PART 1 – GENERAL

1.1 GENERAL REQUIREMENTS

.1 Related Work Specified Elsewhere:

.1 Concrete Reinforcement, Section 03 20 00.

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

.3 Concrete Floor Finishes, Section 03 35 00.

.2 Work Installed but Furnished Elsewhere:

.1 Structural Steel anchor assemblies, bolts and the like supplied under Section 05 12 00.

1.2 STANDARDS, CODES AND ACTS

.1 Conform with the Ontario Building Code 2012 under Ontario Regulation 332/12 and any applicable acts of any authority having jurisdiction and the following (most recent edition, including any applicable supplements):

.1 CAN/CSA-A23.1 - Concrete Materials and Methods of Concrete Construction, Canadian Standards Association

.2 ACI-347R - Guide to Formwork for Concrete, American Concrete Institute.

.3 CAN/CSA-S269.3 - Concrete Formwork, Canadian Standards Association

.4 CAN/CSA-O86 - Engineering Design in Wood (Limit States Design), Canadian Standards Association.

.5 CAN/CSA-O121 - Douglas Fir Plywood, Canadian Standards Association.

.6 CSA STANDARD O151, Canadian Softwood Plywood.

.7 CAN/CSA O153, Poplar Plywood.

.8 CAN/CSA 3-O188.0, Standard Test Methods for Mat-Formed Wood Particleboards and Waferboard.

.9 CSA STANDARD O437.0, Standards for OSB and Waferboard.

.10 COFI Exterior Plywood for Concrete Formwork

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

1.3 TOLERANCES

.1 Perform forming operations and place hardware so that finished concrete will be within the tolerances set out in CAN/CSA-A23.1 and as listed below:

.1 Variations in building lines which result in extension of the building over lot lines or restriction lines will not be permitted.

.2 These tolerances are acceptable with regard to visual and structural requirements. Interfacing tolerances may not be compatible with the above. Review and coordinate interfacing tolerances so that the various elements come together properly.

.1 Note the need for accurate alignment of perimeter slab edges both horizontally and vertically.

1.4 DESIGN OF FORMS

.1 Design forms and reshoring to safely support vertical and lateral loads until they can be supported by the structure. Design formwork for loads and lateral pressures recommended in ACI 347R/CAN/CSA-S269.3. Wood design to conform to CAN/CSA-O86.

.2 Where required by the local authorities, arrange with the local building by-law authorities for approval of forms and shop drawings.

.3 Well in advance of the work submit to the Consultant details of the principles of reshoring prepared by a Registered Professional Engineer in the Province of Ontario.

1.5 SUBMITTALS

.1 Submit the following for review by the Consultant:

.1 Shop Drawings for architectural concrete,

.2 Samples for Architectural Concrete Forms

.2 As-Built Drawings

.1 Mark on two complete sets of final drawings any changes, additions or deletions that occur during construction as a result of the Contractor's work, change orders, or for any other reason.

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 00- Waste Management and Disposal and the Waste Reduction Workplan.

.2 Place materials defined as hazardous or toxic waste in designated containers.

.3 Ensure emptied containers are sealed and stored safely for disposal away from children.

.4 Use sealers, form release and stripping agents that are non-toxic, biodegradable and have zero or low VOC's.

PART 2 – PRODUCTS

2.1 MATERIALS

.1 Forms

.1 Formwork lumber: plywood and wood formwork materials to CAN/CSA-A23.1

.2 Falsework materials: to CSA Standard S269.1, Table 1, bearing grade marks or accompanied with certificates, test reports or other proof of conformity.

.2 Waterstops: Vinylex Type RB4-316 for expansion joints and Type R4-316T for construction and control joints as supplied by Dayton/Richmond Concrete Accessories, or equal.

.3 Expansion Joint Filler:

.1 Non-extruding resilient bituminous preformed expansion joint filler conforming to MTO Form 1308 Type A.

.2 Non-extruding resilient non-bituminous preformed expansion joint filler conforming to MTO Form 1308 Type B.

.4 Rigid insulation for protection of foundations from frost adjacent to foundation walls and under normal paving slabs: Extruded Polystyrene, Styrofoam SM or equivalent.

.5 Form release agent: non-toxic, biodegradable, low VOC product such as Clean Strip WB (J-4) distributed by Dayton Superior, Euro Wax or approved equivalent.

PART 3 – EXECUTION

3.1 FORMS

.1 General

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

.2 The reinforced concrete members designated on the drawings are not structurally stable until walls and slabs intersecting with them have been constructed and the concrete has reached at least 70% of the specified strength.

.3 Design shores for these slabs and walls to safely support the total vertical and lateral loads until the walls and slabs are complete and have reached 70% of their specified strength. Design the shores so that they can be unloaded gradually. Well in advance of construction, submit to the Consultant drawings showing complete design of shores and footings by a Registered Professional Engineer in the Province of Ontario.

.2 Construction

.1 Form footing sides unless footings are shown to be placed against undisturbed soil.

.2 Mark building, grid or other lines on forms as required to permit the accurate positioning of reinforcing steel.

.3 Construct templates and supports as required to rigidly fix reinforcing dowels in the forms prior to concreting.

.4 Where necessary, provide suitable markers to indicate the location and configuration of continuing concrete members so that dowels can be positioned accurately in relation to their position in the continuing members.

.5 Set anchor bolts, templates, steel connection units or other inserts into the forms and secure them rigidly so that they do not become displaced during concreting. Set and secure these items to the tolerances specified and required in the appropriate Sections.

.3 Sleeves, Chases and Formed Openings

.1 All openings, sleeves, recesses are not necessarily shown on the structural drawings nor are their sizes or locations shown. Refer to architectural, mechanical and electrical drawings for openings and sleeving requirements not shown, located and dimensioned on the structural drawings.

.2 No sleeves, chases and openings through structural members shall be formed without the Consultant's approval.

.3 Where pipes or services pass through walls, beams or slabs, form the openings by an approved sleeve or form as necessary, except where such openings are specified to be formed or sleeved by the appropriate trade. Form chases or recesses as shown or required.

3.2 STRIPPING OF FORMS AND RESHORING

.1 As a minimum, conform to requirements of CSA Standard S269.1 and the following:

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

3.3 CONSTRUCTION JOINTS

.1 Obtain approval from the Consultant for location and details of construction joints not shown.

.2 Provide reglets in joints as shown.

3.4 WATERSTOPS

.1 Install continuous waterstops in all wall construction joints. Build waterstops into forms and support against displacement during pouring of concrete. Do not displace concrete reinforcing when installing waterstops.

3.5 EXPANSION AND CONTROL JOINTS

.1 Construct expansion and control joints at the locations indicated and in accordance with the details shown.

.2 Construct clean expansion joints free of foreign material likely to impair the proper operation of the joint.

.3 Provide a non-extruding joint filler in expansion joints for the full area between adjacent concrete members. Anchor the filler material to one of the adjacent members or between concrete members and adjacent members of other materials.

.4 Provide waterstops in expansion joints. Make waterstops continuous for the full length of the joint. Rigidly fix waterstops in forms to prevent their displacement during concreting.

.5 Expansion joints in side walks shall be placed vertically at intervals at intervals of 6 m or as indicated on the drawings prior to placing concrete.

.6 Divide sections between expansion joints in walks transversely into lengths not more than 1.5 m. Tool finish edges and divisions.

.7 Provide expansion joints in curbs transversely at intervals of 6 m 20', unless ordered otherwise by the Consultant. Such joints shall be asphalt impregnated felt, 12 mm, set perpendicularly to the surface of the curb and gutter and firmly secured to act as a bulkhead. Place the top of the felt 12 mm thick below the surface. Place removable cap pieces securely in position and remove when the concrete has achieved its initial set. Fill the groove thus formed after being thoroughly cleaned, with a bituminous filler material.

PART 4– ADDITIONAL REQUIREMENTS FOR ARCHITECTURAL CONCRETE

4.1 AEC 1 - Basic Elements

.1 Approved Surfaces

.1 Approved areas of architectural concrete of the surface quality will be designated by the architect.

.2 View these approved areas prior to tendering and during construction employ necessary methods and procedures to achieve surfaces of at least equal quality.

.2 Submittals

.1 Shop Drawings for Architectural Concrete Forms

.1 Show method and schedule of construction, materials, arrangement of joints, ties, shores, liners and locations of temporary embedded parts.

.2 Samples for Architectural Concrete Forms.

.1 Two pieces 1000 mm square of the plywood specified for smooth architectural concrete.

.2 Form tie and corner tie.

.3 Sample of form joint sealer and caulking to be used in form construction.

.3 Quality of Finish:

.1 The quality of finish shall be such that when the forms are stripped, it meets the standards set out below, without further finishing work other than treatment of tie holes, sandblasting, and clean-up, except in the case of smooth concrete for paint, grinding of joints and filling of voids will be permitted.

.2 Dense, even concrete free of major defects such as deep or extreme honeycombing, inconsistencies in plane, severe cold joint lines and major loss of fines. Minor imperfections may be acceptable. Major defects will necessitate replacement. The judgement as to what constitutes major or minor defects will be the Consultant's. Patching will not be permitted and if used, will constitute a major defect. Repairs, i.e. removal of sections of a member, may be carried out if approved by the Consultant, but the repair shall match the colour and texture of the surrounding concrete.

.3 Concrete members of generally uniform colour.

.4 Concrete members with sharp, accurate definition at corners, arrises, reglets and the like, generally free of chipped or spalled areas and within dimensional tolerances set out in ACI 347R/CAN/CSA-S269.3. Members shall be visually straight.

.5 Plane surfaces without protuberances, indentations, ridges or bulges.

.6 Sandblasted surfaces with the required uniform depth of cut-back, distribution of aggregate and with colour and texture matching the sample panel designated by the consultant.

.7 Under no circumstances shall repair to any architectural concrete be undertaken without the consultant's consent will be classified as defective Work and the consultant may require their removal and replacement.

.4 Forms

.1 Construct grout tight forms for concrete exposed to view in finished building.

.2 Make joints of forms sufficiently tight to prevent leakage of concrete fines at corners of exposed beams, walls and columns or at the corners of exposed edges of slabs.

.3 Construct grout tight forms for exposed surfaces of perimeter concrete band course and other concrete exposed to view in the finished building.

.4 Provide 25 mm chamfer strip at all exposed edges of concrete and 18 mm band course control joints.

.5 Form panels for exposed concrete may be reused 3 times, providing the tie holes are reused and panels are not damaged in a way that will cause visual defects.

.5 Architectural Concrete Form Materials

.1 Plywood sheathing for smooth concrete: High Density Overlay (HDO) Plywood.

.2 Chamfer strips: Angled corner or rounded corner for walls and columns as distributed by Greenstreak Plastic Products Company.

.3 Grooves or reglets: White pine dresses to exact size.

.4 Form ties: Removable ties fitted with plastic cones leaving holes not larger than 37 mm in concrete surface.

.5 Corner ties: At all vertical outside corners of forms for walls, balustrades, piers and the like, use continuous threaded coil and corner ties with associated corner brackets and coil wing nuts.

.6 Construction of Formwork

.1 Construct forms for architectural concrete so that they are grout tight at corners, panel joints, construction joints, arrises and recesses and so that concrete surfaces that are shown to be plane are plane and correctly aligned without indentations or protuberances other than those shown.

.2 Use straight lumber making an accurate tight fit.

.3 Seal, tape or caulk form panel joints.

.4 Solidly back all joints between sheathing panels and tightly secure panels thereto.

.5 Employ corner ties at all external corners.

.6 Construct side forms for balustrades, sills, upstand beams and the like to the exact height of the member. Align the top edges of the forms to the correct elevation or slope so that the tops of the members can receive a fine wood float finish to a straight line.

.7 In walls and the like, provide suitable spaced clean-out doors at the bottom of the forms. Place the doors, in the side of the member which is not exposed. Where this cannot be arranged accurately, construct clean-out doors and install so as to leave no indentations or protuberances and to prevent concrete leakage.

.7 Form Ties:

.1 Align ties on a particular member both vertically and horizontally.

.2 Ties shall not be placed horizontally closer than 300 mm to a corner, or at an edge of an opening, or to a vertical reglet nor vertically closer than 150 mm to an edge of an opening or to a horizontal reglet. The tie pattern shall be symmetrical and to the Architect's approval.

.3 Install ties at right angles to the form in tight fitting holes to prevent concrete leakage. Where re-use of forms is permitted, arrange so that tie holes are also re-used. All form ties, particularly at corners and construction joints, shall be fully tightened so as to eliminate leakage of concrete fines.

.8 Walls, Columns and Deep Beams:

.1 Studs shall be carefully plumbed and not spaced over 400 mm on centre. Reduce spacing 300 mm where the grain of the outer piles is parallel to the studs. Walers shall consist of two members and the joints in the top and bottom members shall be staggered at least the spacing of the form ties. Walers shall not be spaced more than 600 mm on centres and ties not more than 700 mm on centres when used with double 50 mm x 100 mm walers.

.2 For forms 6 m or more in height, double 50 mm x 150 mm vertical walers spaced not more than 3 m on centres and extended the full height of the forms shall be bolted to every other set of horizontal walers to maintain the forms in straight and true alignment.

.3 Forms for duct openings, sills and the like shall be removable to permit access for concrete placing and vibration.

.4 Braces or shores through exposed faces of walls will not be permitted.

.9 Construction Joints in Walls:

.1 Horizontal joints will be permitted at locations approved by Consultant. Build forms to finish flush with the top of construction joints to permit trowelling the surface to accurate alignment. Install and securely fix reglets as shown.

.2 Vertical construction joints will only be permitted at locations approved by the Consultant. Construct the bulkhead in a manner which will prevent leakage of concrete fines.

.3 When erecting forms for the continuing concrete, use a system where the forms, including reglets from the pour below remain in place, undisturbed for the pour above.

.10 Control Joints:

.1 Construct control joints at the location shown and accurately place reglet so that the cut in the discontinuous longitudinal bars falls at the joint. Accurately align vertical control joints above and below horizontal construction joints.

.11 Tolerances:

.1 Construct forms for architectural concrete so that all concrete surfaces exposed to view will be visually straight.

.12 Release Agent:

.1 Coat surface of forms to be in contact with concrete with an approved material which provides complete bond-breaking action. Apply surface treatment strictly in accordance with manufacturer's instruction. Re-coat surface of forms after use as necessary.

.13 Stripping of Forms:

.1 Forms for architectural concrete shall not be stripped until at least 7 days after concrete is poured. Take particular care when stripping to ensure that no damage occurs at corners, arises or the like.

.2 To help avoid colour variation, the length of time between pouring and stripping shall be approximately the same for each portion of the Work.

.14 Re-Use of Forms:

.1 Thoroughly clean forms and treat with the parting agent as required before re-use.

.2 Forms may not be re-used if they are damaged in any way which will leave blemishes on the finished surface. Also, they may not be re-used if the original tie holes ate not re-used.

END OF SECTION 03 10 00

PART 1 – GENERAL

1.1 GENERAL REQUIREMENTS

.1 Provide all material and labour required for the completion of the Contract. Breakdown of Work by Section is for guidance only and is not necessarily complete.

.2 Work Furnished and Installed:

.1 Concrete reinforcement.

.3 Work Installed but Furnished By Other Sections:

.1 Anchor bolts.

.4 Related Work Specified Elsewhere:

.1 Concrete Formwork, Section 03 10 00.

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

.3 Concrete Floor Finishes, Section 03 35 00.

1.2 STANDARDS, CODES AND ACTS

.1 Conform to the Ontario Building Code 2012 under Ontario Regulation 332/12 and any applicable acts of any authority having jurisdiction and the following:

.1 Manual of Standard Practice (2004), Reinforcing Steel Institute of Canada (RSIC).

.2 CAN/CSA-A23.1-04 - Concrete Materials and Methods of Concrete Construction, Canadian Standards Association.

.3 CSA STANDARD A23.3-04 - Design of Concrete Structures, Canadian Standards Association.

.4 CSA-G30.3-M1983 (R2002), G30.5-M1983 (R1998), G304-M1983 (R1998), G305-M1983 (R1998), and CAN/CSA-G308-M92 (R1998) - series of standards for Concrete Reinforcement, Canadian Standards Association.

.5 CSA W186-M1990 (R2007), Welding of Reinforcing Bars in Reinforced Concrete Construction, Canadian Standards Association.

.6 ASTM D3963/D3963M-01, Standard Specification for Epoxy-Coated Reinforcing Steel.

.7 Ontario Ministry of Transportation and Communications, Highway Engineering Division, Publication EM-69, 1983, Guidelines for Inspection, Patching and Acceptance of Epoxy Coated Reinforcing Bars at the Job Site.

.8 CSA-G279-M1982 (R1998) - Steel for Prestressed Concrete Tendons, Canadian Standards Association.

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

1.3 TOLERANCES

.1 Perform fabrication and setting so that completed work will be within the tolerances set out in CSA Standard A23.1, and RSIC Manual.

.2 These tolerances are acceptable with regard to structural requirements. Interfacing tolerances may not be compatible with the above. Review and coordinate interfacing tolerances so that the various elements come together properly.

1.4 SAMPLES AND ASSISTANCE

.1 General

.1 Supply samples of all materials and the following, the cost of which shall be paid for by this trade.

.2 Reinforcement

.1 Provide the Consultant access to the reinforcement fabricator's plant. Inform the Consultant of the period during which fabrication will be undertaken.

.2 Cut samples of reinforcing steel designated by the Consultant from steel shipped to jobsite. Replace cut reinforcement or splice where permitted by the Consultant. Maintain an adequate supply of representative steel to permit immediate replacement of steel removed from the site as test specimens.

.3 Coordinate sampling and testing so that test results are received by the Consultant before concrete is placed in the members from which the samples are taken.

1.5 SUBMITTALS

.1 Submit opening information, shop drawings for reinforcement, and certificates for review by the Consultant:

.1 Refer to Section 01 30 00.

.2 All submissions to be in pdf format. Leave room on drawings for the stamps of the Consultants. Check and sign before submission.

.2 Opening Information

.1 Prior to detailing reinforcement, submit drawings of the structure showing formed holes, recesses and sleeving required under all Sections.

.2 Where openings are to be cut into existing structure, submit record x-rays or other approved positive records, indicating all cast-in materials including reinforcing steel, post-tensioning wires, conduits etc., related to grid lines and elevation datum along with proposed cutting location.

.3 Complete dimension openings, recesses and sleeves, and relate to suitable grid lines and elevation datum.

.3 Shop Drawings for Reinforcement

.1 After Consultant has reviewed and returned opening drawings, prepare reinforcement placing drawings and bar lists taking into account all openings and recesses.

.2 Prepare placing drawings to a minimum scale of 1:50 in a clear complete manner that will permit placing of reinforcement to be performed without reference to contract drawings. Do not reproduce the structural drawings.

.3 Detail reinforcement in accordance with the contract documents, CAN/CSA-A23.1 and detailing standards in RSIO Manual.

.4 Except as noted otherwise on the drawings, provide standard hooks on reinforcement in accordance with CSA Standard A23.3.

.5 Amongst other items, indicate the following:

.1 Bar sizes

.2 spacing

.3 location and quantities of reinforcing

.4 mesh

.5 chairs

.6 spacers

.7 hangers

.8 Identify each bar with a code mark corresponding to the bar lists.

.6 Detail sections to fully illustrate placement of reinforcement at areas such as openings, change of levels, spandrels, stairs and wherever else required.

.7 Large scale detail sections at areas of congested steel such as at intersections of beams and columns, column splices or wherever else required.

.8 Placing sequence for reinforcement such as intersections of beams and beams, slabs and beams and within flat and two-way slabs.

.9 Minimum clearances between reinforcement and minimum concrete protection to reinforcement.

.10 Location of each bar relative to grid line or other feature which can be identified on the formwork.

.11 Location and embedment of dowels.

.12 Location, number and type of support accessories, including support bars suitably sized and spaced to rigidly support the weight of reinforcement and construction loads.

.13 Details of bending, cutting or placing to special tolerances.

.14 Location and details of reinforcement at separation strips.

.4 Certificates

.1 Steel of Canadian Manufacture: Mill test certificates properly correlated to the reinforcement used for fabrication.

.2 Steel of other than Canadian Manufacture: Test data that each size and grade of reinforcement proposed meets specification requirements. Reinforcement approved for use by the Consultant shall be identified in a manner suitable to the Consultant. Only steel that has been approved will be accepted on jobsite.

.3 Submit code marks or symbols used on reinforcement of each manufacturer so that Consultant may readily identify grades and sizes of reinforcement.

.5 Substitutions

.1 Substitution of different size bars permitted only upon written approval of Consultant.

.6 Contractor to submit to the Consultant and the Architect, detailed quality control measures for placement of reinforcing in accordance with structural drawings. They're to include methodology and qualifications of persons performing this work. These measures are to be independent of Consultant's and testing agency's review and performed prior to Consultant's review.

PART 2 – PRODUCTS

2.1 MATERIALS

.1 Reinforcement

.1 Deformed steel to CSA G30 Series and to the material specification shown on the drawings.

.2 Reinforcement to be welded shall conform to the material recommendations contained in CSA-W186.

.2

.3 Welded Wire Fabric

.1 Conform to CSA-G30.5M.

.4 Support Accessories

.1 Chairs, bolsters or spacers of sufficient strength to rigidly support the weight of reinforcement and construction loads. In the case of concrete exposed to view or weather the accessories shall be such that no metal is permitted to come closer than 38 mm from a formed face and 50 mm from a trowelled surface. Use precast concrete supports for exposed concrete beams and soffits and concrete cast against soil.

PART 3– EXECUTION

3.1 FABRICATION

.1 Fabricate reinforcing in accordance with CAN/CSA-A23.1.

.2 Identify with a metal tag each bar with code mark corresponding to that appearing on bar list.

.3 Bend reinforcement once only and at room temperature. Do not straighten or rebend reinforcement. Do not use bars with kinks or bends not shown on the drawings.

.4 Replace bars which develop cracks or splits.

3.2 PLACING

.1 Prior to concreting, place reinforcement, support and secure against displacement in accordance with the requirements contained in RSIO Manual and to the tolerances specified in CSA-A23.1. Tolerances shall be non-cumulative.

.2 Conform to requirements shown for concrete cover to reinforcement.

.3 Place reinforcement accurately and secure against displacement by using annealed iron wire ties or clips, or as otherwise specified, at intersections. Tack welding of reinforcement to secure in place will not be permitted.

.4 Secure reinforcement in walls using sufficient spacers on each face to maintain the requisite distance between reinforcement and wall face and so that vertical bars are plumb. Provide a minimum of 10 mm diameter spreader bars spaced at 2 m centres in both directions.

.5 Set column and wall dowels prior to concreting with wooden templates or other approved means.

.6 Do not drive or force reinforcement into fresh concrete.

.7 Preassemble column and beam cages as necessary. Do not "spring" or bend ties and stirrups in order to place longitudinal reinforcement.

.8 Pre-tie reinforcement for footings and lower into place so as not to disturb the soil at founding elevation.

3.3 FIELD BENDING

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

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

.3 Replace bars which develop cracks or splits.

3.4 WELDED WIRE FABRIC

.1 Supply welded wire fabric in flat sheets on grade.

.2 Lap ends and sides of fabric not less than 150 mm.

3.5 CONSTRUCTION JOINTS

.1 Obtain approval from the Consultant for locating and details of construction joints not shown.

.2 Continue reinforcement through the joint in its normal position. Add additional reinforcement across the joint as shown or directed.

PART 4– ADDITIONAL REQUIREMENTS FOR ARCHITECTURAL CONCRETE

.1 Strictly maintain bar clearances for architectural concrete. Place spacers regularly and squarely against forms. Spacers shall not be used between reinforcement and an exposed vertical concrete face.

.2 The location of spacers shall not cause constriction adjacent to other inserts which may impede the placing of concrete. The cover to reinforcement shall be taken from the deepest penetration of arrises or reglets.

.3 Use spacers and support accessories so that no metal comes closer than 40 mm to an exposed surface.

.4 Ensure that no tie wires project within 40 mm of an exposed face.

.5 Take particular care not to damage form sheathing surfaces during installation of reinforcement.

.6 Support Accessories for Architectural Concrete

.1 An approved precast concrete, plastic or other non-corroding type of chair, bolster or spacer of sufficient strength to rigidly support the weight of reinforcement and construction loads. Tie wires shall be non-corrosive to sample approved by Consultant.

END OF SECTION 03 20 00.

PART 1 – GENERAL

1.1 GENERAL REQUIREMENTS

.1 Provide all material and labour required for the completion of the Contract. Breakdown of Work by Section is for guidance only and is not necessarily complete.

.2 Work Furnished and Installed:

.1 Cast-in-place concrete.

.3 Work Furnished but not Installed:

.1 Concrete for masonry including lintels, band courses and piers.

.4 Related Work Specified Elsewhere:

.1 Concrete Formwork and Falsework, Section 03 10 00.

.2 Concrete Reinforcement, Section 03 20 00.

.3 Concrete Floor Finishes, Section 03 35 00.

.4 Backfilling below base course beneath slabs and behind walls under Section 31 23 23.13.

.5 Sub-grade material including moisture barrier, Section 31 23 23.13.

.6 Lifting of structural steel plates, Section 05 12 00.

.7 Waterproofing of expansion and control joints, Section 07 10 00.

1.2 STANDARDS, CODES AND ACTS

.1 Conform with the Ontario Building Code 2012 under Ontario Regulation 332/12 and any other applicable acts of any authority having jurisdiction and the following (latest edition, including any supplements):

.1 CAN/CSA-A23.1, Concrete Materials and Methods of Concrete Construction, Canadian Standards Association.

.2 CAN/CSA-A23.3, Design of Concrete Structures for Buildings, Canadian Standards Association.

.3 CAN/CSA-A3000, Cementitious Materials Compendium, Canadian Standards Association.

.4 CAN/CSA-A3001, Cementitious Materials for Use in Concrete, Canadian Standards Association.

.5 ASTM C260, Standard Specification for Air-Entraining Admixtures for Concrete, ASTM International.

.6 ACI-347 - Guide to Formwork for Concrete, American Concrete Institute.

.7 CAN/CSA-S269.3 - Concrete Formwork, Canadian Standards Association.

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

1.3 TOLERANCES

.1 Perform placing operations so that completed work will be within the tolerances set out in CAN/CSA-A23.1 and as listed below:

.1 Variations in building lines which result in extension of the building over lot lines or restriction lines will not be permitted.

.2 These tolerances are acceptable with regard to visual and structural requirements. Interfacing tolerances may not be compatible with the above. Review and coordinate interfacing tolerances so that the various elements come together properly.

.3 Note the need for accurate alignment of perimeter slab edges both horizontally and vertically.

1.4 CONCRETE MIX DESIGN

.1 Design of Mix

.1 Design the mix in accordance with CSA Standard A23.1 so that concrete will be homogeneous, uniformly workable, and readily placeable into corners and angles of forms and around reinforcement by the methods of placing and consolidation employed on the work, but without permitting materials to segregate or excessive free water to collect on the surface. The concrete, when hardened, shall have the qualities specified.

.2 Cement Type: Type GUL or GUb-SF, General Use.

.3 Specified Strength: As called for on drawings. Where walls are integral with columns such as foundation walls pour walls and columns with concrete of the specified strength for columns.

.4 Water Cement Ratio, Slump and Air Content: As called for on the Drawings. These requirements are for concrete at the point of placing.

.5 Admixtures: Type WN water reducing admixture.

.6 Supplementary Cementitious Materials:

.1 Slabs to receive a polished surface are limited to having a maximum of 15% supplementary cementitious materials.

.2 Slag Cement: Except as noted above, cementing materials for concrete shall contain a minimum of 25% (maximum 50%) ground granulated blast-furnace slag (GGBFS) by mass. Do not use slag cement in concrete that will be exposed to de-icing chemicals. If the concrete is to be placed in cold weather, as defined by CSA-A23.1, a minimum GGBFS replacement level of 15% by mass may be used.

.7 Do not use recycled concrete aggregate in slabs or in concrete exposed to view. Except as noted, recycled concrete may constitute up to 100% of the coarse aggregate for concrete.

.8 Use of calcium chloride is not permitted.

.9 DCI Corrosion inhibiting admixture. Refer to drawings for scope.

1.5 SAMPLES AND ASSISTANCE

.1 General

.1 Supply samples of all materials and the following, the cost of which shall be paid for by this trade.

.2 Concrete Test Cylinders

.1 Cooperate in the execution of the concrete cylinder testing program. Furnish concrete required, protect specimens against injury and loss, and assist in the sampling and storage of specimens.

.2 Sample concrete and cast cylinders in accordance with CAN/CSA-A.23.1 where directed by the Consultant.

.3 If required, In accordance with requirements of CAN/CSA-A.23.1, provide storage facilities for the initial 24 hours of site storage of all cylinders and the subsequent site storage of field cured cylinders. Suitably equip the 24-hour storage facility with humidity and temperature control equipment and maximum/minimum thermometers. It shall be sufficiently large to handle the maximum number of cylinders required at any one time.

.4 If required, provide sufficient field curing storage facilities so that cylinders representing the various areas can be safely stored in locations representing the curing conditions for those areas. Move the field-cured cylinder storage facilities from area to area as the work progresses.

.3 Soil Inspection

.1 Assist the testing company or soils investigation firm to make their inspections or tests.

.4 Cold Weather Concreting Plan

.1 If concrete is to be placed during cold weather, submit for review a plan for cold weather concreting. Included as a minimum:

.1 Slag replacement level to be used in the mix design.

.2 Curing period for concrete selected if accelerators are to be used to reduce the length of time winter heat is required.

.3 Method of application of winter heat to the concrete and soil for the initial curing period, be it through construction of a heated enclosure or application of radiant, hydronic heaters such as Ground Heaters® or approved equivalent.

.4 Method of protection of the concrete and soil for the balance of the curing period, be it through the use of insulating blankets, straw, fill or other methods.

.5 Method of pre-heating of embedded elements such as reinforcing steel and cast-in inserts.

1.6 SUBMITTALS

.1 Submit the following for review by the Consultant:

.1 Certified mix designs for each type of concrete to be used, stating the specific location, using gridlines as a reference, or structural element for which the mix applies.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 19 and the Waste Reduction Workplan

.2 Use excess concrete for: additional paving, post footing anchorage, swale rip-rap reinforcing, mud slab, flowable fill, footing bottom, retaining wall footing ballast, storm structure covers, underground utility pipe kickers, storm pipe flared end section, toe wash protection, shoulder and toe outfall restraints for temporary erosion pipes, and the like.

.3 Use trigger operated spray nozzles for water hoses.

.4 Designate a cleaning area for tools to limit water use and runoff. Cleaning area should be a portion of the site which is be paved at a later date.

.5 Carefully coordinate the specified concrete work with weather conditions.

.6 Ensure emptied containers are sealed and stored safely for disposal away from people.

.7 Prevent plasticizers, water-reducing agents and air-entraining agents from entering drinking water supplies or streams. Using appropriate safety precautions, collect liquid or solidify liquid with an inert, non-combustible material and remove for disposal. Dispose of all waste in accordance with applicable local, provincial and national regulations.

.8 Choose least harmful, appropriate cleaning method which will perform adequately.

PART 2 – PRODUCTS

2.1 MATERIALS

.1 Concrete

.1 Conform to CAN/CSA-A.23.1.

.2 Coarse Aggregate: from locally quarried non-alkali reactive rock, mineral or air-cooled blast furnace slag

.3 Recycled Concrete Coarse Aggregate: Clean, hard, strong, durable particles, free of absorbed chemicals, coatings and other fine materials, crushed from concrete having a compressive strength not less than 35 MPa

.4 Blended Hydraulic Cement: Conform to CAN/CSA A3001

.5 Supplementary Cementing Materials:

.1 Type F Fly Ash to CAN/CSA-A23.5

.2 Cementitious Hydraulic Slag to CAN/CSA-A363

.6 Water: Conform to CAN/CSA-A23.1

.7 Admixtures: Air entraining agents or water reducing admixtures conforming to CSA CAN3-A266.1.

.8 Chemical admixtures: to ASTM C494. Consultant to approve accelerating or set retarding admixtures during cold and hot weather placing.

.9 Concrete retarders: to ASTM C494 water based, low VOC, solvent free. Do not allow moisture of any kind to come in contact with the retarder film.

.10 Curing Compound: Water based curing compound conforming to CSA Standard A.23.1. such as Safe Cure & Seal (J-18, J-19) by Dayton/Richmond or approved equivalent.

.11 Grout Beneath Base Plates: Non-shrink flowable grout having a compressive strength at 28 days of at least 35 MPa. Where grout is exposed to view or weather, use non-ferrous grout.

.12 DCI Corrosion Inhibiting Admixture, as supplied by W.R. Grace & Co. Dosage in accordance with manufacturer's recommendations, but at least 10 litres per cubic metre.

.13 Crystalline Waterproofing Admixture: AQUAFIN-IC ADMIX.

PART 3 – EXECUTION

3.1 FOOTINGS

.1 Refer to drawings for soil criteria for bearing of footings.

.2 Founding elevations, based upon the report of the sub-surface investigation, at which it is presumed these conditions pertain are shown.

.3 Founding elevations must be verified by the sub-surface investigation firm before footings are placed.

.4 See Section 31 23 23.13 .for excavation and backfilling requirements for footings and for the procedure of adjusting contract price where changes to foundations are required.

.5 If, the geotechnical engineer determines that the required soil conditions are not fulfilled, the Consultant will provide instructions as to how to proceed.

.6 Keep a record of footing founding elevations.

.7 Construct footings in a particular area commencing from the lowest footing elevation and proceeding to the higher elevation.

.8 Proceed in a similar manner for continuous footings to walls which vary in founding elevation by commencing with the continuous footing at the lowest elevation.

.9 Remove water, disturbed soil or loose rock or foreign matter from footing excavations before placing concrete. Do not permit the soil at founding elevations to soften due to the presence of water in the excavations or construction activity.

.10 During cold weather, prevent soil or rock adjacent to and beneath all footings from freezing. Do not pour footings on frozen soil on soil which has been allowed to freeze and thaw. If the soil at specified founding elevations is frozen or was frozen and thawed, remove affected material and found footings on unaffected soil with the required characteristics at no extra cost to the Owner.

.11 If the actual founding elevations differ from those shown by more than 600 mm, the Contractor may be reimbursed for the extra cost of such work, except as stipulated below, or shall credit the Owner for deletions based upon the unit prices quoted for concrete reinforcing steel and formwork. Extras or credits shall be calculated by establishing the total net extras or credit for the footings for each material and then multiply by the appropriate unit price.

.12 Extras will be paid only if upon excavating to the specified founding elevations, it is found that soil conditions do not meet the requirements set forth. No extras will be paid if soil becomes weakened through agencies within the control of the Contractor, such as through the action of ground water, inadequate protection from weather, construction activity, over-excavation, or through undermining by the installation of nearby electrical or mechanical services.

.13 Depending upon the degree of defective workmanship, corrective measures may include such measures as redesign of footings and their increase in size as the Consultant may direct. Corrective measures required to overcome defective workmanship shall be made at no extra cost to the Owner.

.14 Where excavations for mechanical or electrical services, pits adjacent to foundations and the like encroach upon a 7 in 10 slope between corners of footings and bottom corners of excavations, lower footings a suitable amount so as not to exceed the 7 in 10 slope at no extra cost to the Owner.

3.2 CONSTRUCTION JOINTS

.1 Obtain approval from the Consultant for location and details of construction joints not shown.

.2 The maximum length of a concrete pour shall be 40 m.

.3 The maximum height of a concrete pour shall be 5 m.

3.3 WATERSTOPS

.1 Setting waterstops: In order to eliminate faulty installation that may result in joint leakage, take care in the correct positioning of the waterstops during placing of concrete. Support the waterstops during the progress of the work to ensure the proper embedment in the concrete. Equally divide the symmetrical halves of the waterstops between the concrete pours at the joints. The centre axis of the waterstops shall coincide with the joint openings at the plane of installation of the waterstop. Ensure maximum density and imperviousness of the concrete by thoroughly working it in the vicinity of all joints.

.2 Placement of concrete around waterstops: Take care in placing concrete around waterstops by careful working, routing, and vibrating to ensure that all air and rock pockets have been eliminated.

.3 All water stops are to be continuous for the full height of all walls.

3.4 PLACING CONCRETE

.1 Conform to requirements of CAN/CSA-A.23.1 and the following:

.2 Immediately before placing concrete, clean forms and reinforcement of foreign matter.

.3 During hot weather conditions, do not use concrete mixed more than 1 hour after introduction of mixing water or 1-1/2 hours during other periods.

.4 Allow 24 hours minimum after placing concrete in columns, piers or walls before placing concrete in beams or slabs supported thereon.

.5 Place concrete on steel joist and steel deck floors in a manner that avoids piling up of concrete. Do not drop concrete directly from buckets, but employ suitable means of distribution. Wet down deck during hot weather prior to concreting.

.6 Remove concrete spilled onto forms around hoisting equipment before depositing concrete in these areas.

.7 Co-ordinate with general contractor placement procedures to ensure the humidity levels in concrete meet warranty requirements of the finishes at time of installation.

3.5 PROTECTION

.1 General

.1 Conform to the requirements of CAN/CSA-A.23.1 and the following to protect freshly deposited concrete from freezing, premature drying and extremes of temperature. Maintain concrete with minimal moisture loss at a relatively constant temperature for the period of time necessary for the hydration of the cement and to achieve the specified strength of the concrete.

.2 Cold Weather Concreting

.1 Between the 15th of October of any year and the 15th of April of the following year, provide on hand and ready for use all equipment necessary for adequate cold weather protection and curing before concrete placement is begun.

.2 When fresh concrete is to be cast against existing concrete, prevent the loss of heat by extending the protection for the fresh concrete at least 600 mm over the existing.

.3 Insulate, or enclose within the protective housing, tie rods, reinforcement or metal which projects from the concrete being protected.

.4 Construct enclosures tight and safe for wind and snow loadings.

.5 Maintain housing, enclosures and supplementary heat in place for entire period of protection, except that sections may be temporarily removed as required to permit placing additional forms or concrete provided the uncovered concrete is not permitted to freeze. Make up time lost from the required period of protection at the required temperature before protection is discontinued and removed.

.6 Dispose heating units to avoid heating concrete locally or drying it excessively. Avoid high temperature and dry heating within enclosures.

.7 Take particular care to maintain edges and corners of concrete at the required temperature owing to their greater vulnerability to freezing.

.3 Hot weather concreting

.1 Between the 15th of April and the 15th of October, the contractor shall establish and follow procedures to ensure proper mix temperatures and curing conditions as specified in CSA A23.1, Clause 7.4.

.4 Slabs on Grade

.1 See Slabs on Grade Section for additional cold weather protection execution requirements for placing concrete slabs on grade.

.5 Protection of Completed Work

.1 At all times during the work, protect exposed concrete, exposed masonry and other exposed members from staining or becoming coated with concrete leakage due to continuing concreting operations. Members which become coated may be classed as defective work by the Consultant.

.2 Protect exposed members from staining due to rusting of reinforcement projecting beyond construction joints.

.3 Take suitable measures to prevent spalling and cracking damage occurring to the structure due to water freezing in expansion joints, small holes, slots, depressions and take suitable measures to prevent damage occurring to foundations and the like due to frost action in the soil or backfill.

.4 The application of de-icing salts on completed work is not permitted.

.5 During the curing period, take suitable measures to protect the surface of the concrete from pitting and loss of fines due to rain.

.6 Co-ordinate with general contractor concrete protection measures to ensure the humidity levels in concrete meet warranty requirements of the at time of installation.

3.6 SLABS ON GRADE

.1 General

.1 Do not place concrete slabs on grade until the specified sub-floor material has been placed, inspected and approved.

.2 Do not place concrete on a frozen sub-grade, or on one that contains frozen materials.

.3 Do not place concrete on a sub-grade that has been frozen and thawed until the sub-grade has been reviewed by the Consultant and approved. If, in the Consultant's opinion, the safe bearing capacity of the sub-grade has been reduced to below 24 kPa, remove the affected materials and replace with compacted granular fill at no additional cost to the Owner.

.4 Refer to drawings for preparation of base to receive slab.

.5 Place bond breaker, minimum of 1 layer of building paper between edges of slab on grade and abutting surfaces.

.6 Upon approval of the placement of the sub-floor material and setting of reinforcing, place and consolidate concrete and finish and cure as specified herein.

.2 Joints

.1 Where slabs abut adjacent construction, provide a layer of joint filler between.

.2 Saw-cut slabs on grade exposed to view in the finished building into panels as shown with a maximum length between saw-cuts equal to 25 times the slab thickness. e.g. a 100 mm thick slab will require saw-cuts at 2.5m c/c. Arrange panels as shown or to the Consultant's approval.

.3 Carry out cutting in accordance with recommendations contained in ACI 302.1R but in any event between 6 and 18 hours after placement of concrete.

.4 After a period of at least 28 days, fill saw-cuts with mortar containing cement, sand and latex bonding agent. Ensure that joints to be filled are clean, dry and free of foreign matter.

.5 Mask edges of saw-cuts to prevent concrete floors from becoming stained.

.6 Construction joints may be provided in slabs on grade so that pours on any one day may be kept to reasonable sizes. Locate construction joints to the Consultant's approval.

.7 In exposed concrete, provide a tooled reglet at construction joints of the approximate width of a saw-cut and fill the reglet as specified for saw-cuts.

3.7 GROUTING BENEATH BASE PLATES

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

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

3.8 OPENINGS THROUGH COMPLETED MEMBERS

.1 Do not cut openings through completed members without the Consultant's approval.

.2 Where the location of openings is approved, locate the reinforcing by x-ray, cover meter or other positive means and adjust the location of the opening so that no reinforcement is cut unless specifically approved otherwise in writing by the Consultant.

.3 Maintain the axis of the hole at right angles to the surface of the member.

.4 In the case of precast concrete slabs, holes shall be cut or drilled only by the precast concrete fabricator.

3.9 MAKING GOOD

.1 Where directed by the Consultant, make good temporary openings left in concrete construction around pipes, ducts and the like using a mortar of the same proportions as the surrounding work. Reinforce mortar with mesh or the like where openings exceed 75 mm. Roughen existing surfaces to receive mortar or apply suitable bonding agent such that mortar will be securely bonded to existing concrete.

3.10 TREATMENT OF FORMED SURFACES

.1 General

.1 After stripping for forms, the bared surface of concrete will be inspected by the Consultant. Do not proceed with repairs or surface treatment to concrete prior to the Consultant's inspection.

.2 After the Consultant's inspection, remove or cut back 25 mm, bolts, ties, nails or other metal not specifically required for construction purposes.

.3 Where no serious defects are revealed by the Consultant's inspection, cut out areas of moderate honeycombing to sound concrete. Saturate with water and fill with cement mortar of the same general composition as that used in the concrete.

.4 Where serious defects are found, such as large voids or extensive honeycombing, repair the defect as directed by the Consultant.

.5 Where surfaces are to be plastered, damp-proofed, waterproofed or similarly finished, remove fins, ridges or bulges which would interfere with the application of the final finishes.

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

PART 4 – ADDITIONAL REQUIREMENTS FOR ARCHITECTURAL CONCRETE

.1 Approved Surfaces

.1 The intended surface finish of the concrete is to be smooth, as formed.

.2 The architect will designate existing areas of architectural concrete of the surface quality required.

.3 View these approved areas prior to tendering and during construction employ necessary methods and procedures to achieve surfaces of at least equal quality.

.2 Quality of Finish:

.1 The quality of finish shall be such that when the forms are stripped, it meets the standards set out below, without further finishing work other than treatment of tie holes, sandblasting, and clean-up, except in the case of smooth concrete for paint, grinding of joints and filling of voids will be permitted.

.2 Dense, even concrete free of major defects such as deep or extreme honeycombing, inconsistencies in plane, severe cold joint lines and major loss of fines. Minor imperfections may be acceptable. Major defects will necessitate replacement. The judgement as to what constitutes major or minor defects will be the Consultant's. Patching will not be permitted and if used, will constitute a major defect. Repairs, i.e. removal of sections of a member, may be carried out if approved by the Consultant, but the repair shall match the colour and texture of the surrounding concrete.

.3 Concrete members of generally uniform colour.

.4 Concrete members with sharp, accurate definition at corners, arises, reglets and the like, generally free of chipped or spalled areas and within dimensional tolerances set out in ACI 347R/CAN/CSA-S269.3. Members shall be visually straight.

.5 Plane surfaces without protuberances, indentations, ridges or bulges.

.6 Sandblasted surfaces with the required uniform depth of cut-back, distribution of aggregate and with colour and texture matching the sample panel designated by the consultant.

.7 Under no circumstances shall repair to any architectural concrete be undertaken without the consultant's consent will be classified as defective Work and the consultant may require their removal and replacement.

.3 Placing of Concrete.

.1 Before concrete is placed, thoroughly clean forms, re-tighten as is necessary and saturate the surface of construction joints and form sides with water.

.2 The maximum free drop of concrete shall not exceed 1.2 m.

.3 Deposit concrete in as close to its final position as possible and do not allow to flow laterally more than 600 mm.

.4 For depositing concrete in walls provide suitably sized tapered pouring boxed to funnel the concrete into the forms. Provide sufficient boxes for each pour such that they can be placed simultaneously at approximately 2 m on centres for the entire length of the pour.

.5 To compact concrete use internal vibrators 25 mm to 50 mm in diameter as required. Apply vibrators at sufficiently short intervals (about 500 mm to 1000 mm) of distance, that vibrated areas overlap without omission of any part. Ensure that the vibrators are inserted through the layer being compacted but take care not to damage form sheathing. Leave vibrator in place from 5 to 15 seconds and withdraw slowly leaving the vibrator operating.

.6 Arrange operations so that once a pour is started, concreting is carried on continuously and the concrete at the surface of the pour is maintained plastic until the completion of section.

.7 Shortly after concrete is placed and compacted to the top of walls or columns or to the top of construction joints, rework the concrete with wooden chisels at the exposed faces to a depth of at least 2' .6 m and then re-vibrate.

.8 At the correct time provide a fine wood float surface to tops of walls, balustrades, retaining walls and the like. Remove laitance as necessary before finishing the concrete. After stripping, lightly rub corners with an emery stone to eliminate sharp edges.

.9 Trowel the surface of construction joints adjacent to exposed faces, flush and level. Joints in walls shall be made at the top of any reglet unless shown otherwise.

.4 Treatment of Formed Surfaces

.1 In addition to the above requirements, go over the surface, remove ties, nails, timber, inserts, minor imperfections, leaving the surface clean.

.2 Where major defects are revealed, repair as the Consultant directs.

.3 Where in the Consultant's opinion defects are minor, repair as follows or as the Consultant may otherwise direct. Cut out affected areas, saturate cut out areas, voids, pit holes and form tie holes with water and fill with a cement mortar containing an approved type of latex bonding agent. Mortar mix and application shall be in accordance with the recommendations of the manufacturers of the bonding agent.

.4 After the mortar stiffens, wipe the whole surface clean such that no material remains on the surface, except that within the voids and such that finished surface is clean and smooth. Cure the patched areas by keeping moist for at least 7 days.

.5 Where directed by the Consultant, power stone concrete surfaces to remove surface imperfections remaining after the treatment noted above has been carried out.

.6 After forms are stripped go over the surface carefully, removing loose concrete, lumber in reglets, minor fins and the like, leaving the surfaces clean. After the surfaces are cleaned the consultant will make an examination of them to determine their acceptability. If unacceptable, the Contractor shall remove the members and replace them at no extra cost to the Owner.

.7 Patching will only be permitted where it is required to an insignificant extent. If the consultant permits patching, demonstrate to the Consultant's satisfaction that the patch will accurately match the colour and texture of the surrounding concrete and will have satisfactory tenacity.

.5 Protection.

.1 At all times during the work protect architectural members as required with polyethylene sheets or the like from staining or becoming coated with leakage, due to continuing concreting operations. Protect concrete from staining due to rusting of reinforcing steel.

.6 Sandblasting.

.1 Sandblasted concrete is not the intended surface finish of the concrete walls for this project. Should the as-formed finish be found to be unacceptable, the architect may explore sand blasting as an alternative to replacement. Do not proceed with sandblasting operations until the Consultant has inspected and approved the surface to be sandblasted.

.2 Protect adjacent surfaces not noted to be sandblasted.

.3 Fill form tie holes prior to sandblasting. Add high strength cement to the grout as necessary so that it will match the parent concrete strength.

.4 Sandblast surfaces within 28 days after concreting.

.5 Individual concrete members shall be sandblasted at the same age to ensure reasonable colour uniformity. Protect adjacent surfaces not noted to be sandblasted.

.6 Maintain reglet filler strips in place until sandblasting is complete.

.7 Following inspection of concrete following removal of forms, and only if directed by the consultant, sandblast the exposed surface of concrete members as required to a depth sufficient to remove the surface skin and to just expose the coarse aggregate and to match the approved sample.

.7 Cleaning Surfaces

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

END OF SECTION 03 30 00

PART 1 – GENERAL

1.1 GENERAL REQUIREMENTS

.1 Provide all material and labour required for the completion of the Contract. Breakdown of Work by Section is for guidance only and is not necessarily complete.

.2 Work Furnished and Installed:

.1 Structural steel work, including steel joists and bridging.

.3 Related Work Specified Elsewhere:

.1 Grouting beneath column bases and bearing assemblies on concrete members: Section 03 30 00.

.2 Grouting beneath baseplates bearing on masonry: Section 04 05 16.

.3 Concrete for slabs on steel joists: Section 03 30 00.

.4 Concrete reinforcement: Section 03 20 00.

.5 Metal fabrications (miscellaneous metal): Section 05 50 00.

.6 Metal stairs and hangers for stairs: Section 05 51 00.

.7 Reinforcing edges of openings in metal deck that are not larger than 450mm in roof deck and 300mm in floor deck: Section 05 31 00.

.4 Work Furnished but not Installed:

.1 Anchor bolts, bearing assemblies and other structural steel connections to be cast into concrete.

.2 Bearing plates and related connections for metal deck to be built into masonry or concrete.

.3 Paint and steel preparation for paint systems: Section 09 91 00.

.4 Paint and steel preparation for high performance paint systems: Section 09 96 00

1.2 STANDARDS, CODES AND ACTS

.1 Conform to the Ontario Building Code 2012 under Ontario Regulation 332/12 and any applicable acts of any authority having jurisdiction and the following (latest edition including any and all supplements):

.1 CAN/CSA-S16 - Limits States Design of Steel Structures, Canadian Standards Association.

.2 CAN/CSA-G164 - Hot Dip Galvanizing of Irregularly Shaped Articles, Canadian Standards Association.

.3 CAN/CSA-S136 - North American Specifications for the Design of Cold Formed Steel Structural Members (using the Appendix B provisions applicable to Canada)

.4 CSA-W47.1 - Certification of Companies for Fusion Welding of Steel Structures, Canadian Standards Association.

.5 CISC/CPMA 1-73a – A Quick-drying One-coat Paint for Use on Structural Steel, Canadian Institute of Steel Construction.

.6 CISC/CPMA 2-75 - A Quick-Drying Primer for use on Structural Steel, Canadian Institute of Steel Construction.

.7 SSPC-SP2, Hand Tool Cleaning, The Society for Protective Coatings

.8 SSPC-SP6/NACE No. 3, Commercial Blast Cleaning, The Society for Protective Coatings

.9 SSPC-SP7/NACE No. 4, Brush-Off Blast Cleaning, The Society for Protective Coatings

.10 SSPC-SP10/NACE No. 2, Near-White Blast Cleaning, The Society for Protective Coatings

.11 ASTM D6386, Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting

.12 CISC Code of Standard Practice for Structural Steel

.13 EN ISO 13920 General Tolerances for Welded Constructions

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

1.3 TOLERANCES

.1 Conform to erection tolerances specified in CAN/CSA-S16 Clause 29.3 and as follows:

.1 Tolerances not specifically covered by S16 such as angular and dimensional tolerances for welded construction shall be governed by EN ISO 13920, Class D.

.2 Refer to section on AESS for additional tolerance requirements that may apply to architecturally exposed structural steel.

.2 Interfacing tolerances may not be compatible with the above. Review and coordinate interfacing tolerances so that the various elements come together properly.

1.4 QUALIFICATIONS

.1 Be certified under the requirements of Division 1, or Division 2.1 of CSA Standard W47.1.

1.5 DESIGN

.1 General

.1 Design connections in accordance with the requirements of CSA Standard S16 and the following for the loads shown or implied.

.2 Design calculations shall be carried out by a professional engineer licensed to practice in the Province of Ontario.

.2 Connections

.1 Use types of shop or field connection shown, or in absence of such indication, use most appropriate type of connection.

.2 Design of connections shall include not only those between columns, beams, girders, trusses and braces, but also between such members as spandrel angles and beams, hangers, stiffeners, etc., and their supporting members (be they steel or concrete).

.3 Design connections to safely withstand the combined effects of shear, moment and torque at applicable design stresses.

.4 Do not weld galvanized members without the Consultant's approval.

.5 Design connections that are exposed to weather so that moisture, dirt and the like cannot gain entry to the interior of hollow built-up members.

.6 Design and detail connections so as not to interfere with architectural clearance lines or finishes.

.7 Where connections between beams and columns and the like result in loss of bearing to the metal deck, NLT or the like, design and provide support as required.

.8 Design and provide connections of inclined members and joists such that the bearing plane between them and their supporting members is horizontal.

.9 Design connections that are to be cast into concrete to provide for the maximum deviation that can occur in erection and based on the following:

.1 Specified steel erection tolerances.

.2 Maximum permissible tolerances in the location of inserts cast into concrete of plus or minus 15 mm in any direction.

.10 Design connections for diagonal braces to be slip critical.

.11 All field connections are to be bolted.

1.6 SUBMITTALS

.1 Submit for review by the Consultant the following shop drawings:

.1 Standard Connection Design Details – when requested.

.2 Non-standard and Exposed Connection Design Details.

.3 Erection Diagrams.

.4 Shop Details – when requested.

.5 Erection Procedures – when requested.

.6 Field Work Details.

.7 Calculations – when requested.

.8 Do not reproduce the structural drawings to serve as erection or setting drawings.

.9 Shop drawings shall bear the signature and stamp of a qualified professional engineer licensed to practice in the Province of Ontario responsible for design of their respective work.

.2 Standard Connection Design Details

.1 Connection design details shall be prepared before the preparation of shop details and submitted to the Consultant for review that the intent of the design is met.

.3 Non-standard and Exposed Connection Design Details

.1 Moment and torsion connections.

.2 All connections exposed to view.

.3 Connection design details shall bear the signature and stamp of a qualified professional engineer licensed to practice in the Province of Ontario.

.4 Erection Diagrams

.1 Amongst other items show the following:

.1 General arrangement of the structure including all steel load-resisting elements essential to the integrity of the completed structure

.2 Principal dimensions of the structure

.3 Piece marks

.4 Sizes of the members

.5 Bearing details.

.6 Holes.

.7 Surface preparation, primer or other coatings.

.8 Grades of steel.

.9 Size and type of bolts and bolt installation requirements

.10 Shop and field welds

.11 Elevations of column bases

.12 All necessary dimensions and details for setting anchor rods

.13 Required clearances and other details to receive correlative items

.14 Any other information necessary for the assembly of the structure

.2 Show necessary dimensions and details for setting structural steel bearings, anchorages, assemblies and the like where they interface with other building components.

.3 Co-ordinate with shop drawings of cast-in-place concrete, masonry, miscellaneous metal work, metal deck and other interfacing work.

.5 Shop Details

.1 Shop details shall provide complete information for the fabrication of various members and components of the structure, including the required material and product standards; the location, type, and size of all mechanical fasteners; bolt installation requirements; and welds.

.6 Erection Procedures

.1 Erection procedures shall be prepared before erection and submitted to the Consultant for review.

.2 Erection procedures shall outline the construction methods, erection sequence, temporary bracing requirements, and other engineering details necessary for shipping, erecting, and maintaining the stability of the steel frame.

.3 Drawings and sketches that identify the location of permanent and temporary load-resisting elements essential to the integrity of the partially completed structure shall supplement erection procedures.

.4 Submit details of method proposed to apply and verify the magnitude of tension to bracing members within the specified tolerances.

.5 Submit procedures proposed when erection is carried out at temperatures greatly differing from 20 degrees C.

.7 Fieldwork Details

.1 Sealed fieldwork details shall be submitted for review by the Consultant whenever modifications to the original details shown on shop drawings are required.

.2 Fieldwork details shall provide complete information for modifying fabricated members in the shop or on the job site. All operations required to modify the member shall be shown on the fieldwork details.

.8 Calculations

.1 Submit calculations bearing the signature and stamp of a qualified professional engineer licensed to practice in the Province of Ontario and such further proof as may be necessary to show that non-standard connections and the like and truss connections and steel joist construction conform to the requirements set forth herein.

.9 Substitution

.1 If the Contractor wishes to make substitutions for steel materials or sizes indicated, submit proposals with the tender with necessary calculations for review of the Consultant.

.10 Drawings for Inspection Company

.1 Furnish inspection company with a copy of erection diagrams, shop details, erection procedures and fieldwork details bearing the Consultant's reviewed stamp.

.11 As-Built Drawings

.1 Mark on 2 complete sets of final drawings any changes, additions or deletions that occur during the construction as a result of the Contractor's work, change orders or for any other reason.

.2 If the Contractor wishes to make use of the structural CAD drawings, the cost of each drawing’s CAD file is $150, payable directly to Blackwell. The Contractor is required to sign a waiver stating the intended use prior to release of the drawings.

.12 Mill Test Reports

.1 Submit copies of mill test reports properly correlated to the materials available to the testing agency for review and to the Consultant for records.

PART 2 – PRODUCTS

2.1 MATERIALS

.1 Rolled Wide Flange Sections: Conform to CAN/CSA-G40.21-04 350W, unless otherwise noted.

.2 Rolled channels and angles: Conform to CAN/CSA-G40.21-04 300W, unless otherwise noted.

.3 Steel plate, bars and rods: Conform to CAN/CSA-G40.21-04 300W, unless otherwise noted.

.4 Hollow Structural Sections: Conform to CAN/CSA-G40.21-04 Grade 350W, Class C.

.5 Bolts: ASTM A325, galvanized where exposed to weather.

.6 Washers: ASTM F436, galvanized where exposed to weather.

.7 Headed stud: Conform to CSA W59 Appendix H and with a tensile strength of 450 MPa and yield strength of 350 MPa.

.8 Nominal Grade paint protection: in accordance with CISC/CPMA 1-73a – A Quick-drying One-coat Paint for use on Structural Steel.

.9 DTM primer/finish: Direct to Metal (DTM) Acrylic Primer/Finish:

.1 Acceptable products:

.1 Sherwin Williams B66W1 DTM Acrylic Primer/Finish

.2 PPG Pitt-Tech 90-712 DTM Primer/Finish

.10 Universal Shop primer: Phenolic Alkyd Primer

.1 Acceptable products:

.1 Devguard 4360 Low VOC Universal Primer.

.2 Sherwin Williams B50 Kem Bond HS Universal Metal Primer.

.3 PPG Amercoat 185H Universal Phenolic Primer.

.11 Repair primer for application in the field:

.1 Water Based Acrylic Primer. Acceptable Products:

.1 Devflex 4020PF Direct to Metal Primer

.2 Sherwin Williams Pro-Cryl B66-310 Series Universal Primer

.3 PPG Pitt-Tech Plus 90-912 Series DTM Industrial Primer

.12 Primer for steel to receive Intumescent fireproofing: Determined to be acceptable based on adhesion and compatibility characteristics under laboratory conditions in accordance with ASTM D3359-09e2, Method A and / or ASTM D4541-09e1, and approved by manufacturer of Intumescent fireproofing to be applied.

.13 Cold Galvanizing Coating for repair of galvanized surfaces:

.1 Acceptable Products:

.1 ZRC Zero-VOC Galvanizing Compound as manufactured by ZRC Worldwide, Marshfield, MA

.2 Aervoe Industries, Inc. ‘Low VOC Cold Galvanize Coating 93% Zinc

.14 Sheet Rubber for Thermal Separation at Steel Connections: AB-563 EPDM, Hardness: 60±5 Shore "A" Durometer, 3 mm thickness unless otherwise indicated, as manufactured by American Biltrite or approved equivalent. Distributed by Robco (Mississauga) 905-564-6555, Goodall (Oshawa) 905-728-1658 or Chambers and Cooke (Markham) 905-475-1331.

PART 3 – EXECUTION

3.1 WORKMANSHIP AND FABRICATION

.1 Conform to CAN/CSA-S16 and the following:

.2 Camber

.1 Provide camber to beams and girders as noted on the drawings.

.2 Provide camber in a manner that will not reduce the safe load carrying capacity of the members.

.3 If no camber is indicated, orient the section so that any natural camber in the member counteracts the dead load deflection. Note that for beams with large cantilevers the orientation may be opposite.

.3 Provide holes to 15mm in diameter indicated at any time before shop drawings are reviewed, as required to permit the attachment of other materials.

.4 Unless noted or required otherwise, provide a minimum 6mm thick cap plate on all HSS and other closed column sections.

.5 Openings

.1 Conform to requirements shown for location, size, reinforcing and cutting of openings through structural members.

.2 Obtain written permission of Consultant prior to field cutting or altering of structural members not shown on the drawings.

.6 Galvanized Steel

.1 Detail and fabricate steel such that it will not trap the galvanizing material.

.2 Detail so that welding of galvanized material is not required.

.3 Provide with vent holes as required.

.4 Clean of all weld slag prior to galvanizing.

.5 Upon completion of erection, touch up with cold galvanizing coating at all locations where galvanizing is damaged.

.6 Fabricate steel in a manner that will prevent or minimize distortion during galvanizing. Do not weld continuous elements, such as angles to elements which are to be galvanized.

3.2 PROTECTION

.1 Primers and paints used in multi-coat systems where a final shop or field paint finish is to be applied shall be selected and pre-approved by the Architect based on surface preparation, exposure conditions, and compatibility with other coatings.

.2 Reference Section 09 91 00 for locations of applicable paint systems.

.3 Black Steel

.1 This steel type applies to structural steel concealed from view in the finished building and not exposed to weather or high humidity environments.

.1 No cleaning or painting is required for this steel type.

.4 Steel Encased in concrete or coated with spray applied fire proofing

.1 This steel type applies to structural steel which is to be encased in spray applied fire proofing or concrete including:

.1 No cleaning or painting is required for this steel type.

.5 Steel to Receive Intumescent Fireproofing:

.1 This steel type applies to structural steel exposed to view and to receive an intumescent fireproofing coating:

.1 Preparation: Clean structural steel in accordance with SSPC SP6, Commercial Blast Cleaning

.2 Follow manufacturer guidelines for coatings.

.6 Painted Steel – Nominal Grade

.1 This steel type applies to concealed interior structural steel which is not scheduled to receive additional paint coats. This includes steel which is to be concealed from view in the finished building but where some nominal protection may be desired due to prolonged exposure during erection.

.1 Preparation: Clean structural steel in accordance with SSPC SP2, Hand Tool Cleaning

.2 Apply quick-drying one coat paint, in accordance with CISC/CPMA 1-73a.

.7 Primed Steel – Service Grade

.1 This steel type applies to interior structural steel which is to be primed, but which is not scheduled to receive a shop or field paint finish. This includes steel which is to remain exposed to view in the finished building but not accessible to public such as in a mechanical or storage room. This protection system is coordinated with the requirements of CISC/CPMA 2-75.

.1 Clean structural steel in accordance with SSPC SP7, Brush Off Blast Cleaning.

.2 Apply Universal shop primer within one hour following cleaning.

.3 Touch-up primer with approved field-applied primer. Prepare steel in accordance with manufacturer's recommendations.

.8 Primed Steel – Premium Grade

.1 This steel type applies to interior structural steel which is scheduled to receive a shop or field paint finish. This includes all steel exposed to public view in the finished building.

.1 Clean structural steel in accordance with SSPC SP6, Commercial Blast Cleaning. [SSPC SP10 Near-White Blast Cleaning].

.2 Apply Universal shop primer within one hour following cleaning.

.3 Touch-up primer with approved field-applied primer. Prepare steel in accordance with manufacturer's recommendations.

.4 Touch-up primer and top coats in accordance with Section 09 91 00.

.9 Galvanized Steel

.1 Unless noted otherwise, this steel type applies to exterior structural steel which is fully or partially outside the building envelope, and interior structural steel which is exposed to moisture in the finished building but is not designated as "architectural". Examples include, but are not limited to:

.1 Steel within the cavity of cavity walls

.2 lintels

.3 shelf angles

.4 plates, hangers, braces etc. outside the building envelope

.5 exterior beams

.6 exterior columns

.7 connection materials and inserts associated with the above.

.2 Fully galvanize, in accordance with CSA Standard G164 to a minimum zinc coating of 600 g/m^2.

.10 Except for steel which is to be left uncoated, upon completion of erection, apply specified field primer to welds, bolts and at locations where original primer is damaged. Prepare steel in strict accordance with the manufacturers' recommendations. For galvanized steel, touch up with specified zinc rich coating.

.11 Protect all steel from damage during storage, transportation and erection.

.12 Protect weep holes at base of closed column sections that have base plates, but no cap plates.

.13 During cold weather, protect members from damage due to water freezing in confined areas.

.14 Provide drain holes in closed sections to prevent water build-up during erection.

3.3 ERECTION

.1 General

.1 Conform to requirements of CAN/CSA-S16 and the following:

.2 Bracing members and anchor bolts shown are for the finished structure and may not be adequate to resist forces present during construction.

.3 Maintain temporary bracing until completion of entire structure including floor and roof decks, slabs, masonry walls and other elements which are part of the wind resisting system.

.4 Carry out erection operations, including installation of any temporary guying and shoring required, without loading portions of the existing structure already constructed in excess of its safe load carrying capacity.

.5 During erection, forces or reactions in the steel frame members and their connections may exceed those on which the design is based.

.6 Determine the magnitude of such forces and reactions and take such measures as are necessary to ensure that the safety and stability of the structure is maintained until the entire structure, including floor and roof slabs is complete.

.7 Splices, other than those shown, shall not be permitted in members without the Consultant's approval. If approval is given to permit welded splices, they shall be non-destructively tested at no extra cost to the Owner.

.8 Report to the Consultant where members cannot be erected within the specified tolerances without modification or special procedures. Take corrective measures to the Consultant's approval.

.2 Bearing on Concrete

.1 Set steel bases and bearing assemblies true and level at the proper elevation so that upon grouting, they will have full bearing.

.2 Unless a specific method is shown, levelling devices or steel shimming may be used to support bases prior to grouting. Subsequent to grouting, loosen the leveling devices so that all loads pass only through the bases, or remove the steel shims so that the resulting voids can be fully grouted.

.3 Openings

.1 Conform to the requirements shown for location, size, reinforcing and cutting of openings through structural members.

.2 No openings through structural steel members will be permitted without the Consultant's approval.

3.4 ARCHITECTURALLY EXPOSED STRUCTURAL STEEL (AESS)

.1 General

.1 Architecturally exposed steel (AESS) is all steel which is left exposed to view in the completed building in areas accessible to the public.

.2 This section applies to any structural steel members noted on the contract drawings as AESS. All AESS members must also be identified by their Category.

.3 This section pertains to the appearance, surface preparation and integration of AESS. Refer to the preceding sections for all technical requirements.

.2 Submittals

.1 Shop Drawings detailing fabrication of AESS components:

.1 Provide erection drawings clearly indicating which members are considered as AESS members and their Category

.2 Include details that clearly identify all of the requirements listed in subsections .5 “Fabrication” and .10 “Erection” of this section. Provide connections for AESS consistent with concepts, if shown on the Structural Design Documents

.3 Indicate welds by standard CWB symbols, distinguishing between shop and field welds, and show size, length and type of each weld. Identify grinding, finish and profile of welds as defined herein

.4 Indicate type, finish of bolts. Indicate which side of the connection bolt heads should be placed

.5 Indicate any special tolerances and erection requirements.

.6 Show clearly the required fabrication tolerances on shop drawings. Show the required tolerances for setting embedded items on erection drawings.

.3 Quality Assurance

.1 Fabricator Qualifications: In addition to those qualifications listed in other subsections of Division 5 “Structural Steel” Section, engage a firm competent in fabricating AESS similar to that indicated for this Project with sufficient production capacity to fabricate the AESS elements

.2 Erector Qualifications: In addition to those qualifications listed in other Subsections of Division 5 “Structural Steel” Section, engage a competent Erector who has completed comparable AESS work.

.3 Comply with applicable provisions of the following specifications and documents:

.1 CISC Code of Standard Practice, latest edition

.4 Visual Samples when specified may include any of the following:

.1 3-D Rendering of specified element;

.2 Physical sample of surface preparation and welds;

.3 First off inspection: First element fabricated for use in finished structure subject to alterations for subsequent pieces.

.4 Mockups: As specified in Structural Design Document. Mockups are either scaled or full-scale. Mockups are to demonstrate aesthetic effects as well as qualities of materials and execution:

.1 Mockups may have finished surface (including surface preparation and paint system)

.2 Architects approval of mockups is required before starting fabrication of final units;

.3 Mockups are retained until project is completed;

.4 Approval full-scale mockups may become part of the completed work.

.4 Delivery, Storage, and Handling

.1 Ensure that all items are properly prepared, handled and/or packaged for storage and shipping to prevent damage to product.

.2 Erect finished pieces using softened slings or other methods such that they are not damaged. Provide padding as required to protect while rigging and aligning member’s frames. Weld tabs for temporary bracing and safety cabling only at points concealed from view in the completed structure or where approved by the architect.

.5 Fabrication

.1 For the special fabrication characteristics, see Table 1 – AESS Category Matrix.

.2 Fabricate and assemble AESS in the shop to the greatest extent possible. Locate field joints in AESS assemblies at concealed locations or as approved by the Architect.

.3 Fabricate AESS with surface quality consistent with AESS Category and visual samples, if applicable.

.4 Perform fabrication with special care and necessary straightening to maintain the condition of the material as described herein.

.5 Make copes, mitres and butt cuts in surfaces exposed to view within the closest possible tolerances consistent with structural shop equipment and practice. Plan erection sequence so that these tolerances can be maintained.

.6 Where the fit-up of adjacent members is such that permissible tolerances specified above may result in any unsightly joint, take special care to obtain a visual plane on the exposed surfaces. If both surfaces are exposed, detail joints in such a way as to minimize these unavoidable variations.

.7 All exposed edges of plates shall be universal mill or guided flame cut. Exposed cut edges of beam flanges shall be guided flame cut. Cut surfaces shall be equal in smoothness to a mill finish.

.8 Where bolted connections are shown, ensure that connections are neatly arranged with tight joints.

.6 Tolerances

.1 Tolerances for AESS shall be twice as stringent as those required by S16 otherwise.

.2 Tolerances not specifically covered by S16 shall be governed by EN ISO 13920 Class B.

.7 Shop Connections

.1 Bolted Connections: Make in accordance with Section 05 12 00. Provide bolt type and finish as specified and place bolt heads as indicated on the approved shop drawings.

.2 Welded Connections: Comply with CSA W59-03 and Section 05 12 00. Appearance and quality of welds shall be consistent with the category and visual samples if applicable. Assemble and weld built-up sections by methods that will maintain alignment of members to the tolerance of this subsection.

.8 Field Connections

.1 Bolted Connections: Make in accordance with this section. Provide bolt type and finish as specified and place bolt heads as indicated on the approved shop drawings.

.2 Welded Connections: Unless otherwise permitted, all field connections are to be bolted. Where permitted, comply with CSA W59-03 and Section 05 12 00. Appearance and quality of welds shall be consistent with the Category and visual samples if applicable. Assemble and weld built-up sections by methods that will maintain alignment of members to the tolerance of this Subsection.

.1 Assemble and weld built-up sections by methods that will maintain alignment of axes. Verify that weld sizes, fabrication sequence, and equipment used for AESS will limit distortions to allowable tolerances.

.9 Welding

.1 Form and weld all joints exposed to weather to exclude water by the use of "seal" welds.

.2 Exposed welds, except filler welds and concealed welds, where clearances or fit of other items may so necessitate, shall be ground smooth and otherwise finished flush and even with adjacent surfaces. Grinding is not required for well formed fillet welds.

.3 Grind bevel welds smooth, forming neat, well-made corners.

.10 Erection

.1 The erector shall check all AESS members upon delivery for twist, kinks, gouges or other imperfections, which might result in rejection of the appearance of the member. Coordinate remedial action with fabricator prior to erecting steel.

.2 Provide connections for temporary shoring, bracing and supports only where noted on the approved shop erection drawings. Temporary connections shown shall be made at locations not exposed to view in the final structure or as approved by the Architect. Handle, lift and align pieces using padded slings and / or other protection required to maintain the appearance of the AESS through the process of erection.

.3 Set AESS accurately in locations and to elevations indicated, and according to CSA S16.

.4 In addition to the special care used to handle and erect AESS, employ the proper erection techniques to meet the requirements of the specified AESS Category:

.1 AESS Erection tolerances: Erection tolerances shall meet the requirements of standard frame tolerances for structural steel per CSA S16, unless noted otherwise.

.2 Bolt Head Placement: Bolt heads in a given connection shall be placed to one side

.3 Removal of field connection aids: Run-out tabs, erection bolts and other steel members added to connections to allow for alignment, fit-up and welding in the field shall be removed from the structure. Welds at run-out tabs shall be removed to match adjacent surfaces and ground smooth. Holes for erection bolts shall be plug welded and ground smooth where specified;

.4 Filling of connection access holes: Filling shall be executed with proper procedures to match architectural profile, where specified;

.5 Field Welding: Weld profile, quality, and finish shall be consistent with Category and visual samples, if applicable, approved prior to fabrication.

.11 Painting

.1 After inspection and before leaving the shop, clean all steel work as described in the appropriate AESS category section below.

.2 Immediately after cleaning, apply a shop coat of primer to all steel work. Allow to dry in a dust free area.

.3 Apply 1 additional shop coat of primer as specified to parts of shop coated steel surfaces that will be inaccessible after erection.

.4 Clean surfaces within 50 mm of any field weld location of materials that would prevent proper welding or produce objectionable fumes while welding is being done.

.5 After erection and immediately after grinding welds, etc. touch up primer with the specified products. Prepare steel in accordance with manufacturers' recommendations. Paint in accordance with 09 10 00.

.12 Galvanizing

.1 Ensure that the galvanizing process leaves a smooth and uniform surface.

.2 During galvanizing, use procedures to ensure that members do not deform excessively.

.13 Architectural Review

.1 The Architect shall review the AESS steel in place and determine acceptability based on the Category and visual samples (if applicable). The Fabricator/Erector will advise the consultant the schedule of the AESS work.

.2 Galvanized Surfaces: Clean Abraded areas and repair galvanizing to comply with ASTM A780.

.14 Protection

.1 Prevent staining of architecturally exposed steel by concrete, mortar, plaster, oils, paints or other foreign substances.

.2 Do not use marking paint, crayons or other marking materials on exposed surfaces.

.15 Specific Requirements based on AESS Category

.1 AESS 1 Basic Elements

.1 All AESS is to confirm to category AESS 1

.2 Rough surfaces are to be deburred and ground smooth. Sharp edges resulting from flame cutting, grinding and especially shearing are to be softened.

.3 Intermittent welds are made continuous, either with additional welding, caulking or body filler. For corrosive environments, all joints should be seal welded.

.4 Seams of hollow structural sections shall be acceptable as produced.

.5 Standard structural bolts shall be used. Bolted connections shall be neatly arranged. All bolt heads in connections shall be on the same side, as specified, and consistent from one connection to another.

.6 Weld spatter, slivers, surface discontinuities are to be removed. Weld projection up to 2 mm is acceptable for butt and plug welded joints. All exposed edges of plates shall be universal mill or guided flame cut. Exposed cut edges of beam flanges shall be guided flame cut. Cut surfaces shall be equal in smoothness to a mill finish.

END OF SECTION 05 12 00

PART 1 – GENERAL

1.1 GENERAL REQUIREMENTS

.1 Provide all material and labour required for the completion of the Contract. Breakdown of Work by Section is for guidance only and is not necessarily complete.

.2 Work Furnished and Installed:

.1 Steel roof and floor deck.

.2 Holes in deck for other trades.

.3 Hole and edge reinforcing welded to deck.

.4 Closures.

.3 Related Work Specified Elsewhere:

.1 Concrete on metal deck: Section 03 30 00

.2 Concrete reinforcement: Section 03 20 00

.3 Framing of openings in deck exceeding 450 mm in roof deck and 300 mm in floor deck and framing of edges of openings in metal deck where loss of bearing to metal deck occurs: Section 05 12 00

.4 Clip angles at columns to support metal deck: Section 05 12 00

.5 Steel bearing plates and related anchors to receive metal deck: Section 05 12 00

1.2 STANDARDS, CODES AND ACTS

.1 Conform with the Ontario Building Code 2012 under Ontario Regulation 332/12 and any applicable acts of authority having jurisdiction and the following:

.1 CAN/CSA-S136, North American Specifications for the Design of Cold Formed Steel Structural Members (using the Appendix B provisions applicable to Canada)

.2 CAN/CSA-S16, Limit States Design of Steel Structures

.3 CSA Standard W47.1, Certification of Companies for Fusion Welding of Steel Structures, Canadian Standards Association.

.4 CSA Standard W59, Welded Steel Construction, Canadian Standards Association.

.5 CSSBI 10M-96, Canadian Sheet Steel Building Institute (CSSBI) Standards for Steel Roof Deck - 1976 Revised 1981 and Steel Floor Deck - 1976 Revised 1981.

.6 ASTM A108, Standard Specification for Steel Bars, Carbon, Cold Finished, Standard Quality, American Society of Testing and Materials.

.7 ASTM A653/A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process, American Society of Testing and Materials.

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

1.3 QUALIFICATIONS

.1 Any organization undertaking to weld under this Contract shall be certified by the Canadian Welding Bureau under the requirements of CSA Standard W47.1.

.2 Welders engaged in this work shall furnish proof that they have successfully carried out welding of gauge metal.

1.4 DESIGN

.1 Design deck in accordance with requirements of the Ontario Building Code to safely support loadings shown or implied.

.2 Design deck such that the live load deflection of the deck shall not exceed 1/360 of the span for floor deck, nor 1/240 of the span for roof deck, except that when decks support a plastered ceiling or similar finish, the deflection due to live load shall not exceed 1/360 of the span.

.3 Design deck anchorage to the supporting framework or walls to safely resist net uplift forces shown, but not less than 0.50 kPa.

.4 Wherever possible, design units to span over three or more supports in order to obtain increased rigidity.

.5 Determine structural properties of the structural concrete slab and composite construction in accordance with requirements of the Ontario Building Code.

.6 Design composite deck to safely support the weight of the concrete and reinforcing steel and other construction loads before the composite action of the deck system takes place, without excessive deflection and without exceeding allowable working stresses and without shoring of deck.

.7 If required, design and detail temporary intermediate support of the composite deck so that allowable working stresses are not exceeded before composite action takes place

.8 Where shown, design headed studs to purlins to act compositely with deck system so as to limit purlin deflection under live load to L/360

.9 Where headed studs to purlins and beams to act compositely with concrete/deck system have been indicated, these have been based on cellular steel deck where the flute average width is at least twice the height if the deck. Where 2 studs are required per flute perpendicular to the beam, design value is 72% of that for a single stud. If 3 studs per flute, design value is 60% of a single stud. In any event, do not tender on less than shown on the structural drawings.

.10 Do not assume composite action between girders and concrete/deck system.

.11 Design and connect metal edge and closure strips to safely resist construction loads and prevent the loss of grout when the deck is concreted.

.12 Design and install deck units to safely sustain uplift forces due to wind during erection until the concrete slabs are placed.

.13 Design and connect metal screeds forming vertical sides of the concrete slabs placed on the metal deck to obtain concrete edges with an accuracy of 6 mm based on a concrete slump of 75 mm and the use of mechanical vibrators.

.14 Design framing for openings or holes through the roof deck up to 450 mm maximum width and in floor deck up to 300 mm maximum width measured perpendicular to the span of the deck.

1.5 SUBMITTALS

.1 Shop Drawings

.1 Submit erection and fabrication drawings for review by the Consultant.

.2 Each drawing submitted shall bear the signature and stamp of a qualified Professional Engineer licensed in the Province of Ontario.

.3 Amongst other items, show the following:

.1 Types of deck and their locations

.2 Design loads

.3 Net uplift pressures

.4 Openings and their reinforcement

.5 Gauge of steel deck

.6 Surface protective coating

.7 Flashings and closure plates

.8 Welding details

.9 Sufficient detail sections showing the deck's orientation to support members to facilitate erection of deck

.4 Do not reproduce the structural drawings to serve as shop drawings without the consent of the Consultant.

.5 Furnish the inspection company with a copy of each shop drawing bearing the Consultant's reviewed stamp.

.2 Mill Test Reports

.1 Submit two copies of mill test reports properly correlated to the materials.

.3 As-Built Drawings

.1 Mark on 1 complete sets of final drawings any changes, additions or deletions that occur during the construction as a result of the Contractor's work, change orders or for any other reason.

PART 2 – PRODUCTS

2.1 MATERIALS

.1 Metal Deck

.1 To CSSBI 10M. Minimum steel core thickness 0.76 mm except that deck exposed to view in the finished building shall have a minimum steel core thickness of 0.91 mm.

.2 Form deck with integral ribs of a shape acceptable to the Consultant.

.3 Provide a minimum width of rib contact with the supporting steel work of 40 times the thickness of the deck.

.4 Provide sections with interlocking type side joints.

.5 Supply composite deck floor units with suitable lugs or deformations to provide composite action with the concrete fill.

.2 Sound absorbing Element

.1 Glass fibre insulation, density of 22 kg/m^2, profiled to completely fill the flutes in the top of the acoustic deck.

.3 Miscellaneous Metal

.1 Metal cover plates, cell closures, web stiffeners, edge strips and flashings shall conform to material and finish as specified for deck and have a minimum steel core nominal thickness of 1.22 mm.

PART 3– EXECUTION

3.1 Protection:

.1 Galvanizing in accordance with ASTM A653/A653M-06a.

.1 Interior exposure:

.1 Concealed from view: ZF75 galvanneal wipe coat.

.2 Exposed to view and scheduled to receive a field-applied paint system: ZF75 galvanneal wipe coat.

.3 Exposed to view and scheduled to remain unfinished: ZF275 galvanized.

.2 Exterior exposure:

.1 Concealed or exposed to view: Z275 galvanized

.3 Touch up abrasions and welds with a brush coat of zinc rich primer.

3.2 INSTALLATION

.1 General

.1 Ensure that construction loads caused by the erection of the deck will not load structural members in excess of their design loads.

.2 Erect deck such that it is free of dirt, scale, foreign matter, dents or deformations.

.3 Adjust deck units to their final position before securing to supporting members. Supply and install steel packing between supporting members and deck to provide a minimum of 50 mm bearing. Permanently secure packing.

.4 Lap ends of non-composite deck units a minimum of 50 mm and only over supporting members.

.5 Where deck with pre-finished Barrier Coating system is used, all connections to the supporting structure are to be mechanical connections. Use galvanized screws.

.6 Where steel deck spans parallel to beams that are to have studs added to top flange, arrange flutes to be centred over beams. If this is not possible, have decking interrupted so that studs can be properly placed on beams to allow composite action to take place.

.7 When deck units are adjusted to their final position, anchor to supports and to members parallel to the deck span to safely resist uplift forces and lateral forces, but with not less than 19 mm diameter fusion welds at a maximum spacing of 400 o.c. or every second flute, whichever is less. Where deck will be exposed to weather without cover, or where welding of deck is impracticable, secure deck with a minimum #12 self taping screws at an average spacing of 300 o.c.

.8 Provide a minimum of 50 mm of end bearing on supports. Fasten side joints of deck units between supports by clinching at 600 mm intervals or with 25 mm long welds at 1000 mm intervals. Secure structural flashings and the like to deck with sheet metal screws or welding.

.9 Make fusion welds of deck to supporting members well within bearing width of supporting members.

.10 Weld gauge metal to obtain satisfactory fusion between the deck and supports without damage to the deck or its supports.

.11 Provide minimum closure channels along edges of all deck parallel to span where deck is not otherwise supported.

.2 Holes Through Deck

.1 Cut openings and reinforce edges as required for pipes, ducts, hoppers and the like. Indicate openings as reinforcement for openings on fabrication and erection drawings. The maximum size of an unreinforced opening is 150 mm square or in diameter. Reinforce openings having a dimension over 150 mm, but not exceeding 450 mm as required. Framing for openings with a dimension exceeding 450 mm in roof deck and 300 mm in floor deck is specified under Structural Steel Section 05 12 00 . The location of holes through decking shall be to the approval of the Consultant.

.2 Obtain actual opening and holing information before proceeding with the work. Cooperate with other trades as necessary.

END OF SECTION 05 31 00

PART 1 – GENERAL

1.1 GENERAL REQUIREMENTS

.1 Provide all material and labour required for the completion of the Contract. Breakdown of Work by Section is for guidance only and is not necessarily complete.

.2 Where steel members connect to wood members, the nail-laminated sub-contractor shall cooperate with the steel sub-contractor.

.3 Work Furnished and Installed:

.1 Nail-laminated Timber (NLT) structural units

.2 Holes in NLT panels up to 230mm

.3 Nailers on steel beams and foundation walls

.4 Splines connecting NLT panels

.5 Connectors to timber, nailers, splines, structural steel elements etc.

.4 Related Work Specified Elsewhere:

.1 Concrete reinforcement, Section 03 20 00

.2 Concrete topping on NLT, Section 03 30 00

.3 Installation of anchors in concrete, Section 03 30 00

.4 Structural Steel, Section 05 12 00

.5 Protection of steel saddles, plates, brackets and the like forming part of wood connections, Section 05 12 00

.6 Rough Carpentry, Section 06 10 00

.7 Staining and finishing, Section 09 96 00

1.2 STANDARDS, CODES AND ACTS

.1 Conform with the Ontario Building Code 2012 under Ontario Regulation 332.12 and any applicable acts of any authority having jurisdiction, and the following (latest edition including any and all supplements):

.1 CAN/CSA-G40.21, Structural Quality Steel, Canadian Standards Association.

.2 CAN/CSA-G164, Hot Dip Galvanizing of Irregularly Shaped Articles, Canadian Standards Association.

.3 CAN/CSA Standard O86, Engineering Design in Wood, Canadian Standards Association.

.4 CSA O112.10, Evaluation of Adhesives for Structural Wood products (Limited Moisture Exposure), Canadian Standards Association.

.5 CAN/CSA-O122, Structural Glued-Laminated Timber, Canadian Standards Association.

.6 A307 Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

.7 Nail-laminated Timber US Design and Construction Guide

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

1.3 QUALIFICATIONS OF MANUFACTURER

.1 Manufacture structural nail-laminated members in plant certified to produce NLT if such certification exists at the time of manufacture.

.2 Fabricator for welded steel connections to be certified in accordance with CSA Standard W47.1.

1.4 DESIGN

.1 Connections are to be designed by a Professional Engineer registered in the province of Ontario, in accordance with CSA Standard O86 and CSA S16.

.2 Design nailing between laminations to transfer all loads and provide the intended structural performance, but not less than the recommended nailing per "Nail Laminated Timber U.S. Design and Construction Guide".

.3 Design plywood or OSB splines between NLT panels and their nailing to transfer the diaphragm loads shown or implied.

.4 Design screw connections between NLT panels and nailers, and bolted connection of nailers to steel beams or walls, to transfer diaphragm loads shown or implied.

1.5 SUBMITTALS

.1 Product Data: For each type of factory-fabricated product. Submit proposed sealer for review and approval.

.2 Shop Drawings

.1 Submit shop drawings in accordance with Section 01 33 23.

.2 Shop drawings are to be submitted in PDF format.

.3 Connections and details, joint patterns, material specifications, and finishes, including an erection layout.

.4 Clearly indicate stress grade, service grade, appearance grade, shop applied finishes, shop and erection details, temporary intermediate supports of composite NLT panels, panel orientation, including cuts, holes, fastenings and connection hardware and camber.

.3 If requested by the Consultant, submit connection design calculations, stamped by the Engineer responsible for the design.

.4 Each shop drawing and calculation submitted shall bear stamp of a qualified Professional Engineer licensed in the Province of Ontario.

.5 In lieu of grade stamping lumber exposed to view, submit manufacturer's certificate certifying that wood products meet or exceed specified requirements.

.6 The fabricator and erector shall submit a QA/QC log of items such as but not limited to:

.1 Environmental conditions at all stages, such as during fabrication, storage, transportation, erection, and ideally until building is completely finished.

.2 Actual length, thickness, and width of the NLT panels. Length, width, thickness, and diagonal measurement are to be noted on the top surface of the panels.

.3 Site deliveries, including verified load manifests with notes of damaged or missing materials and elements.

.4 Material and element install with sign off for QC on hardware/fastener installation.

.5 Equipment used, such as but not limited to torque drills (with torque clutch) for screw installation through steel plates etc.

.6 Any changes or modifications.

.7 The inclusion of representative pictures within the log is required.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Arrange delivery of members and/or panels in accordance with construction schedule to designated delivery location.

.2 Individually wrap commercial, quality or architectural appearance grade members prior to leaving plant with a moisture resistant wrapping.

.3 Store all materials and assembled NLT panels under cover with proper drainage. Take particular care to protect exposed end grain. Protect from staining and damage at all times during fabrication, transportation, and installation.

.4 Take all necessary precautions to keep NLT dry during and after installation, including temporary sloping tarps and UV protection.

.5 Affix authorized label to all NLT panels supplied. Identify each panel with mark number.

.6 Use padded, non-marring slings for handling members.

.7 Protect corners with wood blocking.

.8 Slit underside of membrane covering during storage at site.

.9 Store nail-laminated timber well blocked off ground and separated with stripping, so air may circulate around all four sides of members.

.10 Cover top and sides with opaque moisture resistant membrane if unprotected.

1.7 PROTECTION

.1 Maintain protection of nail-laminated members until protected by building membrane/finishes, etc.

.2 Except as noted below, bolts, nuts, washers, nails and all other connectors are to be hot-dip galvanized where the connection and or connected member are exposed to view in the finished building.

.3 Screws for interior use may be coated for low exposure.

.4 Screws exposed to the elements or outside the building envelope shall be type 316 stainless steel.

.5 Nails between laminations of NLT panel may be uncoated.

.6 Provide one shop applied coat of Sansin SDF Wood Sealer or approved equal to decking

.7 Coat ends of all nail-laminated members with two coats of clear sealer. For preservative treated lumber allow an appropriate curing/drying time prior to application of sealer.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS – NLT Panels

.1 The following manufacturers are acceptable for the supply and installation of the NLT panels.

Element5
67 Mowat Ave #114
Toronto, Ontario M6K 3E3
1(888)-670-7713
Contact: Patrick Chouinard

Timmerman Timberworks Inc.
3 Greengage Rd
New Lowell, ON L0M 1N0
Phone: 705 424-2222
Contact: Ian Whittington

Structurecraft
1929 Foy St
Abbotsford, BC V2T 6B1, Canada
1 604-940-8889
Contact: Gerald Epp Jr.

Timber Systems Limited
120 Bullock Drive
Markham, ON L3P 1W2, Canada
Phone: +1 905-294-7091
Contact: Chris Williams

.2 Other manufacturer/suppliers may be acceptable subject to prior approval. Submission for supplier approval must be made not less than 2 weeks prior to tender close.

.3 The NLT supplier/fabricator carried by the General Contractor shall be named in the bid submission and shall not be changed following award of contract unless approved by the Consultant on behalf of the Owner.

2.2 MATERIALS

.1 NLT Panels

.1 Lumber: Sustainably harvested Spruce-Pine-Fir to CAN/CSA O122. Grade No.1/No.2 unless noted otherwise.

.2 Do not grade stamp lumber on surfaces exposed to view. Deliver to site with certificates as to species, grades, stress grades, seasoning, moisture content, and other evidence as required to show compliance with the Specifications.

.3 Dress lumber, S4S, unless otherwise indicated.

.4 Maximum Moisture Content: 19% unless noted otherwise.

.5 Finger-Jointed Lumber: Certified Exterior Joints, Heat-Resistant Adhesive (HRA), in accordance with ALSC.

.2 Connectors

.1 Steel for connections: to CSA Standard G40.21M Grade 300W. Bolts, nuts and washers: ASTM A307, galvanized.

.2 Nails, Brads, and Staples: ASTM F1667.

.3 Power-Driven Fasteners: ICC-ES ESR-1539

.4 Metal Straps and Ties: Galvanized Simpson Strong-Tie connectors or approved equal where required.

.5 Structural Steel Connectors: As specified in Section 05 12 00. All steel and connectors shall be hot dip galvanized unless noted otherwise. Fabricate steel hardware and connections with joints neatly fitted, welded, and ground smooth. Test fit in shop.

.6 Galvanizing: to ASTM A153.

.3 Other Materials

.1 Wood Sealer: As specified in Section 09 91 00. Sealer shall be compatible with indicated finish. End sealer shall be effective in retarding the transmission of moisture at cross-grain cuts.

.2 Specialty and/or proprietary products shown on the Drawings have been selected and specified based on the manufacturer's representation. The Consultant shall not become guarantor of the product. Install specialty products in strict conformance with the manufacturer's recommendations. Contractor is responsible for proper workmanship during installation.

2.3 SUBSTUTIONS

.1 Dowel-Laminated Timber (DLT) matching dimensions and minimum structural performance may be substituted for NLT. Obtain approval from consultant prior to making substitution.

PART 3– EXECUTION

3.1 FABRICATION

.1 Hand select members to ensure straightness and architectural-quality appearance.

.1 No wane, knot holes, grade stamps, or stains are permitted to be visible in the completed structure.

.2 Assume a minimum of 30% - 40% lumber rejection rate to achieve acceptable appearance with #2 grade material. Higher grade material (e.g. J-grade or MSR lumber) will reduce the rejection rate and may be substituted for #2 grade material at Contractor's option.

.2 Place soffits of timbers so the least number of checks and knots will be visible in the completed structure.

.3 Place laminations with end joints centered over support members below. No joints are to be visible from below.

.4 Use common steel wire nails unless noted otherwise. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads.

.5 Substitution of common nails with power-driven nails of the same length and diameter is acceptable..

.6 Clearly mark top surface of NLT panels for identification during erection.

.7 As soon as possible after cutting, apply a saturation coat of end sealer to ends and other cross-cut surfaces, keeping surfaces flood coated for not less than 10 minutes.

.8 After end-coat sealing, apply a heavy saturation coat of penetrating sealer on surfaces of each NLT panel, or seal every lam prior to assembling.

.9 Cut openings as required for pipes, ducts and the like in accordance with the following:

.1 Indicate openings on the fabrication and erections drawings

.2 Holes up to 76mm may be cut without special reinforcing.

.3 Holes greater than 76mm and up to 228mm may be made in NLT panels, with screw reinforcing as per "Nail Laminated Timber US Design and Construction Guide".

.4 Do not cut holes greater than 228mm unless specifically shown on the structural drawings.

.5 Minimum spacing of holes shall not be less than three times the dimension of the larger adjacent hole.

.6 Do not overcut corners on straight sided openings.

.7 Holes not conforming to the above shall be approved by the Consultant prior to cutting.

.10 Fabrication Tolerances

.1 Soffit Elevation of Individual Laminations: plus or minus 1 mm.

.2 Panel Width: plus or minus 6 mm.

.3 Panel Length: plus or minus 3 mm.

.4 For rectangular panels, the corner-to-corner diagonal measurements should not deviate from each other by more than 3 mm.

3.2 ERECTION

.1 Examination

.1 Confirm all dimensions prior to fabrication. Coordinate with shop drawings of other trades.

.2 Examine supporting construction in areas to receive NLT, with Installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance of the Work.

.3 Proceed with installation only after unsatisfactory conditions have been corrected.

.2 Fit NLT panels closely and accurately to required levels and lines without trimming, cutting, or other modifications, unless approved in writing by the Consultant.

.3 Provide temporary shores, guys, braces, and other supports during erection to keep NLT secure and in alignment against wind loads, seismic loads, temporary construction loads, and loads equal in intensity to design loads. Any failure to make proper and adequate provisions for stresses during erection shall be solely the responsibility of the Installer. Fasteners required for erection purposes are the responsibility of the Contractor and are to be included in the bid.

.4 Securely attach NLT to supports as indicated on the Drawings.

.5 Site cutting or boring of NLT, other than shown on the shop drawings, is not permitted without written consent of the Consultant. Coat all field-cut openings with minimum two coats of clear sealer.

.6 Provide sill gaskets below laminations and non-rigid vapor barrier sealant between laminations where assembly passes over exterior walls.

.7 Provide moisture barrier at all locations where NLT abuts concrete or masonry construction. Acceptable barriers include light gauge metal, asphalt-impregnated building paper, closed-cell foam gasket material, saturated felt roll roofing, or 6-mil-thick polyethylene.

.8 Provide gaps as required for construction tolerances and swelling. Details and locations shall be discussed with and approved by the Consultant in writing prior to construction. Gaps on the interior of the building are to be filled after the building is fully enclosed and temperature controlled.

.9 Make adequate provisions for erection stresses.

.10 Make splicing and jointing only in locations shown.

.11 Fit members closely and accurately to other members and other assemblies.

.12 Conform to erection tolerances specified in CAN/CSA-S16 Clause 29.3

.13 Interfacing tolerances may not be compatible with the above. Review and coordinate interfacing tolerances so that the various elements come together properly.

.14 Avoid rapid changes in temperature and humidity when commissioning building HVAC system. Gradually increase heat in the building. Do not direct any forced air heating systems onto NLT panels.

.15 Re-tightening Connections:

.1 Connection of bolted connections in the nail-laminated members shall be inspected at 6 and 12 months after completion of the building envelope and commissioning of the HVAC systems, and tightened sufficiently to bring the faces of the connected materials into close contact without deformation.

.2 Any paint or other finishes damaged by these operations shall be made good.

.3 The cost of this work shall be included in the general contract tender price, but also identified as a separate price.

.16 Repairs and Finishing

.1 Prior to finishing, remove any stains, marks, or other damage that may have occurred during construction.

.2 Provide field finish of NLT as specified in Section 09 91 00.

.3 Final approval by Architect will be after installation of all NLT. Remove and replace all Work that does not conform to the standard of the approved mock-up, at Architect's request. Replacement of defective Work is at Contractor's expense.

.17 Erection Tolerances

.1 For rectangular areas, the corner-to-corner diagonal measurements should not deviate from each other by more than 12 mm or 0.25% of the length of the shortest side of the rectangle, whichever is greater.

.2 Overall Surface Levelness (Floors and Flat Roofs): 6 mm in 3 m maximum.

.3 Elevation: plus or minus 10 mm from theoretical.

.4 Joints: 5 mm maximum gap between NLT panels or individual laminations unless noted otherwise except where larger gaps are required to accommodate dimensional changes due to moisture change.

END OF SECTION 06 15 29

PART 1 - GENERAL REQUIREMENTS

1.1 GENERAL DESCRIPTION

.1 Work shall consist of designing, furnishing and installing Rammed Aggregate Pier foundations to the lines and grades designated on the project drawings and as specified herein. The piers shall be constructed by either auguring a shaft to the design depth and vertically ramming lifts of aggregate using the specially designed tamper head and high energy impact densification equipment to create the compacted aggregate pier or rigid inclusion pier. The pier elements shall be in a columnar type configuration and shall be used to produce an intermediate foundation system.

1.2 WORK INCLUDED

.1 Provision of all equipment, material, labor, and supervision to design and install pier elements. Design shall rely on subsurface information presented in the project geotechnical report. Layout of pier elements, spoil removal (as required), footing excavations, and subgrade preparation following aggregate pier installation is not included.

.2 The Rammed Aggregate Pier or Rigid Inclusion Pier design and installation shall adhere to all methods and standards described in this Specification.

.3 Drawings and General Provisions of the Contract, including General and Supplemental Conditions, and Division 1 Specifications, apply to the work in this specification.

1.3 ALTERNATIVE PROPOSALS

.1 Alternative proposals will be entertained during the Tender period, subject to the following:

.1 Alternative proposals may include bulk replacement of existing fill material with engineered fill imported to the site and compacted in lifts as described in the geotechnical report.

.2 A formal submission detailing the proposed alternative submittal must be submitted two weeks prior to the closing of tender. The submission shall be a complete proposal, including calculations for review.

.3 Any variation to the foundations shall be designed by the Contractor at the Contractor's expense and the design shall be submitted to the Consultant for approval along with the information described in this Section.

.4 Alternative proposals may be accepted or rejected at the discretion of the Consultant.

.5 The proposed alternate system is to maintain the bearing and settlement criteria set out above as a minimum performance level.

.6 The submission must include a minimum of three examples of past projects in similar soils.

.1 Include references and contact information for the General Contractor and Owner for each example project.

.2 Example projects are to have been on sites with similar soil properties to the subject site.

.3 Include the geotechnical investigation report for each example project.

1.4 WORK INCLUDED

.1 Provision of all equipment, material, labour, and supervision to design and install Geopier elements. Design shall rely on subsurface information presented in the project geotechnical report. Layout of Geopier elements, construction of a working platform, footing excavations, and subgrade preparation following aggregate pier installation is not included.

.2 The Geopier design and installation shall adhere to all methods and standards described in this Specification.

.3 Drawings and General Provisions of the Contract, including General and Supplemental Conditions, and Division 1 Specifications, apply to the work in this specification.

1.5 APPROVED INSTALLERS

.1 The Geopier Installer (the Installer) shall be approved by the Owner's Engineer prior to bid opening. Without exception, no alternate installer will be accepted unless approved by the Owner's Engineer at least two (2) weeks prior to bid opening.

.2 Installers of Geopier foundation systems shall have a minimum of 10 years of experience with the installation of Geopier systems and shall have completed at least 50 projects in Ontario and shall be able to demonstrate having completed projects in Ontario of similar scope in similar soil types using ground improvement.

.3 Installers licensed by the Geopier Foundation Company, Inc. (www.geopier.com) will be accepted as approved installer.

.4 Without exception, no alternate installer will be accepted unless approved by Owner's Engineer and Geopier Foundation Company, Inc.

.5 Installers currently approved for these works are:

.1 GeoSolv Design/Build, Inc., Vaughan, ON

.2 Rapid Impact Piers, Ltd., Delta, BC

.3 Amcon Limited, Dartmouth, NC

.4 GeoConstructors, Inc., Leesburg, VA

1.6 REFERENCE STANDARDS

.1 Design

.1 "Control of Settlement and Uplift of Structures Using Short Aggregate Piers," by Evert C. Lawton (Assoc. Prof., Dept. of Civil Eng., Univ. of Utah), Nathaniel S. Fox (President, Geopier Foundation Co., Inc.), and Richard L. Handy (Distinguished Prof. Emeritus, Iowa State Univ., Dept. of Civil Eng.), reprinted from *IN-SITU DEEP SOIL IMPROVEMENT, Proceedings of sessions sponsored by the Geotechnical Engineering Division/ASCE in conjunction with the ASCE National Convention held October 9-13, 1994, Atlanta, Georgia*.

.2 "Settlement of Structures Supported on Marginal or Inadequate Soils Stiffened with Short Aggregate Piers," by Evert C. Lawton and Nathaniel S. Fox. *Geotechnical Special Publication No. 40: Vertical and Horizontal Deformations of Foundations and Embankments,* ASCE, 2, 962-974.

.3 "Behavior of Geopier®-Supported Foundation Systems during Seismic Events," by Kord Wissmann, Evert C. Lawton, and Tom Farrell. Geopier Foundation Company, Inc. Blacksburg, VA ©1999.

.2 Modulus Testing

.1 ASTM D 1143 - Pile Load Test Procedures

.2 ASTM D 1194 - Spread Footing Load Test

.3 Materials and Inspection

.1 ASTM D 1241 - Aggregate Quality

.2 ASTM D 422 - Gradation of Soils

.4 Where specifications and reference documents conflict, the Geopier Designer shall make the final determination of the applicable document.

1.7 CERTIFICATIONS AND SUBMITTALS

.1 Design Calculations - The Installer shall submit detailed design calculations and construction drawings prepared by the Geopier Designer (the Designer) for review and approval by the Owner or Owner's Engineer. All plans shall be sealed by a Professional Engineer licensed in the Province of Ontario.

.2 Professional Liability Insurance - The Geopier Designer shall have Errors and Omissions design insurance for the work. The insurance policy should provide a minimum coverage of $2 million per occurrence.

.3 Modulus Test Reports – A modulus test(s) is performed on a non-production Geopier element as required by the Geopier Designer to verify the design assumptions. The Installer shall furnish the General Contractor a description of the installation equipment, installation records, complete test data, analysis of the test data and verification of the design parameter values based on the modulus test results. The report shall be prepared under direction of a Registered Professional Engineer in the Province of Ontario.

.4 Daily Geopier Progress Reports – The Installer shall furnish a complete and accurate record of Geopier installation to the General Contractor. The record shall indicate the pier location, length, volume of aggregate used or number of lifts, densification forces during installation, and final elevations or depths of the base and top of piers. The record shall also indicate the type and size of the installation equipment used, and the type of aggregate used. The Installer shall immediately report any unusual conditions encountered during installation to the General Contractor, to the Designer and to the Testing Agency.

PART 2: MATERIALS

2.1 AGGREGATE

.1 Aggregate used by the Geopier Installer for pier construction shall be pre-approved by the Designer and shall demonstrate suitable performance during modulus testing. Typical aggregate consists of Type 1 Grade B in accordance with ASTM D-1241-68, No. 57 stone, recycled concrete or other graded aggregate approved by the Designer.

.2 Potable water or other suitable source shall be used to increase aggregate moisture content where required. The General Contractor shall provide such water to the Installer.

PART 3 DESIGN REQUIREMENTS

3.1 GEOPIER DESIGN

.1 The design of the Geopier system shall be based on the structural loads and the allowable total and differential settlement criteria of all footings indicated by the design team for support by the Geopier system. The Geopier system shall be designed in accordance with generally accepted engineering practice and the methods described in Section 1 of these Specifications. The design life of the structure shall be 50 years.

.2 The design shall meet the following criteria.

.1 Maximum Allowable Bearing Pressure for Footings supported by Geopier Reinforced Soils:

.1 Serviceability Limit States 100 kPa

.2 Ultimate Limit States 150 kPa

.2 Estimated Total Long-Term Settlement for Footings less than or equal to 25 mm

.3 Estimated Total Long-Term Differential Settlement for Adjacent Footings - less than or equal to 19 mm

.4 The Geopier elements shall be designed and installed to completely penetrate existing fill.

.5 The Geopier elements shall be designed using a Geopier stiffness modulus to be verified by the results of the modulus test described in Section 5.02 of these specifications.

3.2 DESIGN SUBMITTAL

.1 The Installer shall submit detailed design calculations including FEA, construction drawings, and shop drawings, (the Design Submittal), for approval at least 3 week(s) prior to the beginning of construction. A detailed explanation of the design parameters for settlement calculations shall be included in the Design Submittal. Additionally, the quality control test program for the Geopier system, meeting these design requirements, shall be submitted. All computer-generated calculations and drawings shall be prepared and sealed by a Professional Engineer, licensed in the Province where the piers are to be built. Submittals will be submitted electronically only unless otherwise required by specific submittal instructions.

PART 4 EXECUTION

4.1 APPROVED INSTALLATION PROCEDURES

.1 The following sections provide general criteria for the construction of the Geopier elements. Unless otherwise approved by the Designer, the installation method used for Geopier construction shall be that as used in the construction of the successful modulus test.

.1 Geopier Impact systems shall be constructed by advancing a specially designed mandrel with a minimum 15-ton static force augmented by dynamic vertical ramming energy to the full design depth. The hollow-shaft mandrel, filled with aggregate, is incrementally raised, permitting the aggregate to be released into the cavity, and then lowered by vertically advancing and/or ramming to densify the aggregate and force it laterally into the adjacent soil. The cycle of raising and lowering the mandrel is repeated to the top of pier elevation. The cycle distance shall be determined by the Geopier designer.

.2 Special high-energy impact densification apparatus shall be employed to vertically densify the Geopier elements during installation of each constructed lift of aggregate.

.3 Densification shall be performed using a mandrel/tamper. The mandrel/tamper foot is required to adequately increase the lateral earth pressure in the matrix soil during installation. Compaction equipment that induces horizontal vibratory energy (such as Vibroflot equipment) is not permitted.

.4 Downward crowd pressure shall be applied to the mandrel during installation.

4.2 PLAN LOCATION AND ELEVATION OF GEOPIER ELEMENTS

.1 The as-built center of each pier shall be within 6 inches of the locations indicated on the plans. Piers installed outside of the above tolerances and deemed not acceptable shall be rebuilt at no additional expense to the Owner.

4.3 REJECTED GEOPIER ELEMENTS

.1 Geopier elements installed beyond the maximum allowable tolerances shall be abandoned and replaced with new piers, unless the Designer approves the condition or provides other remedial measures. All material and labor required to replace rejected piers shall be provided at no additional cost to the Owner, unless the cause of rejection is due to an obstruction or mislocation.

PART 5 QUALITY CONTROL

5.1 CONTROL TECHNICIAN

.1 The Installer shall have a full-time, on-site Quality Control Technician to verify and report all installation procedures. The Installer shall immediately report any unusual conditions encountered during installation to the Geopier Designer, the General Contractor, and to the Testing Agency.

5.2 GEOPIER MODULUS TEST

5.3 As required, Rammed Aggregate Pier Modulus Tests will be performed at locations agreed upon by the Pier Designer and the Testing Agency to verify or modify Rammed Aggregate Pier designs. Test Procedures shall utilize appropriate portions of ASTM D 1143, ASTM D 1194, or ASTM D7383-08 as outlined in the design submittal.**BOTTOM STABILIZATION TESTING (BSTs) / CROWD STABILIZATION TESTING (CSTs)**

.1 Bottom stabilization testing (BSTs) or Crowd stabilization testing (CSTs) shall be performed by the Control Technician during the installation of the modulus test pier. Additional testing as required by the Geopier Designer shall be performed on selected production Geopier elements to compare results with the modulus test pier.

PART 6 - QUALITY ASSURANCE

6.1 Independent Engineering Testing Agency (Owner's Quality Assurance)

.1 The Geopier Installer shall provide full-time Quality Control monitoring of Geopier construction activities. The Owner or General Contractor is responsible for retaining an independent engineering testing firm to provide Quality Assurance services.

6.2 Responsibilities of Independent Engineering Testing Agency

.1 The Testing Agency shall monitor the modulus test pier installation and testing. The Installer shall provide and install all dial indicators and other measuring devices.

.2 The Testing Agency shall monitor the installation of Geopier elements to verify that the production installation practices are similar to those used during the installation of the modulus test elements.

.3 The Testing Agency shall report any discrepancies to the Installer and General Contractor immediately.

.4 The Testing Agency shall observe the excavation, compaction and placement of the foundations as described in Section 7.05. Dynamic Cone Penetration testing may be performed to evaluate the footing bottom condition as determined by the Testing Agency.

PART 7 – RESPONSIBILITIES OF THE GENERAL CONTRACTOR

7.1 Site Preparation and Protection

.1 The General Contractor shall locate and protect underground and aboveground utilities and other structures from damage during installation of the Geopier elements.

.2 Site grades for Geopier installation shall be within 1 foot of the top of footing elevation or finished grade elevation to minimize Geopier installation depths. Ground elevations and bottom of footing elevations shall be provided to the Geopier Installer in sufficient detail to estimate installation depth elevations to within 75 mm.

.3 The General Contractor will provide a firm, stable and reee draining working surface capable of supporting a 60 tonne high mast rig.

.4 The General Contractor will provide site access to the Installer, after earthwork in the area has been completed. A working surface shall be established and maintained by the General Contractor to provide wet weather protection of the subgrade and to provide access for efficient operation of the Geopier installation.

.5 Prior to, during and following Geopier installation, the General Contractor shall provide positive drainage to protect the site from wet weather and surface ponding of water.

.6 If spoils are generated by Geopier installation, spoil removal from the Geopier work area in a timely manner to prevent interruption of Geopier installation is required.

7.2 GEOPIER LAYOUT

.1 The location of Geopier-supported foundations for this project, including layout of individual Geopier elements, shall be marked in the field using survey stakes or similar means at locations shown on the drawings.

7.3 Contractor's / Owner's Independent Testing Agency (Owner's Quality Assurance)

.1 General Contractor is responsible for acquiring an Independent Testing Agency (Quality Assurance) as required. Testing Agency roles are as described in Part 6 of this specification. The Aggregate Pier Installer will provide Quality Control services as described in Part 5 of this specification.

7.4 Excavations of Obstructions

.1 Should any obstruction be encountered during Geopier installation, the General Contractor shall be responsible for promptly removing such obstruction, or the pier shall be relocated or abandoned. Obstructions include, but are not limited to, boulders, timbers, concrete, bricks, utility lines, etc., which shall prevent placing the piers to the required depth, or shall cause the pier to drift from the required location.

.2 Dense natural rock or weathered rock layers shall not be deemed obstructions, and piers may be terminated short of design lengths on such materials.

7.5 Utility Excavations

.1 The General Contractor shall coordinate all excavations made subsequent to Geopier installations so that excavations do not encroach on the piers as shown in the Geopier construction drawings. Protection of completed Geopier elements is the responsibility of the General Contractor. In the event that utility excavations are required in close proximity to the installed Geopier elements, the General Contractor shall contact the Geopier Designer immediately to develop construction solutions to minimize impacts on the installed Aggregate Pier elements.

7.6 Footing Bottoms

.1 Foundation excavations to expose the tops of Geopier elements shall be made in a workman-like manner, and shall be protected until concrete placement, with procedures and equipment best suited to (1) avoid exposure to water, (2) prevent softening of the matrix soil between and around the Geopier elements before pouring structural concrete, and (3) achieve direct and firm contact between the dense, undisturbed Geopier elements and the concrete footing.

.2 All excavations for footing bottoms supported by Geopier foundations shall be prepared in the following manner by the General Contractor. Recommended procedures for achieving these goals are to:

.1 Limit over-excavation below the bottom of the footing to 75 mm (including disturbance from the teeth of the excavation equipment).

.2 Compaction of surface soil and top of Geopier elements shall be prepared using a motorized impact compactor ("Wacker Packer," "Jumping Jack," or similar). Sled-type tamping devices shall only be used in granular soils and when approved by the designer. Loose or soft surficial soil over the entire footing bottom shall be recompacted or removed, respectively. The surface of the aggregate pier shall be recompacted prior to completing footing bottom preparation.

.1 Place footing concrete immediately after footing excavation is made and approved, preferably the same day as the excavation. Footing concrete must be placed on the same day if the footing is bearing on moisture-sensitive soils. If same day placement of footing concrete is not possible, open excavations shall be protected from surface water accumulation. A lean concrete mud-mat may be used to accomplish this. Other methods must be pre-approved by the Designer.

.3 The following criteria shall apply, and a written inspection report sealed by the project Testing Agency shall be furnished to the Installer to confirm:

.1 That water (which may soften the unconfined matrix soil between and around the Geopier elements, and may have detrimental effects on the supporting capability of the Geopier reinforced subgrade) has not been allowed to pond in the footing excavation at any time.

.2 That all Geopier elements designed for each footing have been exposed in the footing excavation.

.3 That immediately before footing construction, the tops of Geopier elements exposed in each footing excavation have been inspected and recompacted as necessary with mechanical compaction equipment.

.4 That no excavations or drilled shafts (elevator, etc) have been made after installation of Aggregate Pier elements within the excavation limits described in the Geopier construction drawings, without the written approval of the Installer or Designer.

.4 Failure to provide the above inspection and certification by the Testing Agency, which is beyond the responsibility of the Geopier Installer, may void any written or implied warranty on the performance of the Geopier system.

PART 8 PAYMENT

8.1 Method of Measurement

.1 Measurement of the aggregate piers is on a lump sum basis.

.2 Payment shall cover design, supply and installation of the aggregate pier foundation system. Excavation of unsuitable materials, delays, re-engineering, and remobilization as documented and approved by the Owner or Owner's Engineer, shall be paid for under separate pay items.

8.2 Basis of Payment

.1 The accepted quantities of piers will be paid per approval, in-place aggregate-pier. Payment will be made under:

	Pay Item:	Pay Unit:
	Preparation of plans and specifications and installation of Geopier elements	$____ Lump Sum
.1	Unit prices shall be provided to account for:	
.2	Additional Installed Piers (w/o remobilization)	$____/m up to 6m
.3	Additional Installed Piers (w/o remobilization)	$____/m over 6m
.4	Add for Casing Holes	$____/m
.5	Additional Mobilizations	$____ Each
	Additional Modulus or Load Tests	$____ Each

END OF SECTION 31 62 33