints in columns level from column to column and consistent with form joints in other parts of the structure. Locate lowest horizontal form joints 2400mm (8'-0") above finished floor elevation.

.4 Where grooves, reglets or chamfers are shown, locate panel form joints behind them.

.5 Provide reglets at all concrete joints.

.6 Seal all joints in formwork and between formwork and concrete.

.7 Place 16 mm (5/8") bevel strips at member corners to form chamfers unless architectural details show an alternative profile. When beams are supported on columns of the same width, extend chamfer across face of column.

.8 Do not reuse formwork if there is any evidence of surface damage or wear, which could impair the visual quality of the concrete surface.

.9 Reuse forms only on identical sections, using the original tie holes. Clean forms and fill nail holes before reuse.

.10 Use only galvanized nails.

.11 Remove form tie plastic cones. Install concrete plugs where indicated. Recess 6mm (1/4") and bond to concrete using a cement slurry with a bonding agent conforming to Section 03 30 00.

3.5 ARCHITECTURAL CONCRETE

.1 Refer to architectural drawings for concrete members requiring architectural exposed finishes.

.2 Conform to CSA A23.1.

.3 Construct forms for architectural concrete, and place ties as indicated. Joint pattern may not be based on using standard size panels or maximum permissible spacing of ties.

.4 Use form liners as indicated.

.5 Ensure members have sharp and accurate definition of corners, reglets, etc. and are free from chips and spalls.

.6 Incorrect tie holes, spacers, reglets or formwork joints may be cause for rejection at the discretion of the Consultant.

.7 Forms for columns and walls thicker than 900 (3’-0”) to be insulated.

3.6 CONCRETE ACCESSORIES AND EMBEDDED ITEMS

.1 Install into forms concrete accessories, sleeves, inserts, anchor bolts, anchorage devices and other miscellaneous embedded items furnished by other trades or that are required for other work that is attached to or supported by cast-in-place concrete.

.1 Use setting drawings, diagrams, instructions and directions provided by suppliers of items to be attached.

.2 Install reglets to receive top edge of foundation sheet waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, relieving angles, and other conditions.

.3 Install dovetail anchor slots in concrete structures as indicated on drawings or required by other trades.

.4 Forms for Slabs: Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and contours in finished surfaces.

.5 Coordinate with CONCRETE REINFORCEMENT AND EMBEDDED ASSEMBLIES Section in Specification 032000.

.6 Install accessories and embedded items straight, level, plumb and secure in place to prevent displacement by concrete placement.

3.7 TEMPORARY OPENINGS

.1 Locate temporary openings in forms at inconspicuous locations.

.2 For clean-outs and inspection before concrete placement, locate temporary openings where interior area of formwork would otherwise be inaccessible.

.3 For cleaning and inspections, locate openings at bottom of forms to allow flushing water to drain.

.4 Securely brace temporary openings and set tightly in forms to prevent loss of concrete.

.5 Close temporary openings with tight fitting panels, flush with inside face of forms, neatly fitted so that joints will not be noticeable on exposed concrete surfaces.

3.8 PROVISIONS FOR OTHER TRADES

.1 Coordinate and provide openings in concrete formwork to accommodate work of other trades.

.1 Determine size and location of openings, recesses, chases, offsets, openings, depressions, and curbs from information provided by trades requiring such items.

.2 Accurately place and securely support items built into forms.

3.9 CLEANING

.1 Normal Conditions

.1 Thoroughly clean forms and adjacent surfaces to receive concrete.

.2 Remove chips, wood, sawdust, dirt, standing water or other debris just before placing concrete.

.3 Flush with water or use compressed air to remove remaining foreign matter.

.4 Verify that water and debris can drain from forms through clean-out ports.

.2 During Cold Weather

.1 Remove ice and snow from within forms.

.2 Do not use de-icing salts.

.3 Do not use water to clean out completed forms, unless formwork and concrete construction will proceed within heated enclosure.

.4 Use compressed air or other means to remove foreign matter.

3.10 FORM RELEASE AGENTS

.1 Before placing reinforcing steel and miscellaneous embedded items, coat contact surfaces of forms with an approved non-residual, low VOC form release agent in accordance with manufacturer's published instructions.

.2 Do not allow release agent to accumulate in forms or come into contact with reinforcement or concrete against which fresh concrete will be placed.

.1 Coat steel forms with nonstaining, rust-preventative material.

.3 Remove form release agent and residue from reinforcement or surfaces not requiring form coating.

3.11 BEFORE PLACING CONCRETE

.1 Inspect and check completed formwork, shoring and bracing to ensure that work is in accordance with formwork requirements of this section and Contract Documents, and that supports, fastenings, wedges, ties, and parts are secure.

.1 Make necessary corrections or adjustment to formwork to meet tolerance requirements.

.2 Retighten forms and bracing before concrete placement to prevent mortar leaks and maintain proper alignment.

.3 Notify Owner’s Testing Agency sufficiently in advance of placement of concrete to allow inspection of completed and cleaned forms.

3.12 DURING CONCRETE PLACEMENT

.1 Maintain a check on formwork to ensure that forms, shoring, ties and other parts of formwork have not been disturbed by concrete placement methods or equipment.

.2 Use positive means of adjustment as required for formwork settlement during concrete placing operations.

3.13 CAMBER

.1 Provide camber in formwork as required for anticipated deflections due to weight and pressures of fresh concrete and construction loads.

.2 Camber bottom forms where indicated on the drawings. Whenever forms are cambered, screeded levels for establishing top of concrete must be cambered to the same amount and to the same profiles such that scheduled depth of member is not reduced by lifting of forms. Check camber and adjust forms before initial set as required to maintain camber.

3.14 SURFACE DEFECTS

.1 Install forms that will not impair the texture of the concrete and are compatible with the specified finish type.

3.15 FORMWORK LOADS ON GRADE

.1 Where loads from formwork bear on grade, provide suitable load-spreading devices for adequate support and to minimize settlement. In no event shall frozen ground or soft ground be utilized directly as the supporting medium.

3.16 FOOTINGS AND GRADE BEAMS

.1 Provide forms for footings and grade beams if soil or other conditions are such that earth trench forms are unsuitable.

.2 When trench forms are used, provide an additional 1” (25mm) of concrete on each side of the minimum design profiles and dimensions indicated.

3.17 SLABS-ON-GRADE

.1 For slabs-on-grade, secure edge forms in such a manner as to not move under weight of construction loads, construction and finishing equipment, or workers.

3.18 REMOVAL AND RESHORING

.1 Conform to CSA A23.1 and to ACI 347.

.2 Survey top of formwork and slab elevations before concrete placement, prior and after falsework removal, refer to drawing notes for detailed requirements. Submit survey data for Engineer’s record.

.3 Use pullout tests, on-site cured cylinders (kept beside and treated as the concrete in the structure they represent) or maturity tests to determine in-situ strength of concrete prior to removal of falsework. Do not locate pullout inserts on concrete surfaces exposed to view. Retain a testing company to supply, locate and test the inserts in accordance with ASTM C900.

.4 Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50^{o}F (10^{o}C) for 12 hours after placing concrete, provided concrete is sufficiently hard to avoid damage by form-removal operations, and provided curing and protection operations are maintained after removal of formwork.

.5 Maintain falsework supporting beams and slabs until concrete has reached at least 75% of its specified 28 day strength.

.6 Keep falsework or reshoring in place for a minimum of 28 days unless longer time is required to reach the specified concrete strength.

.7 If reshoring is installed to replace falsework, strip and re-shore simultaneously so that no more than 9 m^2 of soffit is left unsupported by either formwork or reshoring at any time.

.8 Install reshores tight to structure above and below so that they do not shorten under load. Do not pre-load or lift the structure above by overtightening.

.9 Locate shores/reshores such that the factored (ultimate) construction load imposed onto any slab or beam at any time during the construction cycle does not exceed 90% of the factored (ultimate) design load for that slab or beam, scaled down to reflect effect on capacity of lower concrete strength at time of loading.

.10 Construction load shall include the weight of wet concrete, total weight of formwork and shoring/reshoring, and a minimum construction live load of 2.5kPa. Design load includes self-weight of the slab, and superimposed dead and live loads as indicated on the drawings.

.11 For comparison of construction loads to design loads, compare factored (ultimate) construction loads to factored (ultimate) design loads. For construction dead and live loads, use the same load factors and load combinations as required by CSA A23.3 for design dead and live loads. The specified strength reduction factors from CSA A23.3 should also be applied during the strength evaluation of the partially completed structure.

.12 For cantilever beams and cantilever slabs, the shoring beneath the cantilever portion of the beams and slabs shall not be removed until the cantilever portion reaches 100% of the specified 28 day strength.

.13 Construction joints: maintain falsework supporting beams and slab adjacent to the construction joint until the concrete beyond the joint reaches at least 75% of its specified 28 day strength, maintain falsework supporting transfer beams and transfer slab adjacent to the construction joint until the concrete beyond the joint reaches at least 100% of its specified 28 day strength.

.14 Construction gaps: Do not remove falsework supporting beams and slabs adjacent to construction gaps until the gaps are filled and concrete in gaps has reached at least 75% of its specified 28 day strength. For transfer slabs and transfer beams, do not remove falsework supporting beams and slabs adjacent to construction gaps until the gaps are filled and concrete in gaps has reached at least 100% of its specified 28 day strength.

.15 Remove formwork progressively using methods to prevent shock loads or unbalanced loads from being imposed on structure.

.16 Loosen forms carefully. Do not wedge pry bars, hammers, or tools against concrete surfaces.

.17 Reshore structural members where required due to design requirements, construction requirements, or construction conditions.

.1 Reshore on same day shoring and forms are removed.

.18 Whenever formwork is removed during the curing period, the exposed concrete shall be cured per requirements of Section 033000.

.19 All wood formwork, including that used in void spaces, pockets and other similar places shall be removed.

.20 Form tie holes shall be filled as per approved samples submitted to the Design Professionals.

.21 The Contractor shall assume responsibility for all damage due to removal of the forms.

.22 Re-use formwork and falsework subject to requirements of CSA A23.1/A23.2.

3.19 FIELD QUALITY CONTROL

.1 Refer to Section 01 45 00 Quality Control.

.2 Obtain field review of falsework and reshoring by the Professional Engineer responsible for that work prior to each pour. The Consultant will not field review the formwork, falsework or reshoring.

.3 An independent Inspection and Testing Agency will be appointed to inspect all features of formwork affecting appearance of finished architectural concrete surfaces for conformance with Contract documents.

3.20 CORRECTIVE MEASURES

.1 Where the Contractor requests that the Design Professionals develop the corrective actions or review corrective actions developed by others, the Design Professional shall be compensated as outlined in Part 3 – CORRECTIVE MEASURES section of Specification 033000.

END OF SECTION 03 10 00

PART 1 - GENERAL

1.1 GENERAL

.1 Work of this Section shall conform to requirements of Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections.

1.2 SCOPE

.1 Provide all labor, materials, equipment, services and transportation for reinforcing steel, accessories, embedments and miscellaneous anchorage accessories, joint fillers, and waterstops for cast-in-place concrete work as shown on Drawings, as specified herein, and as required by the job conditions.

1.3 RELATED REQUIREMENTS

.1 Section 03 30 00: Cast-in-Place Concrete.

.2 Section 04 20 00: Unit Masonry.

1.4 REFERENCES

.1 All referenced standards shall be the current edition or the edition referenced by the applicable Building Code in force at the time of building permit application, as noted on Structural Drawings.

.2 Canadian Standards Association (CSA International)

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

.2 CSA A23.3, Design of Concrete Structures.

.3 CSA G30.18, Carbon Steel Bars for Concrete Reinforcement.

.4 CSA G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.5 CSA W186, Welding of Reinforcing Bars in Reinforced Concrete Construction.

.3 Reinforcing Steel Institute of Canada (RSIC)

.1 Reinforcing Steel Manual of Standard Practice.

.4 American Concrete Institute (ACI)

.1 SP-66, ACI Detailing Manual.

.5 ASTM International Inc.

.1 ASTM A1064/A1064M, Standard Specification for Carbon Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.

.2 ASTM A775/A775M, Standard Specification for Epoxy-Coated Reinforcing Steel.

.3 ASTM D3963 / D3963M, Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Steel Reinforcing Bars.

.4 ASTM A1044 / A1044M, Standard Specification for Steel Stud Assemblies for Shear Reinforcement of Concrete.

1.5 QUALITY ASSURANCE

.1 In accordance with Section 01 43 00 – Quality Assurance.

.2 Qualifications

.1 Welding of reinforcing steel to be performed by welders certified under CSA W186.

1.6 QUALITY CONTROL

.1 Submit in accordance with Section 01 45 00 - Quality Control.

.2 Source Quality Control Submittals:

.1 Upon request, provide Consultant with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis.

.2 Upon request, inform Consultant of proposed source of reinforcement material to be supplied.

.3 Upon request, provide the Consultant with a copy of plant certificate by the Concrete Reinforcing Steel Institute for epoxy coating of reinforcement.

.4 Upon request, provide the Consultant with a copy of manufacturer’s instructions for patching factory applied epoxy coating.

1.7 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data

.1 Submit manufacturer’s data sheets for mechanical rebar splices.

.3 Shop Drawings

.1 Prepare shop drawings in accordance with RSIC Manual of Standard Practice unless the Contract Documents contain a more stringent requirement. Conform to ACI SP-66 Detailing Manual whenever a detail condition is not covered by any of the above.

.2 Submit plans, elevations, sections and details necessary to fabricate, place and review reinforcement without reference to structural drawings, including masonry wall reinforcement. Draw to scale not smaller than 1:50 (¼" = 1'-0").

.3 Show on drawings

.1 Sizes, spacings and locations of reinforcement, with identifying labels.

.2 Bar bending details.

.3 Lengths and locations of all lap splices.

.4 Types and locations of mechanical splices.

.5 Placing sequence.

.6 Large scale details at areas of steel concentrations (such as column / beam / wall intersections), and around cast-ins.

.7 Bar lists.

.8 Quantities of reinforcement (including all rebars added to accommodate installation).

.9 Construction joint, control joint and pour gap locations.

.10 Strip dimensions for flat slab and flat plate.

.11 Concrete cover.

.4 Do not release for fabrication reinforcing bars whose length may be affected by field conditions, such as the final elevation of footings, until obtaining the required field measurements.

.5 Product Data

.1 Submit for action for each type of product identified in Part 2. Product Data shall be clearly marked to indicate all technical information which specifies full compliance with this section and Contract Documents, including published installation instructions and I.C.C reports, where applicable, for products of each manufacturer specified in this section.

1.8 DELIVERY, STORAGE, AND HANDLING

.1 Comply with General Conditions and Division 1, including the following:

.1 Deliver reinforcing steel to Project site bundled, tagged and marked.

.1 Use weatherproof tags indicating bar sizes, lengths and other information corresponding to markings shown on placement diagrams.

.2 Deliver welded wire fabric in sheets. Do not deliver in rolls.

.3 During construction period, properly store reinforcing steel and accessories to assure uniformity throughout the Project.

.4 Deliver and store welding electrodes in accordance with AWS D1.4.

.5 Immediately remove from site materials not complying with Contract Documents or determined to be damaged.

.6 Store reinforcing steel above ground so that it remains clean.

.1 Maintain steel surfaces free from materials and coatings that might impair bond.

.2 Keep covered.

.3 Protect against corrosion or deterioration of any kind.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Reinforcing steel: carbon steel, deformed bars to CSA G30.18., unless indicated otherwise.

.2 Weldable Reinforcing steel: weldable low alloy steel deformed bars to CSA G30.18.

.3 Cold-drawn annealed steel wire ties: to ASTM A82/A82M.

.4 Welded steel wire fabric: to ASTM A185/A185M. Provide in flat sheets only.

.5 Epoxy Coating of reinforcement: to ASTM A775/A775M.

.6 Galvanizing of reinforcement: to ASTM A767/A767M.

.7 Chairs, bolsters, bar supports, spacers: to CSA A23.1/A23.2.

.8 Mechanical splices: to develop 125% of specified rebar yield strength.

.9 Shear stud reinforcing: per ASTM A1044. Min yield strength for studs – 350MPa, for rails – 300MPa.

.10 Expansion cap for dowels at expansion / contraction joints: plastic, tight fitting, with internal pin to locate dowel and create void for expansion.

PART 3 - EXECUTION

3.1 FABRICATION

.1 Fabricate reinforcing steel in accordance with CSA A23.1/A23.2 and Reinforcing Steel Manual of Standard Practice.

.2 Fabricate epoxy coated reinforcing steel in accordance with ASTM D3963/D3963M. Plants to be certified by the CRSI for epoxy coated steel. Provide colour to contrast sharply with reinforcing steel and rust colour.

.3 Stagger mechanical splices 750mm (2'-6") unless otherwise noted on drawings.

.4 Weld reinforcement in accordance with CSA W186 where indicated.

.5 Ship bundles of bar reinforcement, clearly identified in accordance with bar lists.

.6 Provide standard hooks at ends of all hooked bars.

.7 Substitute different size bars only if permitted in writing by the Consultant.

3.2 FIELD BENDING

.1 Do not field bend or field weld reinforcement except where indicated or authorized by Consultant.

.2 When field bending is authorized, bend without heat, applying slow and steady pressure.

.3 Where key-creating stay form with pre-installed blind dowels is used, bend the dowels out using special tools approved by the stay form manufacturer.

.4 Replace bars which develop cracks or splits.

3.3 PLACING REINFORCEMENT

.1 Place reinforcing steel as indicated on reviewed placing drawings and in accordance with CSA A23.1/A23.2.

.2 Remove all loose scale, dirt, oil or other coatings which would reduce bond.

.3 Ensure cover to reinforcement is maintained during concrete pour.

.4 Turn ends of tie wire towards the interior of concrete.

.5 Use bar supports for beams and slabs.

.6 Use precast concrete chairs where supports rest on the ground. Where welded wire fabric is used in slabs-on- grade, place precast concrete chairs at 600 mm (2'-0") on centre each way. Do not attempt to position welded wire fabric by lifting it after concrete is poured.

.7 Pre-assemble reinforcement for footings and lower full cages into place not to disturb soil at founding elevation.

.8 Use side form spacers for walls and columns.

.9 Do not splice reinforcing at locations other than shown on placing drawings without Consultant's written approval.

.10 Do not cut reinforcement without Consultant's written approval.

.11 Install end bearing compression splices so that bearing ends are fitted to within 3 degrees of full bearing after splice installed.

.12 Exposed concrete surfaces

.1 Use plastic or plastic tipped bar supports and spacer with colour to match concrete.

.13 Use plastic bar supports, epoxy coated support bars and plastic coated tie wire for epoxy coated reinforcement.

.14 Do not field weld reinforcement except where indicated or authorized by the Consultant.

.15 Do not weld epoxy coated reinforcement.

.16 Slip dowels

.1 Use plain round bars.

.2 Paint portion of dowel intended to move within hardened concrete with one coat of asphalt paint.

.3 When paint is dry, apply thick even film of mineral lubricating grease.

3.4 FIELD TOUCH-UP

.1 Touch up damaged and cut ends of epoxy coated reinforcing steel with compatible finish to provide continuous coating.

END OF SECTION 03 20 00

PART 1 - GENERAL

1.1 GENERAL

.1 Work of this Section shall conform to requirements of Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections.

1.2 SCOPE

.1 Provide all labor, materials, equipment, services and transportation for reinforcing steel, accessories, embedments and miscellaneous anchorage accessories, joint fillers, and waterstops for cast-in-place concrete work as shown on Drawings, as specified herein, and as required by the job conditions.

1.3 RELATED REQUIREMENTS

.1 Section 03 10 00: Concrete Forming and Accessories.

.2 Section 03 20 00: Concrete Reinforcing.

.3 Section 05 12 23: Structural Steel for Buildings.

.4 Section 04 20 00: Unit Masonry.

1.4 REFERENCES

.1 All referenced standards shall be the current edition, or the edition referenced by the applicable Building Code in force at the time of building permit application, as noted on Structural Drawings.

.2 Canadian Standards Association (CSA International)

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

.2 CSA A283, Qualification Code for Concrete Testing Laboratories.

.3 CSA A3000, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

.4 CSA S413, Parking Structures.

.3 ASTM International Inc.

.1 ASTM C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

.2 ASTM C920 – Standard Specification for Elastomeric Joint Sealants.

.3 ASTM D1751, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

.4 Canadian General Standards Board (CGSB):

.1 CAN/CGSB-51.34, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.

1.5 QUALITY ASSURANCE

.1 In accordance with Section 01 43 00 – Quality Assurance.

1.6 QUALITY CONTROL

.1 Submit in accordance with Section 01 45 00 - Quality Control.

1.7 ADMINISTRATIVE REQUIREMENTS

.1 Batch Logs: keep record of each batch delivered to site.

.2 Concrete Delivery Slips: Keep all concrete delivery slips (“driver’s tickets”) on site until building is completed. Record on delivery slip where concrete was placed, including time and date.

.3 Record Drawings: Record on a set of Structural Drawings extent of each pour including pour date and falsework removal date. Also record all field changes, including footing elevations.

1.8 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.

.2 Minimum 2 weeks prior to starting concrete work, submit all concrete mix designs, and indicate where each concrete mix is to be used.

.3 Minimum 2 weeks prior to placing concrete, submit drawings showing locations of all construction and control joints (including wall control joints and slab on grade sawcut joints).

.4 Minimum submission requirements for each concrete mix design shall include the following:

.1 Minimum specified compressive strength at 28 day.

.2 Maximum aggregate size.

.3 Aggregate type (if not normal density).

.4 Concrete density range, wet and dry (if not normal density).

.5 CSA exposure class.

.6 Cement type (if not type GU).

.7 Percentage and type of supplemental cementing materials.

.8 Maximum water/cementitious materials ratio.

.9 Assumed method of placement of concrete.

.10 Corrosion inhibitor (name and quantity, if applicable).

.11 Plastic or steel fibres (type, name and quantity, if applicable).

.12 Alkali-aggregate resistance.

.13 Architectural requirements (colour of cement and aggregate, if applicable).

.14 Maximum time from batching to placing concrete (if retarding admixtures are used).

.5 Concrete pours: provide accurate records of poured concrete items indicating date and location of pour, concrete mix used, ambient air temperature and test samples taken.

.6 Concrete Travel Times to the Project Site: Submit for record.

.7 Hot and Cold Weather Procedures: Submit for record written procedures for placement of concrete in hot and cold weather conditions. Hot and Cold weather are as defined in the Concrete Placement section of this Specification.

.8 Product Data: Submit for action product data clearly marked to indicate locations to be used and all technical information which specifies full compliance with this section and Contract Documents, including published application instructions, product characteristics, compatibility, and limitations for each of the following where applicable:

.1 Bonding agents.

.2 Curing compound and liquid sealer densifier. Submit for record to Design Professionals a written statement guaranteeing that the compound will not leave discoloration on concrete to be left exposed or affect the bond for paint or other applied finishes. Include provision in written statement that in the event of failure of applied finishes to bond to membrane cured concrete, to remove the curing compound and leave suitable surfaces for bonding such finishes.

.3 Absorptive covers and moisture retaining covers.

.4 Vapor Retarder: See Division 7, Thermal and Moisture Protection.

.5 Self-leveling concrete topping.

.6 Grout: Submittal of grout by manufacturers not listed herein must be accompanied by independent certification of ASTM C 1107 compliance without modification of standard methods.

.7 Other products proposed by Contractor.

.9 Concrete Joint Locations: Submit for action plans indicating locations and details of construction joints, contraction joints, waterstops, sleeves, embedments, etc. that interact with the joints. Contractor to coordinate joint location with reinforcement shop drawings. Reinforcement shop drawings shall indicate additional reinforcement bars where required at construction joints.

.1 Joint locations for concrete slabs to receive a terrazzo or similar finish subject to reflective cracking must be coordinated with layout of finish drawings.

.10 Structural Repairs: Submit for action procedures, intended locations, and product information. Alterations to design shall be sealed and signed by a Professional Engineer licensed in the province where the project is located.

.11 Patching Defective Concrete Finishes: Submit for action procedures, intended locations, and product information.

.12 Conduit and Pipes Embedded in Concrete: Submit for action layout of embedded conduit and pipes.

.13 Hazardous Materials Notification: Submit for record as require.

.14 SER Submittal Review

.1 The Design Professionals' review and approval of shop drawings and other submittals shall be for general conformance with the design intent of the work and with the information given in the Contract Documents only and will not in any way relieve the Contractor or the Contractor's Engineer from:

1 Conforming to the Contract Documents.
2 Coordination with other trades.
3 Responsibility for all required detailing and proper fitting of construction work.
4 The necessity of furnishing material and workmanship required by Drawings and Specifications which may not be indicated on the shop drawings.
5 Control or charge of construction means, methods, techniques, sequences or procedures, for safety precautions and programs in connection with the work.

.2 TYPE 1 – Structural Submittal Review Stamp: For shop drawings for building elements designed by the SER, the responses on the shop drawing review stamp used by the SER require one of the following actions:

6 APPROVED indicates that the SER has found that the information presented on the shop or erection drawing appears to conform to the requirements of the Contract Documents. Fabrication, manufacture or construction of the elements of work shown in the shop drawing may proceed, provided that work is in compliance with the Contract Documents.

7 APPROVED AS NOTED indicates that the SER requires the shop or erection drawing to be corrected to reflect the notes and comments shown. Fabrication, manufacture or construction of the elements of work shown in the shop drawing may proceed, provided that work is in compliance with the notations shown on the shop drawings and the Contract Documents. Promptly resubmit the corrected shop or erection drawing for record.

8 REVISE and RESUBMIT indicates that the SER requires resubmission of the shop or erection drawing after correction per notes and comments. None of the elements of work shown on the shop drawing shall be fabricated, manufactured or constructed until the Contractor has received a returned shop drawing marked Approved or Approved as Noted.

9 NOT APPROVED indicates that the shop or erection drawing does not conform to the Contract Documents and must be extensively revised before re-submittal. None of the elements of work shown on the shop drawing shall be fabricated, manufactured or constructed until the Contractor has received a returned shop drawing marked Approved or Approved as Noted.

.3 TYPE 2 – Delegated Design Review Stamp: For submittals for building elements which are not designed by the SER but are delegated design items, or for items that do not form part of the completed structural system but impose loads on the structure, or for construction items or activities which have an effect on the final structure. The responses on the stamp used by the SER require one of the following actions:

1 NO EXCEPTIONS indicates that the SER has found that the information presented on the submittal appears to conform to the requirements of the Contract Documents. Fabrication, manufacture or construction of the elements of work shown in the shop drawing may proceed, provided that work is in compliance with the Contract Documents.

2 EXCEPTIONS NOTED indicates that the SER requires the submittal be corrected to reflect the notes and comments shown. Fabrication, manufacture or construction of the elements of work shown in the shop

drawing may proceed, provided that work is in compliance with the notations shown on the shop drawings and the Contract Documents. Promptly resubmit the corrected document for record.

3 REJECTED indicates that the SER requires resubmission of the submittal after correction per notes and comments. None of the elements of work shown on the shop drawing shall be fabricated, manufactured or constructed. Contractor to revise and resubmit until SER response of No Exceptions or Exceptions Noted is received.

.15 Substitution Request

1. Requests for any departure from Contract Documents must be submitted in writing by the Contractor and accepted in writing by the Design Professionals, prior to receipt of submittals.
2. All substitutions must be requested using the structural substitution request form included at the end of this section. Acceptance using the structural substitution request form indicates acceptability of the structural concept only. Contractor must submit shop drawings reflecting accepted substitutions for review in accordance with this Specification. The structural substitution request form, even if accepted, does not constitute a change order.
3. Accepted substitutions or modifications shall be coordinated and incorporated in the work at the sole expense of the Contractor.
4. The acceptance by the Design Professionals of a specific and isolated request by the Contractor to deviate from these requirements does not constitute a waiving of that requirement for other elements of, or locations in the project, unless specifically addressed as such and permitted by the Design Professionals in writing.
5. Compensation for Additional Services: Should additional work by Design Professionals such as design, documentation, meetings and/or site visits be required which are necessitated for the review and/or incorporation of the Contractor-requested substitution, including indirect effects on other portions of the work, the Contractor is responsible for paying for additional work performed by the Design Professionals at the standard billing rates plus out-of-pocket expenses incurred at cost + 10%. Additional costs for testing and inspection by the Owner shall also be compensated by the Contractor.
6. Contractor is responsible for means and methods and any impacts on other portions of the work that may arise from this substitution.

.16 Request for Information (RFI)

1. RFIs shall be submitted by the Contractor. RFIs submitted by other entities will be returned with no response.
2. Limit RFI to one subject.
3. Submit RFI immediately upon discovery of the need for interpretation or clarification of the Contract Documents. Submit RFI within timeframe so as not

to delay the Construction Schedule while allowing the full response time described below.

4. The response time for answering an RFI depends on the category in which it is assigned.

    1 Upon receipt by the SER, each RFI will be assigned to one of the following categories:

        1. No cost clarification
        2. Shown in Contract Documents
        3. Change to be issued in future document revision
        4. Previously answered
        5. Information needs to be provided by others.
        6. Request for corrective field work
        7. Request for substitution

    2 RFIs in the first five categories listed above will be turned around by the SER on average of five (5) working days.

    3 RFIs in the last two categories listed above will be immediately rejected and must be submitted as submittals or requests for substitution.

.17 On completion of the works, provide written report to Consultant certifying that the concrete in place meets performance requirements established in PART 2 - PRODUCTS.

1.9 DELIVERY, STORAGE, AND HANDLING

.1 Comply with General Conditions and Division 1.

.2 Storage

- .1 Store materials in accordance with CSA A23.
- .2 Store cement in weather-tight buildings, bins or silos that will exclude moisture and contaminates.
- .3 Store admixtures to avoid contamination, evaporation, damage, and in accordance with manufacturer's temperature and other recommendations.
- .4 Keep packaged material in original containers with seals unbroken and labels intact until time of use.

.3 Handling

- .1 Handle fine and coarse aggregates as separate ingredients.
- .2 Arrange aggregate stockpiles to avoid excessive segregation, and prevent contamination with other materials or with other sizes of like aggregates.
- .3 Do not use frozen or partially frozen aggregates.
- .4 Allow sand to drain until it has reached relatively uniform moisture content before use.

.5 Protect liquid admixtures from freezing and temperature changes that would adversely affect characteristics, and in accordance with manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 DESIGN CRITERIA

.1 To CSA A23.1/A23.2, Alternative 1 – Performance, and as described under Mixes and on Structural Drawings.

2.2 PERFORMANCE CRITERIA

.1 Concrete supplier to meet the concrete performance criteria established by the Consultant and to provide verification of compliance.

2.3 MATERIALS

.1 Portland Cement: to CSA A3001.

.2 Cementitious hydraulic slag: to CSA A3000.

.3 Fly ash: to CSA A3001, Type CI.

.4 Water: to CSA A23.1.

.5 Aggregates: to CSA A23.1/A23.2.Do not use recycled concrete as aggregate.

.6 Admixtures: not to contain chlorides.

.7 Corrosion-inhibiting admixture: calcium nitrIte solution.

.8 Plastic fibre additive: fibrillated polypropylene fibres at least 19mm (3/4”) in length.

.9 Shrinkage compensating grout: premixed compound consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agents to CSA A23.1/A23.2. Minimum compressive strength: 40 MPa at 28 days.

.10 Non premixed dry pack grout: composition of non metallic aggregate and Portland cement with sufficient water for mixture to retain its shape when made into ball by hand and capable of developing compressive strength of 40 MPa at 28 days.

.11 Curing/sealing compound: to CSA A23.1/A23.2 and ASTM C309, Type 1, Class B,water based acrylic, compatible with surface hardener where hardener is used.

.1 Floor surface hardener: See Architectural Specification.

.12 Pre-moulded joint fillers: Bituminous impregnated fiber board to ASTM D1751.

.13 Joint Sealants: to AST C920, class 100/50.

.14 Weep hole tubes: plastic.

.15 Evaporation reducer: water based polymer liquid forming continuous monomolecular temporary film on fresh concrete surface.

.16 Penetrating sealer: single component, water based clear water repellent with 40% active ingredient Alkylalkoxysilane.

.17 Bonding adhesive: Synthetic latex.

.18 Non slip nosing insert for concrete stairs: Fine aluminum oxide strips, 6mm (¼") wide x 10mm (3/8") deep.

.19 Vapour barrier: See Architectural Specification.

.20 Rigid insulation: Extruded polystyrene boards per ASTM C578, structural grade, compressive strength 40 psi (275 kPa).

.21 Control joint filler: semi-rigid filler to protect against slab edge breakdown:

.1 For sawcuts made with “Soff-Cut” saw: two component epoxy.

.2 For conventional sawcuts in interior slab: two component epoxy urethane.

.3 For conventional sawcuts in exterior slabs: two or multy component polyurethane based elastomeric.

.22 Bentonite Geotextile Waterproofing: two interlocked polypropylene geotextile sheets encapsulating a layer of bentonite.

.23 Crack Filler: low viscosity epoxy resin.

2.4 MIXES

.1 Use ready-mix concrete. Proportion concrete in accordance with CSA A23.1, Alternative 1 - Performance Method for Specifying Concrete.

.2 Set performance characteristics of concrete in plastic state in coordination with all trades involved.

.3 Meet performance criteria of concrete in hardened state as shown on Structural Drawings and provide verification of compliance.

.4 Use water-reducing agent in all concrete.

.5 Do not use admixtures containing chlorides.

.6 Dosage of polypropylene plastic fibre additive: 0.9 kg/m3.

.7 Supplementary cementing materials (SCM)

.1 Conform to CSA A23.1.

.2 Follow slag and fly ash manufacturers' directions for proportioning and mixing of concrete.

.3 Do not use SCM in architecturally exposed concrete.

.4 Use a minimum of 15% SCM for concrete that is not architecturally exposed.

.5 Fly ash not to exceed 15% of total cementitious material.

.6 Maximize SCM content in foundations, walls, columns and any other elements that do not require horizontal finished surface or rapid strength gain to permit early formwork stripping.

.7 Limit SCM content for floors with special finishes (such as Retroplate), to be compatible with the finish.

.8 Do not use concrete with more than 40% of SCM when ambient temperature is forecast to be below +10ºC at the time of concrete pour and during the seven days after the pour, except for footings, walls and columns.

.9 Reduce W/C ratio to 0.45 where using more than 40% of SCM in concrete for slabs and other horizontal finished surfaces, in order to reduce bleed water and to increase rate or strength gain.

.10 For HVSCM concrete, reduce W/C ratio and comply with additional curing and protection requirements specified in CSA A23.1, including Annex K.

PART 3 - EXECUTION

3.1 PREPARATION

.1 Provide minimum 24 hours' notice prior to placing of concrete/closing of wall forms.

.2 Obtain written approval of each foundation bearing surface by the Geotechnical Consultant before placing concrete.

.3 Remove water and disturbed soil from excavations before placing concrete.

.4 Before placing slab-on-grade, confirm that subgrade and backfill meet specifications and are free of frost and surface water.

.5 Provide vapour barrier under slabs placed on the ground including slabs-on-grade and framed slabs as described by the Architectural specifications.

.6 Place concrete reinforcing in accordance with Section 03 20 00 - Concrete Reinforcing.

3.2 INSTALLATION/APPLICATION

.1 Set sleeves, conduits, pipe hangers, weep hole tubes, drains and other inserts and openings as indicated or specified elsewhere.

.2 Refer to Typical Details and Drawing Notes for placing guidelines, maximum size and minimum spacing of sleeves, embedded pipes and conduits.

.3 Check locations and sizes of sleeves and openings shown on Structural Drawings with Architectural, Mechanical and Electrical Drawings. Notify Consultant of any discrepancies.

.4 Provide composite sleeving drawings showing sleeves required by all trades. Obtain Consultant's approval for any required sleeves and openings which are not shown on Structural Drawings.

.5 Set special inserts for strength testing as required for non destructive method of testing concrete.

.6 Set anchor rods using templates under supervision of appropriate trade prior to placing concrete. Locate each anchor rod group to within 6mm (1/4") of required location.

.7 Refer to Section 03 10 00 for construction joint requirements.

3.3 PLACING CONCRETE

.1 Place concrete in accordance with CSA A23.1.

.2 Delivery and place concrete with minimum re-handling.

.3 If concrete is pumped or placed pneumatically, control discharge velocity to prevent separation or scattering of concrete mix ingredients.

.4 Do not overload forms.

.5 Use rubber tipped vibrators for concrete containing epoxy coated reinforcement.

.6 Cast slabs and beams at least two hours after casting the supporting columns and walls.

.7 Cast slabs with a top surface that is level or sloping as required by the Drawings. Allow for cambering where required. Set top of slab below finished floor level by the distance required for the type of applied finish.

.8 Where cambered steel beams are used, ensure that slab thickness is as specified. Measure from top of steel to control thickness.

.9 Concrete exposed to view

.1 Exposed surfaces to be dense, even, uniform in colour, texture and distribution of exposed aggregate.

.2 Defects such as honeycombing, voids, loss of fines, visible flow lines, cold joints or excessive bug holes may be cause for rejection at the discretion of the Consultant.

.10 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.

3.4 FINISHING CONCRETE

.1 Finish concrete to CSA A23.1/A23.2.

.2 Cooperate with any trade applying finishes to concrete surfaces and provide surfaces which will ensure adequate bond. Provide chases and reglets where required.

.3 Finishing Flatwork

.1 See Section 03 35 00 - Concrete Floor Finishing.

.2 Protect concrete during finishing process. Refer to Architectural Specifications for the detailed requirements of Finishing Flatwork.

.3 Surface hardeners

.4 Provide where hardened concrete is required by Architectural Drawings or Specifications. Refer to Architectural Specifications for the detailed requirements of Surface hardeners.

.4 Surface Tolerances

.1 Concrete surface tolerance to CSA A23.1, Straightedge Method.

.2 Unless otherwise noted, conform to finish tolerance Class A.

.5 Finishing Formed Surfaces

.6 Completely fill holes left by through-bolts with grout.

.7 Do not patch surfaces until instructed in writing by Consultant.

.8 Concrete exposed to view

.1 Provide smooth-form finish.

.2 Rub exposed sharp edges with carborundum to produce 3 mm (1/8") radius edges unless otherwise indicated.

.9 Architectural Concrete

.1 Refer to Architectural drawings for concrete elements which are considered Architectural Concrete.

.2 Final appearance of architectural concrete is as important a factor as the engineering properties of the concrete and failure of the as-cast concrete to meet the required standard of appearance may be cause for rejection at the discretion of the Consultant.

.3 Do not patch surfaces unless instructed in writing by Consultant. All patches must match colour and texture of adjacent concrete to approval of Consultant.

.4 Provide smooth-form finish. Do not rub surfaces unless agreed to by Consultant.

.5 Provide a sandblast finish where required by Architectural Drawings. Finish surface first as required for smooth rubbed finish and arrange for review by Consultant before sandblasting. After concrete is at least 21 days old and thoroughly cured, sandblast using a hard sharp sand until coarse aggregate is in uniform relief and a light texture is achieved.

3.5 CONCRETE CURING AND PROTECTION

.1 At a minimum cure and protect concrete in accordance with CSA A23.1.

.2 Extend curing and protection period until concrete has reached following strength levels for structural safety:

.1 Framed slabs and beams: 75% of specified 28 day strength.

.2 Columns, walls, piers and footings: 50% of specified 28 day strength.

.3 For concrete containing supplementary cementing materials, curing and protection times may need to be extended beyond those outlined by CSA A23.1 to achieve the required structural properties.

.4 Cure slab surfaces immediately after finishing is completed. Unless otherwise noted, use a curing compound compatible with applied finishes.

.5 Do not use curing compound on parking garage slabs and where bonded topping is to be applied. Cover slab surfaces with absorptive mat or fabric and keep continuously wet.

.6 Slabs on grade and structural slabs receiving resilient floor or other moisture sensitive finishes:

.1 Apply 24 hours of wet curing. Start curing immediately after finishing slab.

.2 Cover slab for at least 72 hours using plastic sheets with joints taped and free edges covered.

.3 Protect finished and cured slab from surface water (i.e. rain, snow).

.4 Refer to Architectural Specifications for required testing methods prior to placing floor finishes.

.7 Concrete exposed to view:

.1 Protect during construction period from wear, damage, marking, discolouration, staining and becoming coated with concrete leakage.

.2 Unless rejected, repair damage and remove marks and stains to the approval of the Consultant.

3.6 JOINTS IN CONCRETE

.1 Locate construction and contraction joints as indicated on Drawings and on approved joint location submittal.

.1 Do not use contraction joints in framed floors or composite slabs.

.2 Locate and install construction joints so they do not impair strength or appearance of the structure, as acceptable to Design Professionals.

.3 Coordinate location of construction and contraction joints with locations of joints in finish materials where they exist.

.2 Maximum joint spacing is as indicated on Drawings.

.3 Construction Joints

.1 Construction joints shall be located within the central third of the span. Any concrete spilling over or through the bulkhead shall be removed at the completion of the pour. All surfaces of the concrete shall have reinforcing extending through the joint.

.2 Horizontal Joints: Horizontal construction joints other than those shown on the Drawings will not be permitted unless approved by the Architect.

.3 Joint Preparation: Forms shall be removed in time to permit roughening of construction joints of structural members by chipping and wire brushing to remove all loose and foreign material and roughen to ¼" [6 mm] amplitude. The existing concrete at joints shall either be (a) dampened to the point that the surface is saturated, but all standing water has been removed, promptly followed by placement and vibration of fresh concrete, or (b) not required to be dampened, with one of the specified bonding compounds applied as appropriate for the joint condition, following manufacturer recommendations, with placement and vibration of fresh concrete to follow while the epoxy bonding agent is still tacky. Joints without epoxy bonding agent require fresh concrete with slump 7 inches (180mm) or greater at horizontal joints, and fresh concrete confined to maintain pressure against the joint at vertical joints. Where such conditions are not present, or where applying water to dampen the surface is impractical, use epoxy bonding agent suitable for dry surfaces.

.4 Isolation Joints:

.1 Interrupt structural continuity resulting from bond, reinforcement or keyway at points of contact between slabs-on-grade and vertical surfaces, such as column pedestals, foundation walls and other locations, as indicated.

3.7 JOINTS IN SLABS ON GRADE

.1 Contraction Joints in Floor Slabs-on-Grade

.1 Maximum slab area controlled by jointing is 400 square feet (35 square meters).

.2 Space joints at 36 times slab thickness unless a smaller spacing is indicated on the Drawings, located to conform to bay spacing wherever possible (at column centerlines, half bays, third bays).

.3 Contraction joints can be provided by sawcuts, formed joints or appropriately detailed construction joints.

.4 Sawcuts shall be made as soon as possible after slab finishing as may be safely done without dislodging aggregate. The Soff-Cut saw shall be used to a depth of ¼ of slab thickness immediately after final finishing. Conventional saw shall be used as soon as possible after final finish without raveling to a depth as indicated on the Drawings.

.5 Where contraction joints coincide with construction joints, detail joint as indicated on Drawings.

.2 Construction joints and sawcut joints

.1 Refer to drawing notes for maximum spacing requirements.

.2 Saw cut depth to be equal to one quarter of the concrete thickness.

.3 Locate joints on column lines wherever possible and on intermediate lines, which result in approximately square panels, without re-entrant corners.

.4 Do not create “L” shaped panels nor “T” shaped joint intersections.

.5 Protect edges of sawcuts from breakage.

.6 Clean out sawcuts in exposed concrete and fill with control joint filler after concrete is at least 120 days old.

.7 Sawcut top 25 mm (1") at construction joints in exposed concrete for a width of 5 mm (3/16") and fill with control joint filler after concrete is at least 120 days old.

.8 Clean out sawcuts in other concrete and fill with a sand-cement paste one month prior to installing floor coverings.

.3 Isolation Joints

.1 Unless otherwise shown on structural drawings, provide min. 10mm (3/8”) thick pre-moulded joint filler of the same depth as the thickness of the concrete wherever slabs-on-grade abut foundation walls, columns and piers. Omit if slab is chased or dowelled into structure.

.2 Furnish filler for each joint in single piece for depth and width required for joint.

.3 When more than one piece of filler is required for a joint, fasten abutting ends and hold securely to shape by stapling or other positive fastening.

.4 Cracks in Slabs-on-Grade

.1 Extensive cracking of slabs-on-grade or cracks in excess of 3mm (1/8”) in width may be cause for rejection of slab or portion of slab at Consultant’s discretion.

.2 Protect edges of cracks in slabs-on-grade from breakage.

.3 Exposed slab on grade: Unless slab is rejected, repair cracks that are over 0.4 mm (0.016") wide:

- Fill cracks with a sand-cement grout after concrete is at least 120 days old.
- Seven days later, cut out top 20 mm (3/4") of crack for a width of 5 mm (3/16") and fill with control joint filler.

.4 Architectural slab on grade: Unless slab is rejected, repair cracks that are over 0.2 mm (0.008") wide:

- Fill cracks with epoxy after concrete is at least 180 days old.
- Take all measures necessary to prevent epoxy on surface of exposed slab.
- Have manufacturer's technical representative present during initial repairs.

3.8 PENETRATING SEALER

.1 Concrete to receive penetrating sealer to be at least 28 days old.

.2 Surfaces to be treated with the sealer to be dry and free of dirt and other contaminants.

.3 Completely remove all curing compounds before the sealer application.

.4 Follow manufacturer's recommendations for coverage rate and application procedure.

.5 Do not apply in inclement weather or if ambient air temperature or concrete surface temperature is less than 5□C or more than 38C.

3.9 GROUTING UNDER BASE PLATES AND BEARING PLATES

.1 Grout under base plates and bearing plates using procedures in accordance with manufacturer's recommendations.

.2 Provide 100% contact over grouted area.

.3 Grout column base plates and beam bearing plates as soon as steelwork is completed.

.4 Do not add load on steelwork until grouting is completed and grout strength has reached at least 20 MPa.

3.10 EXISTING STRUCTURE

.1 In addition to those noted on the structural drawings following requirements shall be satisfied.

.2 Take precautions to protect the existing structure from damage.

.3 Remove portions of existing concrete structure as required.

.4 Provide temporary shoring, bracing and underpinning to the existing structure as required.

.5 Retain a Professional Engineer to design the temporary shoring and bracing and to review this work on site.

.6 Obtain Consultant's approval before coring or cutting existing slabs, beams or walls.

.7 Retain an independent testing company to locate existing reinforcement and conduit in the areas of proposed openings and to mark locations on the surfaces of slabs and walls on which the cores and cuts are to be started using a non-destructive method.

.8 Remove toppings prior to locating reinforcement and conduit.

.9 Mark locations and sizes of cores and openings and locations of reinforcement and conduit using indelible markers as follows:

.1 Red for top bars

.2 Green for bottom bars

.3 Black for cores, openings and conduit.

.10 Relocate proposed openings and repeat process at no extra cost to the Contract if proposed locations are not acceptable to Consultant.

.11 Save the complete length of all cores. Label each core with location taken. Make all cores available for review by Consultant. Dispose of cores only with approval of Consultant. See details on structural drawings for sawcutting procedure.

.12 If new reinforcement is required at an opening, install reinforcement before cutting opening or shore up structure until new reinforcement is installed.

.13 Roughening existing surfaces:

.1 Where drawings call for a roughened surface, bush hammer entire surface to a full amplitude of at least 5mm.

.14 Patching:

.1 Patch existing concrete where necessary to provide required smooth, flat surfaces for reinforcement and for other trades.

3.11 INSPECTION AND TESTING:

.1 An independent Inspection and Testing Agency (certified under CSA A283 with category to suit testing provided) will be appointed to carry out inspection and testing of concrete and concrete materials and check conformance with applicable Standards and Contract documents.

.2 Assist the Inspection and Testing Agency in its work. Notify as to the Work Schedule and provide safe access to the work area as required. Provide concrete samples

.3 The Agency will submit reports to the Consultant, Structural Engineer, Contractor / Construction Manager, Concrete Supplier and Municipal Authorities. Reports will include the Supplier’s mix design numbers, locations in structure to which the tests relate and comments on abnormal results and conditions. The reports will be provided not later than five working days after the testing is completed.

.4 Sampling, storing, curing and testing of concrete will be in accordance with CSA A23.1/A23.2.

.5 The Agency will review all submittals pertaining to concrete mix designs and certification of plant, equipment and materials.

.6 Compressive Strength Testing:

.1 One test is required for each 100 cubic meters of placed concrete, but not less than one test for each concrete mix placed each day.

.2 A group of three cylinders for each test will be provided, One specimens will be tested at 7 and one at 28 days. The third specimen will be tested at 56 days if the required strength at 28 days is not achieved.

.3 If the final concrete strength is specified at 56, 90 or 120 days, a group of four cylinders will be provided. One specimen will be tested at 7 and one at 28 days, with the third specimen tested at the time the final concrete strength is specified. If the required strength is not achieved at the time specified, the fourth specimen will be tested 28 days later.

.4 One additional cylinder will be provided for each concrete mix during cold weather concreting. The specimens will be cured on site adjacent to and under the same conditions as the work they represent, and will be tested prior to form removal..

.5 If standard on site cured cylinders are used to determine concrete strength prior to removal of formwork, they will be kept adjacent to and under the same conditions as the work they represent.

.6 If pull out tests are used to determine concrete strength prior to removal of formwork, the Inspection and Testing Agency will supply, locate and test pull out inserts. The inserts not to be located on surfaces exposed to view.

.7 If maturity tests are used to determine concrete strength prior to removal of formwork, the Inspection and Testing Agency will develop strength-maturity relationship curves, provide and install temperature sensors into fresh concrete and interpret readings in accordance with ASTM 1074.

.7 Air Entrainment Testing:

.1 One standard test for air content in plastic concrete will be conducted for each 100 cubic meters of each air entrained concrete mix.

.2 One standard test per ASTM C457 will be conducted to determine air void spacing factor in hardened concrete for each 100 cubic meters each air entrained concrete mix.

.8 Permeability Testing:

.1 One Rapid Chloride Ion Permeability Test according to ASTM C 1202 will be conducted for each 100 cubic meters of all class C1 concrete mixes used for floor and roof slabs and for salt water pools.

.9 Fresh Density Testing:

.1 One standard fresh density test will be performed on site for each 50 cubic meters of low concrete. Assist the Agency to correlate fresh density with air-dry density prior to the work beginning on site. Reports will include both fresh density and air-dry density.

.10 Bond Strength Testing:

.1 One standard bond test will be provided for each 200 square meters of bonded concrete topping placed over hardened concrete and designed to act compositely with it.

.11 Inspection and testing by the Agency will not augment or replace the Contractor's quality control nor relieve him of his contractual responsibility.

3.12 CONCRETE REPAIRS

.1 Contractor shall submit patching and repair methods and materials for review by Design Professionals.

.2 When complete, all patches and repairs shall match color and texture of adjoining surfaces.

.3 At surfaces that are exposed to view, prepare test areas at inconspicuous locations for review by Design Professionals to verify repair color and texture match before proceeding with repair.

.4 Apply all patching and repair materials in accordance with manufacturer's specifications.

.5 Repairing Cracks In Formed and Unformed Surfaces

.1 Contractor shall notify Design Professionals of all cracks wider than 0.02" (0.50mm) and all cracks wider than 0.01" (0.25mm) that occur in a group of at least three cracks within twelve inches (300mm), in concrete. If Design Professionals deem repairs necessary, Contractor shall be responsible for repairing all such cracks per Design Professionals recommendation at no expense to the Owner. Repairs will generally require one or more of the following: Epoxy Injection, Semi-Rigid Epoxy, Pressure Injected Foam Resin, Methyl Methacrylate and/or Sealant with joint routed and cleaned.

.6 Repairing Formed Surfaces

.1 Immediately after stripping forms, patch all honeycombing, defective joints, voids, etc. before the concrete is thoroughly dry.

.2 Remove all burrs, fins, and ridges before the concrete is thoroughly dry.

.3 Remove stains from rust, grease and oils, from release agents, etc.

.4 Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of the Design Professionals.

- Surface defects, include color and texture irregularities, cracks as defined above, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

- Chip away defective areas, honeycomb, rock pockets, voids over 1/4" (6mm) in any dimension and holes left by tie rods and bolts, down to solid concrete but in no case to a depth less than 1" (25mm) and saw-cut edges to prevent feather edging of fill material.

5. Repair concealed formed surfaces, where possible, containing defects that affect the durability of concrete. If defects cannot be repaired, remove and replace concrete.
6. Clean out form tie holes and fill with dry pack mortar or precast cone plugs secured in place with bonding agent.
7. If honeycombing exposes reinforcement, chip to provide clear space at least 3/4" (20mm) wide all around steel to allow proper bond.

.7 Repairing Unformed Surfaces

1. High and Low areas in concrete surfaces which are in excess of specified tolerances shall be leveled or ground-smooth.

- Correct high areas by grinding after concrete has cured at least 14 days.

- Correct low areas by applying leveling material. Finish leveling material as specified in this section.

2. Repair surfaces containing defects that affect durability of concrete.

- Surface defects include crazing, cracks as defined above, spalling, popouts, honeycombs, rock pockets, and other objectionable conditions.

3. Repair defective areas, except random cracks and single holes not exceeding 1" (25mm) in diameter, by cutting out and replacing with fresh concrete.

- Remove defective areas with clean, square cuts and expose reinforcing steel with at least 3/4" (20mm) clearance all around.

.8 Filling In: Fill in holes and openings left in concrete for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place.

3.13 EVALUATION AND ACCEPTANCE OF CONCRETE

.1 In accordance with CSA A23, except where otherwise specified.

.2 If, at any time during construction, the concrete resulting from the approved mix design deviates from Specification requirements for any reason, such as lack of workability, or insufficient strength, the Contractor shall have his laboratory verify the deficiency and modify the mix design, until the specified concrete is obtained. Modified mix to be submitted for approval per Part 1 - SUBMITTALS.

3.14 CORRECTIVE MEASURES

.1 Conflicts: The Contractor shall be solely responsible for errors of detailing, fabrication, and placement of reinforcement steel; placement of inserts and other embedded items; and the structural adequacy of all formwork.

.2 Compensation for Additional Services: Should additional work by Design Professionals such as design, documentation, meetings and/or site visits be required which are necessitated by failure of the Contractor to perform the work in accordance with the Contract Documents either developing corrective actions or reviewing corrective actions developed by others, the Contractor is responsible for paying for additional work performed by the Design Professionals at their standard firm-wide billing rates plus out-of-pocket expenses incurred at cost + 10%. Additional costs for testing and inspection by the Owner shall also be compensated by the Contractor.

END OF SECTION 03 30 00

PART 1 - **GENERAL**

1.1 RELATED REQUIREMENTS

.1 Work of this Section shall conform to requirements of Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections.

1.2 REFERENCE STANDARDS

.1 CSA Group.

.1 CAN/CSA-A165 Series, CSA Standards on Concrete Masonry Units

.2 CAN/CSA-A371, Masonry Construction for Buildings.

.3 CSA S304.1, Design of Masonry Structures.

.2 National Research Council Canada (NRC)

.1 National Building Code of Canada 2010 (NBC).

.3 South Coast Air Quality Management District (SCAQMD)

.1 SCAQMD Rule 1168-05, Adhesive and Sealant Applications.

.4 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S101-07(R2010), Standard Methods of Fire Endurance Tests of Building Construction and Materials.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00- Common Product Requirements with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.1 Offload concrete unit masonry packages using equipment that will not damage the surfaces.

.2 Do not use brick tongs to move or handle masonry.

.3 Storage and Handling Requirements:

.1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Do not double stack cubes of concrete unit masonry.

.3 Cover masonry units with non-staining waterproof membrane covering.

.4 Allow air circulation around units.

.5 Installation of wet or stained masonry units is prohibited.

.6 Keep concrete unit masonry in individual cardboard packaging provided by manufacturer until units are ready to be installed.

.7 Store and protect concrete unit masonry from nicks, scratches, and blemishes.

.8 Replace defective or damaged materials with new.

.4 Reinforcing bars for masonry are supplied by Section 03 20 00 and installed by the Masonry Trade. Note that shop drawings are to be provided by Section 03 20 00 to the Masonry Trade.

.5 Dovetail anchor slots for tying to concrete walls and columns are supplied and installed by Section 03 30 00.

.6 Loose angle lintels are supplied by Section 05 12 10 and installed by the Masonry Trade.

.7 Shelf angles/plates and wall plates that bear on or are attached to masonry are supplied by Section 05 12 10 and installed by the Masonry Trade.

.8 Masonry anchors for anchoring to steel columns are supplied by Section 05 12 10 and installed by the Masonry Trade.

.9 Lateral support angles at tops of exterior masonry walls are supplied and installed by the Contractor.

.10 Test reports be provided by masonry unit producers and submitted for review.

PART 2 - **PRODUCTS**

2.1 MATERIALS

.1 Standard concrete block units: to CAN/CSA-A165 Series (CAN/CSA-A165.1).

2.2 TOLERANCES

.1 Tolerances for standard concrete unit masonry tolerances in accordance with CAN/CSA-A165.1, supplemented as follows:

.1 Maximum variation between units within specific job lot not to exceed 2 mm.

.2 No parallel edge length, width or height dimension for individual unit to differ by more than 2 mm.

.3 Out of square tolerance not to exceed 2 mm.

2.3 OTHER PRODUCTS

.1 Open-ended blocks where required.

.2 Knock-out blocks where required.

.3 Rebar positioners (dur-o-wal da810 or equivalent).

.4 Masonry connectors (ties and anchors) are to conform to CSA A370 and that a letter, signed and sealed by a professional engineer, be provided by the manufacturer confirming this.

.5 All ties and joint reinforcement in exterior walls are to be hot-dipped galvanized or, where required, stainless steel. See CSA A370 for exact requirements.

PART 3 - **EXECUTION**

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for concrete unit masonry installation in accordance with manufacturer's written instructions.

3.2 PREPARATION

.1 Protect adjacent finished materials from damage due to masonry work.

3.3 CONSTRUCTION

.1 Masonry construction is to conform to CSA A371.

.2 All masonry is to be running bond. This need not apply to a veneer provided that it is tied together with joint reinforcement, coordinate with architect if any stack pattern is being specified.

.3 Rebar positioners be used to position vertical reinforcing bars in walls.

.4 Knock-out blocks be used where horizontal reinforcing bars occur in walls.

.5 Where reinforced walls are built to underside of structure that is already in place, specify that open-ended blocks be used at tops of walls to fit around vertical reinforcing bars.

.6 Masonry reinforcement, except joint reinforcement, shall be as indicated on the Structural Drawings.

.7 For composite walls that mortar joints line up so that wythes can be tied together at 400 mm on center vertically, that all collar joints be filled solidly with mortar or grout, and that the walls be built from units that have been well cured beforehand.

.8 Field control testing is required for all loadbearing masonry and for all reinforced masonry. At least 6 mortar cubes are to be tested for each 500 m2 of wall, or portion thereof. At least 2 cylinder tests shall be made for each 20 cubic meters of grout or less. Test methods and results shall conform to CSA A179.

3.4 INSPECTION AND TESTING

.1 The inspection and testing company use a covermeter to determine approximate cover and splice length of rebar in some newly built walls near mid-height. Locations to be selected by Consultant. Scaffold access to be provided for inspection and testing company by Contractor. Allow for 3 locations, each 3 meters long. Access to be provided at additional locations by Contractor at no extra cost if reinforcement fails test at one or more locations.

.2 Inspection openings shall be made in walls at their mid-height in order to verify location of reinforcement if necessary. Wall to be at least 7 days old when opening is made. Locations to be selected by Consultant based on covermeter results. Scaffold access to openings to be provided for Consultant. Openings to be made good after inspection by Consultant is done. Additional access and inspection openings to be provided by Contractor at other locations at no extra cost if reinforcement fails test at one or more openings.

3.5 PROTECTION

.1 Brace and protect concrete unit masonry in accordance with Section 04 05 00- Common Work Results for Masonry.

END OF SECTION 04 22 01

PART 1 - GENERAL

1.1 SCOPE

.1 Work of this Section shall conform to requirements of Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections.

1.2 SCOPE

.1 The work covered by this Section shall include all labor, material, equipment, permits, engineering and other services necessary for the fabrication and installation of structural steel and related work, complete, in accordance with the Drawings and as specified herein.

1.3 RELATED REQUIREMENTS

.1 Section 03 30 00: Cast in Place Concrete.

.2 Section 09 91 00: Painting.

1.4 REFERENCES

.1 All referenced standards to be the current edition or the edition referenced by the applicable Building Code in force at the time of building permit application, as noted on Structural Drawings.

.2 Canadian Standards Association (CSA International):

.1 CSA G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.2 CSA S16, Limit States Design of Steel Structures.

.3 CSA S136, North American Specifications for the Design of Cold Formed Steel Structural Members.

.4 CSA W47.1, Certification of Companies for Fusion Welding of Steel.

.5 CSA W48, Filler Metals and Allied Materials for Metal Arc Welding.

.6 CSA W55, Certification of Companies for Resistance Welding of Steel and Aluminum.

.7 CSA W59, Welded Steel Construction (Metal Arc Welding).

.8 CSA W186, Welding of Reinforcing Bars in Reinforced Concrete Construction.

.3 ASTM International Inc.:

.1 ASTM A123/A123M, Standard Specification for Zinc (Hot Dip Galvanized) coating on Iron and Steel Products.

.2 ASTM A36/A36M, Standard Specification for Carbon Structural Steel.

.3 ASTM F3125/F3125M, Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPA) Minimum Tensile Strength, Inch and Metric dimensions.

.4 ASTM A500, Specification for Cold Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

.5 ASTM A53/A53M, Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc-Coated, Welded and Seamless.

.6 ASTM A1011/A1011M, Standard Specifications for Steel, Sheet and Strip, Hot Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability and Ultra High Strength.

.7 ASTM A1085/A1085M, Standard Specification for Cold Formed Welded Carbon Steel Hollow Structural Sections (HSS).

.8 ASTM A992, Standard Specifications for Structural Steel Shapes.

.9 ASTM F1554, Standard Specification for Anchor Bolts, Steel 36, 55 and 105 ksi Yield Strength.

.4 Canadian Institute of Steel Construction (CISC)/Canadian Paint Manufacturers Association (CPMA):

.1 CISC Handbook of Steel Construction.

.2 CISC/CPMA Standard 1-73a, A Quick-drying One-coat Paint for Use on Structural Steel.

.3 CISC/CPMA Standard 2-75, Quick-drying Primer for Use on Structural Steel.

.4 CISC Code of Standard Practice, Appendix I, Architecturally Exposed Structural Steel (AESS).

.5 The Society for Protective Coatings (SSPC) and National Association of Corrosion Engineers (NACE) International:

.1 SSPC-SP 1, Solvent Cleaning.

.2 NACE No. 3 / SSPC-SP 6, Commercial Blast Cleaning.

.3 NACE No.4 / SSPC-SP 7, Brush Off Blast Cleaning.

.4 NACE No.2 / SSPC-SP 10, Near White Blast Cleaning.

.5 SSPC Technology Guide No.14 – Guide for the Repair of Imperfections in Galvanized, Organic or Inorganic Zinc-Coated Steel Using Organic Zinc Rich Coating.

.6 SSPC Paint Specification No. 20 – Zinc Rich Coating, Type I – Inorganic and Type II - Organic.

1.5 QUALITY ASSURANCE

.1 In accordance with Section 01 43 00 – Quality Assurance.

.2 Qualifications:

.1 Structural steel fabricator to be certified by the Canadian Welding Bureau under the requirements of CSA W47.1, Division 1 or 2 for fusion welding and/or CSA W55.3 for resistance welding of structural steel components, and to have CWB approved procedure for welding rebars (Grade 400W) to structural steel

.2 Welders to be CWB approved, working under supervision of a CWB approved firm.

.3 Engage a Professional Engineer licensed in the place where the project is located to be responsible for design, detailing and installation of all connections related to structural steel work.

1.6 QUALITY CONTROL

.1 Submit in accordance with Section 01 45 00 – Quality Control.

.2 Tolerances

.1 Conform to the fabrication and erection tolerances of CAN/CSA S16.

.2 Comply with more stringent tolerances if specified elsewhere to suit interfacing materials or AESS members.

1.7 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Calculations and Shop Drawings:

.1 Provide drawings stamped and signed by the Professional Engineer responsible for steel connections.

.2 Material shall not be fabricated or delivered before the shop and erection drawings have been approved or approved as noted by the Design Professionals and returned to the Contractor.

.3 Connection design calculations: Calculations are required for all details that are not indicated on the Drawings as “Completely Designed.” Each calculation package shall be sealed and signed by the Contractor’s Engineer.

.4 Structural Steel Shop Drawings: Submitted shop drawings shall include layouts and details for each member showing the steel type and grade, size, connections, cuts, copes, holes, bolts, welds, surface treatments (cleaning, shop paint, etc.) and provisions for the connection of other work. Steel type, grade and size for all attached elements shall also be shown.

.5 Shop and erection drawings shall contain complete dimensional and geometric information, based on established dimensions shown on Contract Documents, and shall not be scaled from Contract Documents. The shop drawings shall clearly distinguish between shop and field welds and bolts, identify pretensioned high strength bolts and identify surface preparation requirements at slip critical connections.

.6 Welds: All welds shall be indicated by standard welding symbols in the CSA S16 or as accepted by the Structural Engineer. Shop and erection drawings shall show the size, length, and type of each weld, including the electrode type to be used.

.7 Bolts: Details for bolt assemblies shall indicate bolt size, length, type and the presence, type and location of washers where required as part of the assembly; distinguish between N and X bolts, distinguish between slip-critical and bearing bolts; specify approved slip critical coatings; and distinguish between shop and field bolts. Also, indicate bolt orientation where required by the Contract Documents.

.8 Before submitting shop drawings, provide a letter signed and sealed by that Engineer stating that he has been engaged to undertake the responsibility for the above. Also submit a copy of that Engineer's Certificate of Authorization, and proof of his liability insurance.

.9 If additional information is required from the Consultant, allow a minimum of five working days for the Structural Engineer to review and respond to the request for information.

.10 It is advisable to submit erection diagrams for review before preparing shop details. Copies of plans and section details developed by Thornton Tomasetti will not be accepted as erection diagrams.

.3 Fabrication drawings:

.1 Submit fabrication drawings showing designed assemblies, member sizes, components and connections. Show on drawings:

.1 Material specifications.

.2 Surface preparation.

.3 Shop painting / galvanizing.

.4 Section splices.

.5 Types of shop and field connections.

.6 Net weld lengths.

.7 Precautions which will be taken to exclude threads from shear planes of bearing type bolted connections (where applicable).

.8 Protected zones.

.9 Vent holes required for galvanizing process.

.10 Camber.

.11 Architectural clearance lines and finishes where connections could encroach other works.

.12 Beam and column web holes required for services and reinforcing around them.

.2 Indicate members which are considered AESS, and their category. Refer to AESS Category Matrix as shown in Table 1 of the CISC Code of Standard Practice, Appendix I.

.1 For AESS bolted connections, indicate bolt type, finish and which side of the connection bolt heads should be placed.

.2 For AESS welded connections, show grinding, profile and weld finish.

.3 Show details by which steel assemblies, which are set in concrete, are to be connected to the formwork.

.4 Substitution of alternative sections will only be allowed provided the new members have equal or greater capacity and stiffness and their dimensions are approved by the Consultant.

.4 Provide technical specifications for all sliding bearing assemblies.

.5 Quality Control Program: Submit for record complete details of the Contractor's quality control program including the names of the personnel responsible for this work.

.6 Product Data: Submit for action manufacturers' specifications, test reports and applicable standards for all products listed under Part 2: Products. Standard literature shall be edited to suit job conditions.

.7 Welding Procedures Specification (WPS): Submit written welding procedures developed by Contractor’s welding consultant for Heavy Shapes Welds. Submit all welding and qualification procedures to the Owner's Testing Agency for approval.

.8 Welder Certification: Submit for record certification that the welders acceptable to the governing authority.

.9 SER Submittal Review

.1 The review of connection design and the review and approval of shop and erection drawings and other submittals by the Design Professionals shall be for general conformance with the design intent of the work and with the information given in the Contract Documents only and will not in any way relieve the Contractor or the Contractor's Engineer from:

1 Responsibility for the adequacy of the design of the connections designed by the Contractor's Engineer.
2 Responsibility for all required detailing.
3 Responsibility for the proper fitting of construction work in strict conformance with the contract requirements.
4 The necessity of furnishing material and workmanship required by contract Drawings and Specifications which may not be indicated on the shop and erection drawings.
5 Conforming to the Contract Documents.
6 Coordination with other trades.
7 Control or charge of construction means, methods, techniques, sequences or procedures, for safety precautions and programs in connection with the work.

.2 TYPE 1 – Structural Submittal Review Stamp: For shop drawings for building elements designed by the SER, the responses on the shop drawing review stamp used by the SER require one of the following actions:

1 APPROVED indicates that the SER has found that the information presented on the shop or erection drawing appears to conform to the requirements of the Contract Documents. Fabrication, manufacture or construction of the elements of work shown in the shop drawing may proceed, provided that work is in compliance with the Contract Documents.
2 APPROVED AS NOTED indicates that the SER requires the shop or erection drawing to be corrected to reflect the notes and comments shown. Fabrication, manufacture or construction of the elements of work shown in the shop drawing may proceed, provided that work is in compliance with the notations shown on the shop drawings and the Contract Documents. Promptly resubmit the corrected shop or erection drawing for record.
3 REVISE and RESUBMIT indicates that the SER requires resubmission of the shop or erection drawing after correction per notes and comments. None of the elements of work shown on the shop drawing shall be fabricated, manufactured or constructed until the Contractor has received a returned shop drawing marked Approved or Approved as Noted.
4 NOT APPROVED indicates that the shop or erection drawing does not conform to the Contract Documents and must be extensively revised before re-submittal. None of the elements of work shown on the shop drawing shall be fabricated, manufactured or constructed until the

Contractor has received a returned shop drawing marked Approved or Approved as Noted.

.3 TYPE 2 – Delegated Design Review Stamp: For submittals for building elements which are not designed by the SER but are delegated design items, or for items that do not form part of the completed structural system but impose loads on the structure, or for construction items or activities which have an effect on the final structure. The responses on the stamp used by the SER require one of the following actions:

1 NO EXCEPTIONS indicates that the SER has found that the information presented on the submittal appears to conform to the requirements of the Contract Documents. Fabrication, manufacture or construction of the elements of work shown in the shop drawing may proceed, provided that work is in compliance with the Contract Documents.

2 EXCEPTIONS NOTED indicates that the SER requires the submittal be corrected to reflect the notes and comments shown. Fabrication, manufacture or construction of the elements of work shown in the shop drawing may proceed, provided that work is in compliance with the notations shown on the shop drawings and the Contract Documents. Promptly resubmit the corrected document for record.

3 REJECTED indicates that the SER requires resubmission of the submittal after correction per notes and comments. None of the elements of work shown on the shop drawing shall be fabricated, manufactured or constructed. Contractor to revise and resubmit until SER response of No Exceptions or Exceptions Noted is received.

.10 Substitution Request

1. Requests for any departure from Contract Documents must be submitted in writing by the Contractor and accepted in writing by the Design Professionals, prior to receipt of submittals.
2. All substitutions must be requested using the structural substitution request form included at the end of this section. Acceptance using the structural substitution request form indicates acceptability of the structural concept only. Contractor must submit shop drawings reflecting accepted substitutions for review in accordance with this Specification. The structural substitution request form, even if accepted, does not constitute a change order.
3. Such substitutions or modifications, if acceptable to the Design Professionals shall be coordinated and incorporated in the work at the sole expense of the Contractor.
4. The acceptance by the Design Professionals of a specific and isolated request by the contractor to deviate from these requirements does not constitute a waiving of that requirement for other elements of, or locations in the project, unless specifically addressed as such and permitted by the Design Professionals in writing.

5. Compensation for Additional Services: Should additional work by Design Professionals such as design, documentation, meetings and/or site visits be required which are necessitated for the review and/or incorporation of the Contractor-requested substitution, including indirect effects on other portions of the work, the Contractor is responsible for paying for additional work performed by the Design Professionals at the standard billing rates plus out-of-pocket expenses incurred at cost + 10%. Additional costs for testing and inspection by the Owner shall also be compensated by the Contractor.
6. Contractor is responsible for means and methods and any impacts on other portions of the work that may arise from this substitution.

.11 Request for Information (RFI)

1. RFI shall originate with the Contractor. RFI submitted by entities other than that Contractor will be returned with no response.
2. Limit RFI to one subject.
3. Submit RFI immediately upon discovery of the need for interpretation or clarification of the Contract Documents. Submit RFI within timeframe so as not to delay the Construction Schedule while allowing the full response time described below.
4. The response time for answering an RFI depends on the category in which it is assigned.

    1 Upon receipt by the SER, each RFI will be assigned to one of the following categories:

    - No cost clarification.
    - Shown in Contract Documents.
    - Change to be issued in future bulletin.
    - Previously answered.
    - Information needs to be provided by others.
    - Request for corrective field work.
    - Request for substitution.

    2 RFIs in the first five categories listed above will be turned around by the SER on average of five (5) working days.

    3 RFIs in the last two categories listed above will be immediately rejected and must be submitted as submittals or requests for substitution.

1.8 TEMPORARY SUPPORT OF STRUCTURAL STEEL FRAME

.1 The structure as shown on the Contract Documents is designed to withstand the design loads only when all structural elements are installed and fully connected. The contractor shall be responsible for the analysis of all components and assemblies for stresses and displacements that may be imposed by fabrication, shipping, handling, erection, temporary conditions, construction loads, etc., and ensure the stability of all steel components e.g. beams, columns, trusses and braces during erection. The analysis of such shall be performed by the Contractor's Engineer.

1.9 DELIVERY, STORAGE, AND HANDLING

.1 Delivery: Unload all structural steel promptly upon arrival and store in an area designated and approved by the Owner at the site of the work. The Contractor shall be responsible for any charges from failure to unload material promptly.

.2 Storage: Store structural steel to drain properly. Provide weep holes and clean out as required to keep steel free from water. Provide adequate protection and shoring to prevent distortion and other damage. Store structural steel on timber; do not lay on mud, directly on ground or cinders, or otherwise handle in a manner that damages finishes. Stored sections shall be readily accessible for inspection.

.3 Store fasteners in a protected place.

.4 Welding materials to be in moisture resistant, undamaged package. Maintain packages effectively sealed until electrode is required for use.

PART 2 - PRODUCTS

2.1 DESIGN REQUIREMENTS

.1 Design details and connections in accordance with requirements of CSA S16 and CSA S136 to resist forces and to allow for movements indicated. Consider load effects due to fabrication, erection and handling.

.2 Connection design to include consideration of all pass-through forces, including tension, compression, moment and shear. Provide local reinforcement at connection or joint as required.

.3 Follow conceptual connection details if shown on structural drawings. Do not change without TT-S written approval. If welds are defined on drawings, the sizes shown are minimum requirements which might need to be increased to suit connection design.

.4 Increase specified section thickness at no extra cost if required for fabrication (bending) or galvanizing. Alternatively, build up curved sections from plates.

.5 Assume that bolt threads are intercepted by shear plane, unless special measures are indicated on shop drawings to exclude threads from shear plane.

.6 Beams:

.1 Select beam end connections from CISC "Handbook of Steel Construction" when connection for shear only (standard connection) is required.

.2 Typical beam to spandrel beam and beam to column connections to be two sided or end plate connections.

.3 Select or design beam end connections for factored shear indicated on plans, and also refer to general notes on structural drawings for detailed requirements.

.4 When shears are not indicated, select or design non composite beam end connections to resist reaction due to maximum uniformly distributed load capacity of the beam in bending.

.5 Where axial forces occur in beams framing to opposite sides of a supporting member, design connections for a pass-through force equal to the smaller axial force. If beam sizes differ, assume the axial force is centred in the smaller beam.

.6 Where axial forces occur in beams framing into columns, connect each beam for the axial force shown.

.7 Where no axial force is shown for beam to column connection, design to resist horizontal tension / compression equivalent to 2% of the factored axial force in column, in addition to all other loads.

.8 Seated beam connections to have top clip angles.

.9 End bearing connections of inclined members to have horizontal bearing plane at supported member.

.10 Extend beams bearing on walls for the full length of bearing plates.

.11 For beams continuous over supports and for beams supporting columns, provide min. 6 mm (1/4”) stiffener plates at each side of web at point of concentrated load, unless thicker stiffeners are required by connection design or different details are shown on drawings.

.12 Provide all spandrel beams and all floor beams not fully braced by floor construction with top and bottom flange connections for torsional restraint.

.7 Columns:

.1 In addition to all other loads, connect columns to base plates to transfer horizontal load equal to 2% of the column vertical load.

.2 In addition to all other loads, connect columns to base plates to transfer tensile load equal to the capacity of all anchor bolts.

.3 Provide seat angles for joist support at sides of columns continuous through floor.

.4 Provide connection for tie joist bottom chord at all columns supporting joists; coordinate with joist supplier.

.5 Unless otherwise noted on drawings, provide 102 x 102 x 9.5 seat angles attached to sides of columns to support masonry lintels adjacent to columns. Length of seat to equal width of lintel minus 25 mm (1").

.6 Provide connection for masonry wall steel lintels adjacent to columns.

.7 Provide diagonal or cantilevered angles at sides of columns where required to support deck or slab.

.8 Provide cap plates at tops of columns where required for support of deck, slab, joists, beams or roof anchors.

.9 Where columns are built in and stabilized by masonry walls, provide anchors to masonry walls per typical details.

.8 Bracings:

.1 Shape and size gusset plates to accommodate required finishes and clearances; refer to Architectural and Mechanical drawings.

.2 Detail plate and rod bracing connections to be adjustable and to be able to be prestressed to approximately 15 MPa.

.3 Design gusset plates and bracing connections for members which are parts of seismic force resisting system to allow ductile rotation and to satisfy requirements of CSA S16. Design gusset plates for other compression members for the force equivalent to twice the specified compression member force, or provide stiffeners to prevent gusset plate buckling.

.9 Moment connections:

.1 Provide moment connections at splices to maintain continuity of cranked beams. Provide header plates or stiffener plates to resist unbalanced flange forces at splices.

.2 Where moment connections are called for but values are not indicated, design for moment capacity of the smaller member in the connection.

.3 Install web and flange stiffener plates at moment connections as required by connection design and detail but in every case when indicated on the drawings. If the shear generated in column web exceeds its shear capacity, reinforce the web.

.10 Holes:

.1 Where holes for services are required through webs of beams or columns, coordinate size and location with Architectural, Mechanical and Electrical drawings, and show on fabrication drawings. Reinforce in accordance with Typical Detail. Alternatively, design reinforcing in accordance with the procedure set forth in the CISC Handbook of Steel Construction, and provide calculations for TT-S review.

.2 Provide holes in beam flanges or weld threaded studs as required for attachment of wood nailers.

.3 Provide 16 mm (5/8”) diameter weep holes in base plates of HSS columns which are not made watertight.

.4 Provide vent holes in HSS sections where required for galvanizing process. Locate so that any water inside HSS will drain away when HSS is in its final position. Maximum size – 16 mm (5/8”) diameter. Fill holes with vent hole plugs after galvanizing.

.5 Provide 12 mm (1/2”) dia. holes in HSS columns to be filled with concrete. Locate at opposing column faces 150 mm (6”) from each end.

.6 Provide 19 mm (3/4”) dia. vent holes at centerline of all cast in plates supporting columns.

.7 Provide 50 mm (2”) dia, grouting holes in column bearing plates larger than 600 mm x 600 mm (24”x24”)

.11 Provide all wall supporting members (shelf angles, hangers, stubs, back braces, etc.) which are attached to floor beams with adjustable connections capable to compensate for the deflection of the floor beams due to self weight of concrete. Anticipate beam deflection to be equivalent to the camber shown, or 20 mm (whichever is more). Alternatively, fabricate based on actual deflected shape of the beams as measured after concrete is poured.

.12 Provide slotted holes long enough to allow for deflection indicated on drawings plus construction tolerance, assuming bolts are centred in slots. Bolts are to be finger-tight with burred threads to allow for movement during the life of structure without bolts loosening.

.13 Do not oversize anchor rod holes for site tolerances. Use hole sizes suggested in the CISC Handbook of Steel Construction.

.14 Provide closure plates for all exposed and for all exterior tubular members.

2.2 MATERIALS

.1 Structural steel:

.1 Rolled shapes: to CSA G40.21 or ASTM A992, refer to drawings.

.2 Hollow structural sections: to ASTM A500, ASTM A1085 or CSA G40.21.

.3 Structural pipe: to ASTM A53.

.2 Anchor rods: CSA G40.21,or ASTM 1554, refer to drawings.

.3 Bolts, nuts and washers: to ASTM F3125, grade A325.

.4 Load indicating washers: to ASTM F959.

.5 Weldable reinforcing steel: to CSA G30.18, deformed bars.

.6 Grating: Galvanized safety grating. Minimum thickness of material 2mm (0.079"}. Banded ends. Bolted connections. Capacity 4.8 kPa (100 psf) unless noted otherwise on drawings. Maximum deflection 1/180th of span.

.7 Checker plate: to CSA G40.21, Grade 300W. Plate with rolled-in embossments to provide non-slip surface.

.8 Welding materials: to CSA W48 and CSA W59, certified by Canadian Welding Bureau. For members in seismic force resisting system, refer to additional requirements in CSA S16.

.9 Shop paint: to CISC/CPMA 1-73a.

.10 Shop paint primer: to CISC/CPMA 2-75, solvent reducible alkyd, red oxide, compatible with specified topcoat.

.11 Zinc-rich coating: to SSPC Paint Specification No.20, compatible with top coat (where specified).

.12 Hot dip galvanizing: to ASTM A123/A123M, minimum zinc coating of 600 g/m².

.13 Headed studs: to CSA W59.

.14 Joint filler for exposed steelwork: Epoxy resin.

.15 Sliding bearing assembly: Galvanized top steel plate with a type 304 stainless steel highly polished lower surface and bottom elastomeric pad with a polytetrafluoroethylene (Teflon) upper surface. Static and kinetic coefficients of friction not to exceed 5% under 7MPa to 14MPa working stress. Elastomeric bottom pad to allow a 2% rotation of upper plate and still maintain a substantially uniform bearing pressure between plate and pad.

.16 Elastomeric bearing pad: Structural grade 50 durometer neoprene.

.17 Galvanizing vent hole plug: Grade 6061 Aluminum circular plug.

2.3 FABRICATION

.1 Fabricate structural steel in accordance with CSA S16 and with reviewed shop drawings.

.2 Install shear studs in accordance with CSA W59.

.3 Continuously seal hollow members exposed to weather by intermittent welds and plastic filler unless continuous welds are indicated on drawings.

.4 Provide holes in beam flanges or weld threaded studs as required for attachment of wood nailers.

.5 Position beams having permissible mill camber so that the camber is up.

.6 Install stud anchors in shop with end welds in accordance with the recommendations of the stud manufacturer. Lengths of studs given on drawings are the lengths after welding. Replace studs that crack in the weld or shank.

.7 Increase specified section thickness at no extra cost if required for fabrication (bending) or galvanizing, Alternatively, fabricate curved sections from plates.

.8 Provide 16mm (5/8”) diameter weep holes in base plates of HSS columns which are not made watertight.

.9 HSS members which require galvanizing to either be per CSA G40.21, grade 350W, Class H, or to be stress relieved prior to galvanizing.

.10 Provide vent holes in HSS sections where required for galvanizing process. Located so that any water inside HSS will drain away when HSS is in its final position. Maximum size – 16mm (5/8”) diameter. Fill holes with vent hole plugs after galvanizing.

.11 Provide 12 (1/2”) dia. holes in HSS columns to be filled with concrete. Locate at opposing column faces 150mm (6”) from each end.

.12 Provide 19 (3/4”) dia. vent holes at centerline of all cast in plates supporting columns.

.13 Provide 50 (2”) dia, grouting holes in column bearing plates larger than 600x600 (24”x24”).

.14 Extend beams bearing on walls for the full length of bearing plates. Provide cap plates at tops of columns where required for support of deck, slab, joists, beams or safety anchors.

.15 Where columns are built in and stabilized by masonry walls, provide anchors to masonry walls per typical details.

.16 Mill column bearing plates as required to provide full contact bearing and develop column bearing strength.

.17 In addition to all other loads, connect columns to base plates to transfer horizontal load equal to 2% of the column vertical load.

.18 In addition to all other loads, connect columns to base plates to transfer tensile load equal to the capacity of all anchor bolts.

.19 Provide connection for tie joist bottom chord at all columns supporting joists, coordinate with joist supplier.

.20 Provide closure plates for all exposed and for all exterior tubular members.

.21 Provide diagonal or cantilevered angles at sides of columns where required to support deck or slab.

.22 Connect steel lintels in masonry walls to columns where openings are adjacent to columns.

.23 Unless otherwise noted on drawings, provide 102 x 102 x 9.5 (4" x 4" x 3/8") seat angles attached to sides of columns to support masonry lintels adjacent to columns. Length of seat to equal width of lintel minus 25 mm (1").

.24 Prepare contact surfaces of slip critical connections as required by CSA S16.

.25 Complete welded shop connections prior to galvanizing.

.26 Mark materials in accordance with CSA G40.20/G40.21. Do not use die stamping. When steel is to be left unpainted, place marking at locations not visible from exterior.

.27 Match marking: shop mark bearing assemblies and splices for fit and match.

.28 Where shop inspection is required, do not ship material to the site before it has been inspected.

.29 Fabricate in stages complex members for which steel inspection is impossible or difficult once completed, and arrange for the Inspection and Testing Agency to do intermediate shop inspections.

.30 Fabricate AESS with tolerances and surface quality consistent with AESS category.

2.4 SHOP PAINTING

.1 Clean all members to SSPC-SP 1 – Solvent Cleaning, remove loose mill scale, rust, oil, dirt and foreign matter using any suitable method.

.2 In addition, for members receiving shop primer paint: Clean steel to SSPC-SP 7 Brush-Off Blast Cleaning.

.3 In addition, for members receiving intumescent coating: Clean steel to SSPC-SP 6 Commercial Blast Cleaning

.4 In addition, for members receiving zinc-rich coating: Clean steel to SSPC-SP 10 Near White Blast Cleaning.

.5 Apply one coat of shop paint CISC/CPMA 1-73a to steelwork in the shop with the exception of:

.1 Members to receive spray fireproofing.

.2 Members to receive a finish coat of paint on site for which a CISC/CPMA 2-75 shop primer is required.

.3 Members to receive intumescent coating for which a compatible shop primer is required.

.4 Members to receive zinc-rich coating.

.5 Galvanized members.

.6 Shear connectors and top flanges of composite beams with field welded shear connectors.

.7 Surfaces encased in or in contact with cast-in-place concrete including top flanges of beams supporting slabs.

.8 Surfaces and edges to be field welded for a distance of 50 mm (2") from joints.

.9 Faying surfaces of slip-critical connections.

.6 Apply one coat of contrasting colour shop paint to all protected zones indicated on structural drawings to clearly delineate their extent.

.7 If members to receive sprayed fireproofing are shop painted, only paints tested to ASTM E736 and approved by spray fireproofing supplier may be used. Any other paint must be removed to bear steel prior to application of spray applied fireproofing.

.8 Apply one coat of compatible primer paint (CISC/CPMA 2-75) in the shop to steelwork to receive a finish coat of paint on site.

.9 Apply one coat of compatible primer paint in the shop for steel to receive intumescent coating on site, see section 07 81 00 Applied Fireproofing.

.10 If more than one type of paint is specified, each paint to be visually identifiable after application.

.11 Galvanize all structural steel located beyond the vapour barrier, including:

.1 Shelf angles and hangers in exterior walls.

.2 Spandrel angles to which precast panels are attached.

.3 Lintels in exterior walls.

.4 Exposed exterior steel members.

.5 Exposed anchor rods.

.6 Other steel noted on drawings.

.12 If galvanized steel is to be painted, use only non passivated galvanizing process (without chromate coating).

.13 Apply paint under cover, on dry surfaces when surface and air temperatures are above 5ºC.

.14 Maintain dry condition and 5ºC minimum temperature until paint is thoroughly dry.

.15 Strip paint from bolts, nuts, sharp edges and corners before prime coat is dry.

.16 No shop coat is applied to steel to be spray fireproofed. If members to receive sprayed fireproofing are shop painted, only paints tested to ASTM E736 and approved by spray fireproofing supplier may be used. Any other paint must be removed to bear steel prior to application of spray applied fireproofing.

.17 If galvanized steel is to be painted, use only non passivated galvanizing process (without chromate coating).

.18 Apply paint under cover, on dry surfaces when surface and air temperatures are above 5ºC.

.19 Maintain dry condition and 5ºC minimum temperature until paint is thoroughly dry.

.20 Strip paint from bolts, nuts, sharp edges and corners before prime coat is dry.

PART 3 - EXECUTION

3.1 GENERAL

.1 Structural steel work: in accordance with CSA S16.

.2 Welding: in accordance with CSA W59.

3.2 CONNECTION TO EXISTING WORK

.1 Verify dimensions and condition of existing works prior to start of fabrication. Report discrepancies, modify connection details if required and submit to Consultant for review. Determine any potential interference with existing services and report problem areas to Consultant for direction before commencing work.

.2 Take precautions to protect existing works from damage. Provide temporary shoring as required. Repair damage to adjacent materials caused by structural steel installation.

3.3 MODIFICATION / REMOVAL OF EXISTING STEEL WORK

.1 A set of Structural Drawings of the existing building may be viewed at the offices of the Architect or TT-S.

.2 Dismantle and cut existing structural steel as required. Provide temporary shoring and bracing required for these operations. Retain a Professional Engineer to design the temporary shoring and to review this work on site.

.3 Clean existing structural steel, which is affected by the work and is to remain in place, down to bare metal, prior to its inspection so that its condition may be ascertained. Notify TT-S when members are ready for inspection.

.4 Remove from site existing steel which is dismantled but not designated for re-use.

3.4 ERECTION

.1 Erect structural steel in accordance with CSA S16 and reviewed erection drawings.

.2 Do not field cut or alter any members without the Consultant's approval.

.3 Make adequate provision for all loads acting on the structure during erection. Provide erection bracing to keep the structure stable, plumb and in true alignment during construction. Bracing members or connections shown on Structural Drawings are those required for the completed structure, and may not be sufficient for erection purposes. Do not remove erection bracings without written approval from the Engineer who designed it.

.4 Set column base plates to the elevation required for grouting using steel shims or leveling screws attached to sides of base plates. Do not fasten leveling nuts to anchor rods. Alternatively, for base plates equal or smaller than 350mm x 350mm (14" x 14"), leveling plates set with grout and level to within 1.5 mm (1/16") across the plate can be used. Do not erect columns upon plates exceeding this tolerance. Lift base plates for inspection when directed.

.5 Grout under column base plates and beam bearing plates as soon as steelwork is completed. Do not add load on steelwork until grouting is completed and grout strength has reached at least 20 MPa.

.6 Do not make permanent connections until structure has been properly aligned.

.7 Install bolts which are not pre-tensioned to be snug tight.

.8 Where slotted connections are shown on structural drawings, finger tighten bolts to a snug fit and burr threads to prevent nuts from working loose.

.9 Apply dry lubricant to threads of all galvanized bolts prior to installation.

.10 Weld beams to bearing plates unless otherwise noted on drawings.

.11 Adjust and finalize connections at wall supporting elements affected by floor beam deflections after concrete is poured.

.12 Provide dissimilar metal separators at connections between aluminum members and structural steel.

.13 Report ill-fitting connections to the Consultant before taking corrective measures.

.14 When welding after galvanizing is in place, grind away galvanizing at areas to be welded.

.15 Do not weld in an ambient temperature below -17ºC. Preheat material adjacent to welding areas when ambient temperature is between -17ºC and +4ºC.

.16 Remove slag from all completed welds so that they may be visually inspected.

.17 Seal members by continuous welds where indicated.

.18 Remove field connection aids from all surfaces which will be exposed to view and where interfering with clearances required by other trades.

.19 AESS members:

.1 Erect using softened slings or other methods to prevent damage.

.2 Provide padding as required to protect while rigging and aligning.

.3 Weld tabs for temporary bracings and safety cabling only at points concealed from view in the complete structure or where approved by the Consultant.

.4 Remove all field connection aids added to allow alignment, fit up and welding.

.5 Remove welds at run-out tabs to match adjacent surface.

.6 Plug weld holes for erection bolts.

3.5 FIELD PAINTING

.1 Paint in accordance with Section 09 91 00 Painting.

.2 Touch up damaged surfaces with the same paint as the shop coat.

.3 Repair any galvanized or zinc rich painted surfaces which have been damaged or field welded in accordance with SSPC Technology Guide No.14.

.4 Clean and prepare surfaces of bolts, which will receive a finished coat of paint in the same manner as the connected steelwork.

3.6 INSPECTION AND TESTING:

.1 Unless noted on structural drawings otherwise, following requirements of inspection and testing shall apply.

.2 An Inspection and Testing Agency (certified to CSA W178.1 & 2) will be appointed to carry inspection and testing of all structural steel.

.3 Do not commence fabrication until details of inspection have been worked out with the Agency.

.4 Assist the Inspection and Testing Agency in its work. Notify as to the Work Schedule and provide safe access to the work area as required.

.5 The Inspection Agency will submit reports to the Consultant, Structural Engineer, Contractor and Municipal Authorities covering the Work inspected and provide details of errors or deficiencies observed.

.6 Work will be inspected in shop and when erected. Store fabricated members in shop so that they are accessible for inspection.

.7 Welding inspection:

.1 Welding inspection will be conducted in field.

.2 The Inspector will check welders' CWB certification.

.3 The Inspector will review welding procedures for conformance with CWB requirements, manufacturers' requirements and standard practice.

.4 The inspector will visually check all welds in moment connections and 20% of all other welds for:

.1 Size, length and profile

.2 Joint preparation, including cleaning and removal of any paint.

.3 Fit up and alignment.

.4 Preheat.

.5 Electrodes.

.6 Penetration and fusion.

.7 Slag removal.

.8 Distortion.

.9 Porosity.

.10 Cracks.

.5 Non-destructive testing will be conducted on the following connections:

.1 All shop and field welded splices.

.2 A representative 10% of all other welded connections.

.6 Test results will be evaluated in accordance with CSA W59.

.8 Field inspection:

.1 Arrange for the Inspector to start field inspection as soon as each section of the Work is completed, plumbed, bolts tightened, and field welding finished.

.2 The Inspector will sample erection procedures for general conformity with Contract requirements.

.3 The Inspector will check general fit-up and tolerances and report any apparent distortions and misalignments.

.4 Field inspection will include:

.1 Checking individual frame members for twisting, sweep and local damage.

.2 Checking levelness of leveling plates.

.3 Inspection of grouting under base plates and bearing plates.

.4 Checking column bearings on cast in plates.

.5 Checking bearings on steel and masonry.

.6 Inspection of bolting, shear studs and post installed anchors as described below.

.7 Checking installation of permanent bracings and nominal tension in finished building (where specified).

.8 Inspection of approved field cutting and reinforcing around openings.

.9 Inspection of field painting.

.10 Inspection of field touch-up.

.5 Bolting

.1 The Inspector will visually check all bolts in bearing connections. Where erection drawings indicate bolts with threads excluded from the shear plane, he will remove nuts from 1% of all bearing bolts and check that thread is excluded from the shear planes.

.6 Post installed anchors

.1 The Inspector will sample check drilled concrete and masonry anchors.

.2 The Inspector will provide full time inspection during installation of post installed adhesive anchors subject to sustained tension loads.

.3 The Inspector will randomly select and pull test 5% of all types and sizes of post installed anchors installed on a weekly basis, but not less than one anchor of each type, size and orientation. Pull test to twice the allowable tensile load, or 1.5 times the factored resistance of the anchor given by the manufacturer. Chose anchor locations where proximity to concrete edge does not affect anchor capacity, or use reduced anchor loads per manufacturer's recommendation. Submit reports to Consultant within one week of testing. Reports to indicate each anchor location, test load and mode of failure, if applicable. Notify Consultant immediately if any anchor fails the pull test.

.9 CORRECTIVE MEASURES

.1 Conflicts: The Contractor shall be solely responsible for errors of detailing, fabrication, and erection of structural steel joists and steel deck.

.2 Compensation for Additional Services: Should additional work by Design Professionals such as design, documentation, meetings and/or site visits be required which are necessitated by failure of the Contractor to perform the work in accordance with the Contract Documents either developing corrective actions or reviewing corrective actions developed by others, the Contractor is responsible for paying for additional work performed by the Design Professionals at their standard firm-wide billing rates plus out-of-pocket expenses incurred at cost + 10%. Additional costs for testing and inspection by the Owner shall also be compensated by the Contractor.

END OF SECTION 05 12 23

Part 1 General

1.1 SUMMARY

Section includes prefabricated metal railings and guardrails.

1.2 ACTION SUBMITTALS

.1 Product Data: handrails and railings, grout, anchoring cement, and paint products indicated.

.2 Shop Drawings: Include plans, elevations, sections, details of installation, and attachments to existing balcony structure.

.1 Include structural calculations for railing system and attachment to existing balcony slab signed and sealed by the qualified professional engineer responsible for their preparation.

.3 Samples: For each exposed finish required.

1.3 INFORMATIONAL SUBMITTALS

.1 Qualification Data: For professional engineer.

.2 Glass Treatment Certificates: Submit glass treatment certificates signed by manufacturer of the heat soaked glass products certifying that products furnished comply with requirements.

.3 Product Test Reports: Indicating handrails and railings comply with CSA A500.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

.1 Reference Standards:

.1 Comply with the following codes and standards

.2 Guardrails: CSA A500 Building Guards Standard

.3 ASTM E 894 or ASTM E935 Standard test Method for Anchorage and Performance of Permanent Metal Railing Systems and Rails for Buildings

.2 Structural Performance:

.1 Guard loads shall conform to the requirements of Part 4 of Division B of the building code, capable of withstanding structural loads required by NBCC 2010, as shown on the drawings

.3 Configuration of Handrails and Railings:

.1 Handrails: mount on both sides of ramp, at consistent height between 865 and 965mm from top of ramp surface

.2 Extend handrail return 300mm

.3 Where change in level is more than 600mm provide guard mounted 1070mm high (minimum) measured vertically to top of the guard from the ramp surface

.4 Provide edge protection 75mm (minimum) high

.5 Ensure design does not facilitate climbing

.6 Spacing of pickets may not allow a 100mm to pass

2.2 METALS

.4 Steel:

.1 Steel Design Standards: Unless more stringent requirements are indicated, steel framing design shall comply with CSA S16-09, Design of Steel Structures

.2 Steel Tubing: ASTM A 500 or CSA equivalent where available, grade as required by structural loads.

.3 Steel Rails and Bars: ASTM A 29/A 29M, Grade 1010 or CSA equivalent where available.

.4 Steel Plates, Shapes, and Bars: 300W, min fy=300 MPa or 350W, min fy=350 MPa.

.5 Galvanize and paint all exterior steel components.

2.3 MISCELLANEOUS MATERIALS

.1 Fasteners: Same basic metal as fastened metal; concealed, unless otherwise indicated or unavoidable, and standard with systems indicated.

.2 Anchors: Fabricated from corrosion-resistant materials with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined per ASTM E 488.

.3 Shop Primers: Provide primers to comply with applicable requirements in Section 09 91 23 "Interior Painting."

.4 Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements in FS TT-P-664 or CSA equivalent where available; with good resistance to corrosion; and compatible with finish paint systems indicated.

.5 Grout and Anchoring Cement: Premixed, non-shrink, nonmetallic grout complying with ASTM C 1107 or erosion-resistant, non-shrink anchoring cement; recommended by manufacturer for use indicated.

2.4 FABRICATION

.1 General: Fabricate to design, dimensions, and details indicated, but not less than that required to support structural loads.

.2 Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

.3 Form changes in direction of railing members by mitering.

.4 Welded Connections: Connect handrail and railing members by welding. Cope and weld or use welded-in fittings. Weld connections continuously.

.5 Brazed Connections: Connect copper-alloy handrails and railings members by brazing. Braze corners and seams continuously.

.6 Nonwelded Connections: Connect handrail and railing members with concealed mechanical fasteners and fittings.

.7 Fabricate splice joints for field connection using epoxy structural adhesive.

.8 Brackets, Flanges, Fittings, and Anchors: Fabricate wall brackets, flanges, miscellaneous fittings, and anchors to connect handrails and railings to other construction.

.9 Cast or form of same metal and finish as supported rails.

.10 Close exposed ends of handrail and railing members with prefabricated end fittings.

.11 Provide wall returns at ends of wall-mounted handrails.

2.5 FINISHES

.1 Shop-Primed Galvanized Finish: Hot-dip galvanize after fabrication to comply with ASTM A 123 or CSA equivalent where available, clean, treat with metallic-phosphate process, and apply primer.

.2 Coating: see 090000 for zinc-rich primer and high performance exterior coating

PART 3 - EXECUTION

3.1 INSTALLATION

.3 Installation, General: Perform cutting, drilling, and fitting required to install handrails and railings. Set units accurately in location, alignment, and elevation.

.1 Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

.2 Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).

.3 Align rails so variations from level for horizontal members and from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (5 mm in 3 m).

.4 Anchor posts to metal surfaces with fittings designed for railing system and for this purpose.

.5 Glass-Supported Handrails and Railings: Attach base channel to building structure, then insert and connect factory-fabricated and -assembled glass panels.

END OF SECTION