SPECIFICATIONS

Town of New Tecumseth Fire Station No. 4

6365 - 14th Line,
New Tecumseth, Ontario

Issued for Tender – May 2024.

Alaimo Architecture Inc.
Project: 2022-007

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1 GENERAL

1.1 The requirements of the Articles of Agreement, Conditions of the Contract, Division 1 apply to and form all Sections of the Contract Documents and the Work.

1.2 Work in this Specification is divided into descriptive sections which are not intended to identify absolute contractual limits between Subcontractors, nor between the Contractor and their Subcontractors. The Contractor is responsible for organizing division of labour and supply of materials essential to complete the Contract. The Consultant assumes no liability to act as an arbiter to establish subcontract limits between Sections or Divisions of Work.

1.3 It is intended that Work supplied under these Contract Documents shall be complete and fully operational in every detail for the purpose required. Provide all items, articles, materials, services and incidentals, whether or not expressly specified or shown on Drawings, to make finished Work complete and fully operational, consistent with the intent of the Contract Documents.

1.4 Work designated as “N.I.C.” is not included in this Contract.

1.5 Specifications, Schedules and Drawings are complementary, and items mentioned or indicated on one may not be mentioned or indicated on the others.

1.6 Contractors finding discrepancies or ambiguities in, or omissions from the Drawings, Specifications or other Contract Documents, or having doubt as to the meaning and intent of any part thereof shall contact the Consultant for clarification. If the Consultant is not contacted for clarification, execute the Work in accordance with the most stringent requirements.

1.7 Mention in the specifications or indication on the drawings of materials, Products, operations, or methods, requires that the Contractor provide each item mentioned or indicated of the quality or subject to the qualifications noted; perform according to the conditions stated in each operation prescribed; and provide labour, materials, Products, equipment and services to complete the Work.

1.8 Where the singular or masculine is used in the Contract Documents, it shall be read and construed as if the plural, feminine or neuter had been used when the context or the statement so requires and as required to complete the Work, and the rest of the sentence, clause, paragraph, or Article shall be construed as if all changes in grammar, gender or terminology thereby rendered necessary had been made.

1.9 The terms “approved”, “review”, “reviewed”, “accepted”, “acceptance”, “acceptable”, “satisfactory”, “selected”, “directed”, “instructed”, “required”, “submit”, “permitted” or similar words or phrases are used in standards or elsewhere in Contract Documents, it shall be understood, that words “by (to) the Consultant” follow, unless context provides otherwise.

1.10 Where the words 'submit', 'acceptable' and 'satisfactory' are used in the Contract Documents, they shall be considered to be followed by the words 'to the Consultant' unless the context provides otherwise.

1.11 The terms “exposed” or “exposed to view” refers to surfaces that are within the line of vision of persons from any accessible viewpoint, both within and without the building. Where any part of a surface is exposed to view, all other portions of that surface shall also be considered as exposed to view.

2 DEFINITIONS

2.1 “Agreement to Bond” means a letter or form issued by a licensed bonding agency advising that, if the Bidder is successful, the bonding agency will issue required bonds.

2.2 “Award” means the acceptance of a Tender in accordance with this Contract.

2.3 “Bidder” means a person or company who submits a Tender.

2.4 “Budget” means an amount approved for operating expenses or capital projects.

2.5 “Certificate of Insurance” means a certified document issued by an insurance company licensed to operate by the Government of Canada or the Province of Ontario, certifying that the Bidder is insured in accordance with the Owner’s requirements.

2.6 “Change Order” means a written order issued from the Owner that changes the scope or specifications of the Work.

2.7 “Consultant” means the provider of a Service who, by virtue of professional expertise or service, is contracted by the Owner to undertake a specific task or assignment. Examples include: an architect or engineer drawing plans and managing construction for a particular building or project; a lawyer representing the Owner for a particular legal matter; an appraiser providing an opinion of value on an asset; etc.

2.8 “Contract Administrator” or “Engineer” or “Project Manager” means the Consultant, or such other officer, as may be authorized by the Owner to act in a particular capacity.

2.9 “Contractor” means the person, partnership or corporation, and any employee or agent thereof that has been successful in the award of a Tender and thereby agrees to supply the goods and/or services under the terms of the Contract and is undertaking the Work as identified in the Contract.

2.10 “Goods and/or Services” means supplies, equipment, maintenance, and professional services.

2.11 "Irrevocable Letter of Credit" means an irrevocable document on a financial institution's standard form requesting that the party to whom it is addressed pay the bearer or a person named therein money as a result of failure to perform or to fulfill all the covenants, undertakings, terms, conditions and agreements contained in the Contract.

2.12 "Material Safety Data Sheets (MSDS)" means Material Safety Data Sheets that must be submitted by the Contractor for all hazardous materials, including an index of chemical compounds, with details of properties, handling details, precautions and first-aid procedures.

2.13 "Owner" or "Authority" or "Corporation" means The Town of New Tecumseth.

2.14 "Place of Work" means 6365 -14th line, New Tecumseth, Ontario, both building and grounds.

2.15 "Request for Tenders (RFT)" means a solicitation from the Owner to potential contractors to submit a Tender.

2.16 "Surety" means a specified dollar amount in the form of certified cheque, bid bond, performance bond, labour and materials bond, letter of credit or any other form as deemed necessary and stated in a quotation, tender or proposal request issued by the Owner.

2.17 "Tender" means a written offer, in the specified form, received from a Bidder in response to a invitation to provide goods and/or services based on an approved format of the Owner containing terms and conditions.

2.18 "Work" means the goods and/or services supplied by the Contractor pursuant to the Contract and includes all labour, materials, equipment, and any other items, which are required to execute the Contract.

3 CONTRACT ADMINISTRATION

3.1 The Contract Administration office functions performed by the General Contractor are to be done through the web-based contract administration software. Example; "Procore" or similar Contract Administration program.

3.2

3.3 The Contractor will be required to participate with the balance of the project team by using Procore for the duration of the project.

3.4 Suppliers and Subcontractors are to be provided with access to Contract Administration software at no cost to the Architect and its consultants. The distribution of information issued by the General Contractor and/or Consultant, and coordination of that information, remains the responsibility of the Contractor.

3.5 The software is to be used for issuing electronic project related documents, including Requests for Information, Supplemental Instructions, Proposed Change Orders, Change Orders, Change Directives, Progress Claims, Certificates of Payment, Submittal Reviews, and other forms as may be required. At the discretion of the Consultant, the software may also be used for the distribution and filing of other project-related documents, including but not limited to Field Review Reports, Test Reports, Meeting Minutes, and so on. The software will also provide automatically generated logs of documents issued within the software.

3.6 The Contractor will be required to print hard copies of all project related documents issued through the software, and to maintain files of those documents on site at all times. At the conclusion of the project, the Contractor shall export digitally to PDF all documents and files that have been issued through the software and shall provide (3) three USB keys to the Owner in the Construction Close out Documentation package.

3.7 Notwithstanding that the software does not require signatures for the issuance and approval of documents, adjustments to the Contract Price and Contract Time in a Change Order shall only be deemed to be agreed to by the Owner and Contractor when executed by hand, and that electronic acceptance does not satisfy the conditions of agreement under GC 6.2.2 of the CCDC2 2008 Stipulated Price Contract.

4 PROGRESS AND COMPLETION

4.1 Substantial Performance of the Work shall be based on the terms of the signed General Contract terms between the General Contractor and the Owner.

4.2 Contract Completion of the Work shall be based on the terms of the signed General Contract terms between the General Contractor and the Owner.

5 EXISTING SITE CONDITIONS

5.1 Make a careful examination of the site and investigate and be satisfied as to all matters relating to the nature of the Work to be undertaken, as to the means of access and egress thereto and therefrom, as to the obstacles to be met with, as to the extent of the Work to be performed and any and all matters which are referred to in the Contract Documents.

5.2 Report any inconsistencies, ambiguities, discrepancies, omissions, and errors between Site conditions and Contract Documents to the Consultant prior to the commencement of Work. If inconsistencies, ambiguities, discrepancies, omissions, and errors are not reported and clarified, the most stringent requirement shall govern, as determined by the Consultant.

5.3 Before commencing the Work of any Section or trade, carefully examine the Work of other Sections and trades upon which it may depend, examine substrate surfaces, and report in writing to the Consultant, defects which might affect new Work. Commencement of Work shall constitute acceptance of conditions and Work of other sections, trades, and Other Contractors upon which the new Work depends. If repair of surfaces is required after commencement of specific work, it shall be included in the work of the trade providing the specific system or finish.

6 USE OF SITE

6.1 Accept full responsibility for assigned work areas from the time of Contract award until Substantial Performance of the Work.

6.2 Check means of access and egress, rights and interests which may be interfered with. Do not block lanes, roadways, entrances of exits. Direct construction traffic and locate access to site as directed by municipality.

6.3 Where encroachment beyond property limits is necessary make arrangements with respective property owners.

7 ACCESS/PROPERTY CONSTRAINTS

7.1 Provide and maintain access facilities as may be required for access to the Work.

7.2 The street/road/thoroughfare fronting the project shall not be occupied or obstructed during the construction at any time except as expressly permitted by any Road Works Permit if such has been applied for by the General Contractor and obtained prior to any occupancy or obstruction of the street/road/thoroughfare.

7.3 Any adjacent private driveways, laneways, right of ways, or other lands not belonging to the Owner shall not be used for any purpose without the prior express written consent of the adjacent property Owners. If the General Contractor intends to utilize adjacent lands to the subject property, it is the sole responsibility of the General Contractor to obtain all requisite approvals and make all necessary preparations including any remedial work required.

7.4 Minimize disruption, noise and dust to the functions of existing operational areas of existing buildings. Times of entry, routes of access and time required to complete the Work shall be arranged and scheduled in cooperation with the Owner.

7.5 Confine Work and operations of employees to limits indicated by the Contract Documents. Do not unreasonably encumber the premises with products.

7.6 Organize delivery of materials/equipment to and removal of debris and equipment from place of Work to permit continual progress of work and suitable for restricted site conditions.

7.7 Determine and make arrangement as required for loading and unloading of equipment and Products at times that will not affect public traffic flow and that will be

permitted by the Town of New Tecumseth. Conform to Town by-laws with regard to parking restrictions and other conditions.

7.8 Make provisions and arrangements and provide allowances if times for loading and unloading allowed by the Town of New Tecumseth are other than regular working hours.

7.9 All Products, materials and equipment required on Site shall be portable and/or size suitable for access and movement on Site and without causing damage to buildings.

7.10 The Work shall be confined to the area defined on the drawings and by the property lines except that services connections and certain portions of landscaping, hard paving and curb work shall be executed on Municipal property under regulation of authorities.

7.11 Provide locked doors in barriers, permit access by Owner and Consultant to Work areas and to areas Contractor is responsible for.

8 **SECURITY**

8.1 Be responsible for security of all areas affected by Work of this Contract until taken over by Owner. Take steps to prevent entry to the Work by unauthorized persons and guard against theft, fire and damage by any cause.

8.2 Provide suitable surveillance equipment and /or employ guard services, as required to adequately protect the work.

8.3 Make provisions to permit Owner's security personnel to view areas where all Work is being performed.

8.4 Take acceptable precautions to guard Work site, premises, materials and the public during and after working hours due to the Work of this Contract.

8.5 Any security service provided by the Owner is for the protection of the Owner's interest in the Work on the Site and shall not relieve the Contractor of the responsibility to protect the Site and the Work of the Contract.

9 **WEATHER**

9.1 Incorporate into the Contract Schedule allowances for the number of working days lost due to inclement weather based on the analysis of information available from Environment Canada, for weather conditions on and near the site, over the time period 1971 - 2022.

9.2 The Contractor may be entitled to a schedule extension for those activities on the critical path which are delayed on account of inclement weather, assessed on a quarterly basis, by the number of days in excess of the anticipated number of working days for the quarter in question by more than 20%. No additional payment will be made on account of any such schedule extension.

10 WASTE AUDIT/PLANS FOR WASTE REDUCTION

10.1 Comply with requirements of authorities having jurisdiction.

10.2 Prepare and submit waste audit and waste reduction plan in accordance with Ontario Regulation 102/94 Waste Audits and Waste Reduction Workplans.

10.3 Prepare and submit source separation plan in accordance with Ontario Regulation 103/94 Industrial, Commercial and Institutional Source Separation Programs.

10.4 Deliver to nearest appropriate depot all materials accepted for recycling by the region or municipality having jurisdiction over the Place of Work, including but not limited to cardboard, paper, plastic, aluminum, steel, and glass. Deliver to nearest appropriate depot all scrap and excess gypsum wallboard for recycling of this material. Pay all costs for this work.

END OF SECTION

1 GENERAL

1.1 Allowances included herein are for items of Work which could not be fully quantified prior to Bidding.

1.2 Expend each allowance as directed by the Consultant in writing. Work covered by allowances shall be performed for such amounts and by such persons as directed by Consultant.

1.3 Each allowance will be adjusted to actual cost as defined hereunder and the Contract Price will be amended accordingly by Contract Change Order.

1.4 Progress payments for Work and Products authorized under allowances will be made in accordance with the payment terms set out in Conditions of the Contract.

1.5 A schedule shall be prepared jointly by the Consultant and Contractor to show when items called for under allowances must be authorized by the Consultant for ordering purposes so that the progress of the Work will not be delayed.

1.6 Where a Cash Allowance is for work performed under a Subcontract, the Contractor shall Bid the work involved and submit the Bids received, with the Contractor's recommendations, for approval.

2 CASH ALLOWANCE(S)

2.1 Cash allowances, unless otherwise specified, cover the net cost to the Contractor of services, Products, construction machinery and equipment, freight, handling, unloading, storage, installation where indicated, and other authorized expenses incurred in performing the Work. Cash allowances shall not be included by a Subcontractor in the amount for their Subcontract work.

2.2 Supply only allowances shall include:
- .1 Net cost of Products.
- .2 Delivery to Site.
- .3 Applicable taxes and duties, excluding HST.

2.3 Supply and install allowances shall include:
- .1 Net cost of Products.
- .2 Delivery to Site.
- .3 Unloading, storing, handling or Products on Site.
- .4 Installation, finishing and commissioning of Products.
- .5 Applicable taxes and duties, excluding HST.

2.4 Inspection and testing allowances shall include:
- .1 Net cost of inspection and testing services.
- .2 Applicable taxes and duties, excluding HST.

2.5 Other costs related to work covered by cash allowances are not covered by the allowance but shall be included in the Contract Price.

2.6 Where costs under a cash allowance exceed the amount of the allowance, the Contractor will be compensated for any excess incurred and substantiated plus an allowance for overhead and profit as set out in the Contract Documents.

2.7 Progress payments on accounts of work authorized under cash allowances shall be included in the monthly certificate for payment.

2.8 Submit, before application for final payment, copies of all invoices and statements from suppliers and Subcontractors for work which has been paid from cash allowances.

2.9 Include in the Bid Price the following cash allowance items:

.1 Testing & Inspection (General Contractor to procure 3 quotations and co-ordinate).

.2 Hydro Connection Fee and Transformer (General Contractor to apply for and co-ordinate including paying all associated fees).

.3 Interior Signage - Door & Room Labels, Occupancy Restrictions etc. (General Contractor to procure 3 quotations and co-ordinate).

.4 Security (General Contractor to co-ordinate with Town's preferred vendor)

.5 Fire Alarm System (General Contractor to co-ordinate with Town's preferred vendor)

.6 Door Hardware. See 08 70 00 in the specifications (General Contractor to procure 3 quotations).

.7 Window Blinds (General Contractor to procure 3 quotations)

.8 Contingency items at the discretion of the Architect to complete project.

.9 Exterior Signage and wall lettering & number including power requirements if not noted on tender package (General Contractor to procure 3 quotations and co-ordinate)

Total Cash Allowance: $ **500,000.00**.

END OF SECTION

1 **GENERAL**

1.1 Coordination of the Work of all Sections of the specifications as required to complete the Project is the responsibility of the Contractor.

1.2 Cooperate and coordinate with Other Contractors including Other Contractor's employed by Owner.

1.3 Ensure that Subcontractors and trades cooperate with other subcontractors and trades whose work attaches to or is affected by their own work. Ensure that minor adjustments are made to make adjustable work fit fixed work.

1.4 Allow access of Owner's Other Contractors on site and to areas of Work. Cooperate and coordinate with such Other Contractors. Schedule work to complement work of such Other Contractors.

1.5 Entry by the Owner's own forces and by Other Contractors shall not mean acceptance of the Work and shall not relieve the Contractor of their responsibility to complete the Contract.

1.6 Placing, installation, application and connection of work by the Owner’s own forces or by Other Contractors on and to the Contractor's Work shall not relieve the Contractor of his responsibility to provide and maintain the specified warranties.

1.7 Coordinate with removals/installations specified in other Divisions and Other Contracts.

1.8 Coordinate the work of this Contract with work of designated substance removal work and demolition work under separate contract. No allowance shall be made subsequently by the Owner or Consultant for lack of coordination and no claim will be considered for circumstances and omissions which could have been coordinated, prevented or included for had these procedures been followed.

1.9 Coordination of the installation of systems specified in Divisions 13, 21, 22, 23 and 26, including the interrelating operation and functioning between components of a system and between systems, is the responsibility of those performing the work of those Divisions, with final coordination the responsibility of the Contractor.

1.10 Coordinate relocation of existing mechanical and electrical items with work specified in Divisions 13, 21, 22, 23, and 26.

1.11 Existing equipment shall remain in present locations unless designated otherwise. Protect from damage. Remove, store and reinstall existing fixed equipment, fixtures and components which interfere with construction and which are scheduled for relocation.

1.12 Pay particular attention to types of ceiling construction and clearances throughout, especially where recessed fixtures are required. Coordinate work with Other Contractors and Subcontractors wherever ventilation ducts or piping installations occur to ensure that conflicts are avoided.

1.13 Install ceiling mounted components in accordance with final ceiling plans. Inform Consultant of conflicting installations.

1.14 Install and arrange ducts, piping, tubing, conduit, equipment, fixtures, materials and product to conserve headroom and space with minimum interference and in neat, orderly and tidy arrangement. Run pipes, ducts, tubing and conduit, vertical, horizontal and square with building grid unless otherwise indicated. Install piping, ducts, and conduit as close to underside of structure as possible unless shown otherwise.

1.15 Make provision, without interference or restriction by items located within the ceiling space, for unrestricted relocation of light fixtures to replace ceiling panels at grid spaces of the same size.

1.16 Where supports or openings are to be left for the installation of various parts of the Work furnish the necessary information to those concerned in ample time so that proper provision can be made for such items. Have cutting, drilling and other remedial work, and the subsequent patching or other work required for failing to comply with this requirement, performed at a later date at no additional Cost to Owner.

1.17 Properly coordinate the work of the various Sections and trades, taking into account the existing installations to assure the best arrangement of pipes, conduits, ducts and mechanical, electrical and other equipment, in the available space. Under no circumstances will any extra payment be allowed due to the failure by the Contractor to coordinate the work. If required, in critical locations, prepare interference and/or installation drawings showing the work of the various Sections as well as the existing installation, and submit these drawings to the Consultant for review before the commencement of work. Proceed with work in these areas only as, and when directed by the Consultant.

1.18 Coordinate with mechanical and electrical trades to ensure protecting supporting, disconnecting, cutting off, capping, diverting, relocating or removing of existing services in areas of Work before commencement of alteration work.

1.19 Execute Work at times to ensure a minimum of disturbance to building occupants and in compliance with the Tenant Leasehold Improvement Manual.

1.20 In case of damage to active services on utilities, notify Consultant and respective authorities immediately and make all required repairs under direction of Consultant and respective authorities. Carry out repairs to such damaged services and utilities continuously to completion, including working beyond regular working hours. Costs to be borne by the Contractor.

1.21 Existing areas shall remain in use except where alteration work is actually in progress. Confine effects of Work to areas indicated on Drawings unless otherwise approved by Owner.

2 METRIC DIMENSIONS

2.1 Measurements in this specification are expressed in metric (SI) units and depending on the progress made in the various sectors of the industry are either hard or soft converted units.

2.2 All metric units specified shall be taken to be the minimum acceptable unless otherwise noted.

2.3 It is the Contractor's responsibility to check and verify with manufacturers and suppliers on the availability of materials and products in either metric or imperial sizes. Be responsible for coordinating products supplied in metric (SI) and imperial units into the overall layout.

2.4 Where both metric and imperial sizes or dimensions are shown, the metric size or dimension shall govern.

3 BUILDING DIMENSIONS

3.1 Take necessary job dimensions for the proper execution of the work. Assume complete responsibility for the accuracy and completeness of such dimensions, and for coordination.

3.2 Verify that work, as it proceeds, is executed in accordance with dimensions and positions indicated which maintain levels and clearances to adjacent work, as set out by requirements of the Drawings, and ensure that work installed in error is rectified before construction resumes.

3.3 Check and verify dimensions referring to the work and the interfacing of services.

3.4 Do not scale directly from the Drawings. If there is ambiguity or lack of information, immediately inform the Consultant. Changes required through the disregarding of this clause shall be the responsibility of the Contractor.

3.5 All details and measurements of any work which is to fit or to conform with work installed shall be taken at the building.

3.6 Advise Consultant of discrepancies and if there are omissions on Drawings, particularly reflected ceiling plans and jointing patterns for surfaces finishes, which affect aesthetics, or which interfere with services, equipment or surfaces. Do not proceed with work affected by such items without direction from the Consultant.

3.7 Provide written requirements for site conditions and surfaces necessary for the execution of respective work, and provide setting drawings, templates and all other information necessary for the location and installation of material, holes, sleeves, inserts, anchors, accessories, fastenings, connections and access panels. Inform respective contractors whose work is affected by these requirements and preparatory work.

4 INTERFERENCE AND COORDINATION DRAWINGS

4.1 Coordinate placement of equipment to ensure that components will be properly accommodated within the spaces provided prior to commencement of work.

4.2 Prepare interference and equipment placing drawings to ensure that all components will be properly accommodated within the spaces provided. Provide copies of interference drawings to Consultant when requested by Consultant.

4.3 Prepare drawings to indicate coordination and methods of installation of a system with other systems where their relationship is critical. Ensure that all details of equipment apparatus, and connections are coordinated.

4.4 Take complete responsibility for any remedial work that results from failure to coordinate any aspect of the Work prior to its fabrication/installation.

4.5 Ensure that accesses and clearance required by jurisdictional authorities and/or for easy maintenance of equipment are provided in the layout of equipment and services.

5 SLEEVING AND INSERT DRAWINGS AND TEMPLATES

5.1 Prepare sleeving drawings for work of Divisions 13, 21, 22, 23, and 26, showing size and location of all penetrations through load bearing elements. Submit sleeving drawings in the form of digital PDF to Consultant for review not less than 15 days prior to construction of affected elements.

5.2 Prepare insert setting drawings for work to be cast into concrete and/or mortared into masonry elements. Submit insert setting drawings in the form of a PDF and 4 prints to consultant for review not less than 15 days prior to construction of affected elements.

5.3 Ensure that setting drawings, templates, and all other information necessary for the location and installation of materials, fixtures, equipment, holes, sleeves, inserts, anchors, accessories, fastenings, connections, and access panels are provided by each Section whose work requires cooperative location and installation by other Sections, and that such information is communicated to the applicable installer.

5.4 Provide cutting, fixing and making good to the work of Other Contractors, Subcontractors and trades as required for sleeving and inserts and make up time lost as a result of failure to comply with this requirement, at no additional cost to the Owner.

END OF DOCUMENT

1 PRE-CONSTRUCTION MEETING

1.1 Attend pre-construction meeting(s), arranged and conducted by the Contractor.

1.2 Arrange and conduct pre-construction meeting(s).

1.3 Co-ordinate and organize attendance by representatives of major Subcontractors and parties in contract with the Contractor.

1.4 Consultant will arrange attendance of other interested parties not responsible to the Contractor.

1.5 Prepare and distribute copies of Agenda prior to meeting.

1.6 Agenda will include but not be limited to the following topics as are pertinent to the Contract.

.1 Review project communications procedures.

.2 Review contract administration requirements including submittals, payment, and change order procedures.

.3 Identify all critical points on construction schedule for positive action.

.4 Identify any product availability problems and substitution requests.

.5 Establish site arrangements and temporary facilities.

.6 Review Consultants inspection requirements.

.7 Review any points which, in Owner’s, Consultants, and Contractor’s opinion, require clarification.

1.7 Be prepared to provide specific information relative to agenda items as they are pertinent to the Contract.

1.8 Record minutes of meeting and distribute type written copies to all participants and other interested parties, within one week of meeting date.

2 PROGRESS MEETINGS

2.1 Attend regularly scheduled progress meetings to be held on Site at times and dates that are mutually agreed to by the Owner, Consultant, and Contractor.

2.2 Co-ordinate and organize attendance of individual Subcontractors and material suppliers when requested. Relationships and discussions between Subcontractor participants are not the responsibility of the Consultant and do not form part of the

meetings content.

2.3 Ensure that Contractor representatives in attendance at meetings have required authority to commit Contractor to actions agreed upon. Assign same persons to attend such meetings throughout the contract period.

2.4 Inform the Consultant in advance of meetings regarding all items to be added to the agenda.

2.5 Prepare and distribute copies of Agenda prior to meeting.

2.6 Be prepared to provide specific information relative to agenda items at each meeting as they are pertinent to the Contract.

2.7 Agenda will include but not be limited to the following topics as are pertinent to the Contract.

.1 Review and agreement of previous minutes.

.2 Construction safety.

.3 Status of submittals.

.4 Quality control.

.5 Co-ordination.

.6 Contract Schedule

.7 Work plan up to next scheduled meeting.

.8 Requests for information/clarification.

.9 Contemplated changes.

2.8 Record minutes of meeting and distribute type written copies to all participants and other interested parties, within one week of meeting date.

3 MEETINGS WITH OTHER CONTRACTORS

3.1 Consultant will arrange and organize coordination meetings with Other Contractors working on the Project.

3.2 Attend all such meetings and ensure that representative has required authority to commit Contractor to actions agreed upon.

3.3 Consultant will document and distribute minutes to participants.

END OF SECTION

1 GENERAL

1.1 Be responsible for planning and scheduling of the Work. As a minimum, prepare and update the following schedules:

.1 Contract Schedule.

.2 Detailed Construction Schedule.

1.2 Be responsible for ensuring that Subcontractors plan and schedule their respective portions of the Work. Subcontractor's schedules shall form part of the above mentioned schedules.

2 CONTRACT SCHEDULE

2.1 Prepare and submit the Contract Schedule within 14 days following award of Contract. This schedule, once it is reviewed by the Consultant and if it meets the Consultant's project requirements, will form part of the Contract.

2.2 The Contract Schedule shall be developed using a logic network technique for planning and scheduling.

2.3 The Contract Schedule shall be submitted for approval in its optimum levelled form. This presentation may be in either a time scaled network or a bar chart form. It shall be subdivided into either work areas or systems as applicable.

2.4 The Contract Schedule shall include the following information:

.1 Starting and ending dates of each activity including the float periods;

.2 Manpower requirements for each activity;

.3 Order and delivery dates for major or critical equipment.

.4 Interdependency with activities of other Contractors;

.5 Dates specified in the Contract Documents;

.6 Dates on which specific data will be required for submittal, i.e., Vendor data, shop drawings, samples, etc.

2.5 This schedule shall be reviewed and updated monthly by the Contractor to reflect any Contract changes as well as major changes to the schedule.

3 DETAILED CONSTRUCTION SCHEDULE

3.1 Prepare and submit a detailed construction schedule within 14 days of final review and acceptance of the Contract Schedule. This schedule, once reviewed and accepted by the Owner, will be updated, and submitted monthly with the Contract Schedule and weekly once the Contractor starts on Site.

3.2 This schedule shall cover the construction period. It will show, in detail, activities daily indicating durations, manpower and constraints. The activities shown on this schedule shall further clarify or detail the activities shown on the Contract Schedule.

3.3 The detailed construction schedule shall be presented in a bar chart form.

4 CASH FLOW CHART

4.1 Within 7 days after award of Contract, submit, in form approved by Owner, cash flow chart broken down monthly in an approved manner. Cash flow chart shall indicate anticipated Contractor's monthly progress billings from commencement of work until completion.

4.2 Update cash flow chart whenever changes occur to scheduling and in manner and at times satisfactory to Owner.

END OF SECTION

1 GENERAL

1.1 Provide labour, Products, equipment, services tools and supervision necessary for submittals. Make submittals specified in this Section to Consultant unless otherwise specified.

.1 Verify accuracy and completeness of submittals prior to submission.

.2 Verify field measurements, field construction criteria, catalogue numbers and similar data.

.3 Co-ordinate each submittal with requirements of the Work and the Contract Documents.

.4 Notify Consultant in writing at time of submission, of any deviation in submittals from requirements of the Contract Documents.

1.2 Submit in accordance with dates established under Section 01 32 13 for shop drawings, fabrication, manufacture, erection and installation to provide adequate time for reviews, securing necessary approvals, possible revisions and resubmittals, placing orders, securing delivery and to avoid construction delays.

1.3 Accompany each submittal with a letter of transmittal in duplicate containing all pertinent information required for identification and checking of submittals including but not limited to the following:

.1 Date of initial submission and date of each subsequent submission if required.

.2 Project title and Consultant’s project number.

.3 Names of:
- .1 Contractor.
- .2 Subcontractor.
- .3 Supplier/manufacturer/fabricator as applicable.

.4 Specification section numbers to which submission is related.

.5 Countersigned stamp of Contractor certifying that they have reviewed the submission.

1.4 Allow two weeks for the Consultant's review of each submission.

1.5 When submittals are resubmitted, transmit under a new letter of transmission.

1.6 Do not carry out Work until Consultants review of submittals has been completed.

1.7 Be responsible for payment of charges for delivery of submissions and resubmission to Consultant.

2 PRODUCT DATA

2.1 Before delivery of Products to the Site, submit Product data as specified in each section or as requested by the Consultant.

2.2 Submit manufacturer's Product data for systems, materials, and methods of installation proposed for use. Such literature shall identify systems, each component, and shall certify compliance of each component with applicable/specified standards.

3 SAMPLES

3.1 Before delivery of Products to the Site, submit samples of Products as specified or as requested by the Consultant. Label samples as to origin and intended use in the Work and in accordance with the requirements of the Specification Sections. Samples must represent physical examples to illustrate materials, equipment or work quality and to establish standards by which completed Work is judged.

3.2 Ensure samples are of sufficient size and quantity, if not already specified, to illustrate:

.1 The quality and functional characteristics of Products, including integrally related parts and attachment devices.

.2 The full range of colours available.

3.3 Notify the Consultant in writing, at time of submission, of any deviations in samples from requirements of the Contract Documents, and state the reasons for such deviations.

3.4 Identify samples with Project name, Contract number, date, Contractor's name, number and description.

3.5 If samples are not acceptable, both samples will be returned. If samples are acceptable, one sample will be so indicated and returned. Be responsible for the cost of samples that are not accepted and for resubmission of samples.

3.6 Acceptable samples shall serve as a model against which the products incorporated in the work shall be judged.

3.7 Each Product incorporated in the Work shall be precisely the same in all details as the acceptable sample.

3.8 Should there be any change to the accepted sample, submit in writing for approval of the revised characteristics and resubmit samples of the Product for approval if requested.

3.9 When samples are very large, require assembly, or require evaluation at the Site, they may only be delivered to the Site with approval and as directed.

4 SHOP DRAWINGS

4.1 Arrange for the preparation of Shop Drawings as called for in the Contract Documents or as may be reasonably requested by the Consultant. The Contractor and each Subcontractor shall operate as experts in their respective fields and all Shop Drawings and samples shall conform to the requirements of the Contract Documents.

4.2 The term “Shop Drawings” means drawings, diagrams, schematics, illustrations, schedules, performance charts, brochures and other data which are required to illustrate details of the Work.

4.3 In addition to Shop Drawings specified in the specification sections, submit Shop Drawings required by jurisdictional authorities in accordance with their requirements.

4.4 Shop Drawings for openings, sleeving and conduit

.1 Prior to preparation of Shop Drawings, coordinate sizes of all structural openings and sleeves with respective fabricators for mechanical ducting. Adjustments to the opening sizes indicated on the Contract Drawings shall not be made without the approval of the Consultant.

.2 Prior to detailing structural reinforcement on Shop Drawings, arrange for the Structural Engineer to review formed holes, recesses and sleeving. Completely dimension openings, recesses and sleeves and relate to appropriate grid line(s) and elevation(s).

.3 Prior to forming of the structure, arrange for the preparation of Shop Drawings for review by the Consultant showing embedded conduit to be cast within the structure. Shop Drawings shall include conduit from all sources.

4.5 Shop Drawings shall indicate the following minimum criteria and any additional criteria indicated in the individual specification sections requiring Shop Drawings:

.1 Clear and obvious notes of any proposed changes from the Contract Documents.

.2 Fabrication and erection dimensions.

.3 Provisions for allowable construction tolerances and deflections provided for live loading.

.4 Details to indicate construction arrangements of the parts and their connections, and interconnections with other work.

.5 Location and type of anchors and exposed fastenings.

.6 Materials, physical dimensions including thicknesses, and finishes.

.7 Descriptive names of equipment.

.8 Mechanical and electrical characteristics when applicable.

.9 Information to verify that superimposed loads will not affect function, appearance, and safety of the work detailed as well as of interconnection work.

.10 Assumed design loadings, and dimensions and material specifications for load-bearing members.

4.6 Include in Shop Drawing submissions detailed information, templates, and installation instructions required for incorporation and connection of the Work.

4.7 Before submitting to the Consultant, review all Shop Drawings to verify that the Products illustrated therein conform to the Contract Documents. By this review, the Contractor agrees that it has determined and verified all field dimensions, field construction criteria, materials, catalogue numbers and similar data and that it has checked and coordinated each Shop Drawing with the requirements of the Work and of the Contract Documents. The Contractor's review of each Shop Drawing shall be indicated by stamp, date and signature of a qualified person possessing the appropriate authorization from the Contractor.

4.8 Be responsible for dimensions, confirmed at the Site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for coordination of the Work of all subtrades.

4.9 Submit Shop Drawings for the Consultant's review with reasonable promptness and in orderly sequence so as to cause no delay in the Work nor in the work of Other Contractors. At the time of submission, notify the Consultant in writing of any deviations in the Shop Drawings from the requirements of the Contract Documents. The Contractor will be held responsible for changes made from the Contract Documents which are not indicated or otherwise communicated in writing with the submission.

4.10 Drawings submitted by the Contractor as required herein are the property of the Owner who may use and duplicate such drawings where required in association with the Work.

4.11 Submit Shop Drawings signed and sealed by a licensed Professional Engineer registered in the place of the Work where indicated in individual Sections.

4.12 Shop Drawings shall have distinct, uniform letters, numerals and line thicknesses that will ensure the production of clear legible prints at original as well as reduced size.

4.13 Provide submissions in electronic Portable Document Format (PDF) format delivered via electronic means as directed by the Consultant.

4.14 Shop Drawings shall contain the following identification:

.1 Project name and Contract number.

.2 Applicable 6-digit Contract Specification number describing the item.

.3 Location (unit, level, room number, etc.).

.4 Name of equipment or Product.

.5 Name of Subcontractor or supplier/fabricator.

.6 Signature of Contractor certifying that Shop Drawing is in conformance with Contract Documents.

.7 On submissions subsequent to the first, the following additional identification:
.1 The revised submission number.
.2 Identification of the item(s) revised.

4.15 Dimensions and designations of elements shall be shown in the same system of measurement used on the applicable Contract Drawings.

4.16 The Consultant reserves the right to refuse acceptance of drawing submissions not meeting the above requirements.

4.17 The Consultant's review will be for conformity to the design concept and for general arrangement only and such review shall not relieve the Contractor of responsibility for errors or omissions in the Shop Drawings or of responsibility for meeting all requirements of the Contract Documents unless a deviation on the Shop Drawings has been approved in writing by the Consultant. Review does not mean that Consultant approves detail inherent in Shop Drawings, responsibility which shall remain with Contractor submitting same.

4.18 The Contractor shall make any changes in Shop Drawings which the Consultant may require consistent with the Contract Documents and re-submit unless otherwise directed by the Consultant. When re-submitting the Shop Drawings, the Contractor shall notify the Consultant in writing of any revisions other than those requested by the Consultant.

4.19 Only drawings noted for revision and resubmission need be resubmitted.

4.20 File one copy of each submitted Shop Drawing at the Site.

5 **CERTIFICATES**

5.1 Submit certificates that are required by authorities having jurisdiction or that are requested in the applicable specification sections.

5.2 Clearly show on each certification the name and location of the Work, name and address of Contractor, quantity and date of shipment and delivery and name of certifying company.

5.3 Certificates shall verify that Products and/or methods meet the specified requirements and shall include test reports of testing laboratories approved to validate certificates.

5.4 Submit certificates in duplicate and signed by an authorized representative of the certifying company.

6 CERTIFICATION OF TRADESMEN

6.1 Provide certificates, at the request of the Consultant, to establish qualifications of personnel employed on the Work where such certification is required by authorities having jurisdiction, by the Consultant or by the Contract Documents.

7 EXTENDED WARRANTIES

7.1 Submit extended warranties as requested in sections of the Specifications showing title and address of Contract, warranty commencement date and duration of warranty.

7.2 Extended warranties shall commence on termination of the standard warranty specified in the conditions of the contract and shall be an extension of these provisions. Clearly indicate what is being warranted and what remedial action is to be taken under the warranty. Ensure warranty bears the signature and seal of the Contractor.

7.3 Submit each extended warranty on a form that is acceptable to the Owner and Consultant.

8 INSPECTION AND TEST REPORTS

8.1 Submit inspection and test reports as specified in the Sections of the specifications for “Source Quality Control” and “Field Quality Control” within 3 working days of inspection or testing. If immediate action is required by the Contractor inform the Consultant immediately and submit inspection and testing report within one working day.

8.2 Submit 3 copies of reports submitted with certificates of compliance indicating but not limited to the following:

.1 Project name and number.

.2 Date of inspection or test and date report is issued.

.3 Name and address of inspection and testing company.

.4 Name and signature of inspector or tester.

.5 Identification of Product and Specification Section covering inspected or tested work.

.6 Specified requirements for which the inspection or testing was performed and results of inspections or tests.

.7 Location of inspection or from which tested material was derived.

.8 Overview of inspection and testing methods and procedures.

.9 Remarks and observations on compliance with Contract Documents.

8.3 Inspection and test reports shall be signed by a responsible officer of the inspection and testing company.

9 **PROGRESS PHOTOGRAPHS**

9.1 Concurrently with monthly application for payment submit PDF files or zipfile via digital transfer services such as dropbox, wetransfer, or other software of digital pictures illustrating the progress of the Work as follows:

.1 A minimum of 20 pictures that best illustrate the progress on the site.

.2 Pictures shall be in focus and properly illuminated; view shall be unobstructed.

.3 Pictures shall be taken with a minimum 8 megapixel camera or better such that quality and details can be discerned from photo.

.4 The Pictures shall either have an accurate date-stamp present in the photo, or be numbered and dated in the digital filename.

.5 The PDF files containing the photo's shall be labeled with the following information: The project name, the period the pictures are taken in, the monthly application number which the pictures are associated with.

10 **PROGRESS REPORTS**

10.1 Prepare a monthly progress report current to the last Friday of each month. The report shall indicate the period covered and include but not be limited to the following:

.1 Executive Summary.

.2 Areas of Concern/Action Required.

.3 Work Accomplished This Period.

.4 Work Planned Next Period.

.5 Schedule Status.

.6 Budget Status.

.7 Status of Submittals.

.8 Quality Control.

.9 Contract Changes.

.10 Outstanding Actions.

10.2 Submit the monthly progress report such that it is received by the Owner & Consultant no later than the Wednesday following the last Friday of the month, regardless of whether or not the Monday is a public holiday.

11 **OPERATION AND MAINTENANCE MANUALS**

11.1 Submit Operation and Maintenance Manuals in accordance with Section 01 78 23.

12 **RECORD DOCUMENTS**

12.1 Submit record documents in accordance with Section 01 78 39.

END OF SECTION

1 CONSTRUCTOR

1.1 For the purposes of the Contract, the term "Constructor", as defined in the Occupational Health and Safety Act, shall mean the Contractor who shall be responsible for ensuring that the provisions of the statutes, regulations and by-laws pertaining to the safe performance of the Work are to be observed. The "Constructor" shall submit the Notice of Project.

1.2 In the event of conflict between any of the provisions of Statues, Regulations and By-laws, and other requirements of authorities, the most stringent provision applies.

1.3 The Contractor's representative shall be responsible for ensuring that the provisions of statutes, regulations and by-laws pertaining to safe performance of the Work and the work of Other Contractors and Owner’s own forces working on the Site are observed and that the methods of performing the Work do not endanger the personnel employed thereon nor the general public, and are in accordance with the latest edition of the Occupational Health and Safety Act. Include on the Joint Health and Safety Committee representatives of Other Contractors working on Site.

1.4 Prior to the Contractor's representative being absent from the Site for an extended period during execution of the Work, the Contractor's representative will name, in writing to the Consultant, another person who is competent to assume these responsibilities. The Contractor shall advise the Consultant of change of the individual identified as the Contractor's representative.

1.5 At the discretion of the Consultant, the "Constructor" designation may be transferred to/from a Contractor at any time at no additional cost to the Owner.

2 PROJECT RESPONSIBILITIES

2.1 The Contractor's representative shall ensure that:

2.2 All measures and procedures prescribed by the following Acts and Regulations are carried out on Site:

.1 The Occupational Health and Safety Act;

.2 The Regulations for Construction Projects;

.3 WHMIS Regulations;

.4 The Environmental Protection Act and regulations,

.5 All other legislation, regulations and standards as applicable.

2.3 Every employer and every worker performing Work on the Site must comply with the requirements referred to above.

2.4 Ensure that the health and safety of workers, employees of the Owner and the general public are protected in relation to the Work performed on the Site.

3 WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM (WHMIS)

3.1 Be familiar with and comply with WHMIS regulations.

3.2 Properly label controlled products. Provide proper warning labels and training at the Site.

3.3 Maintain on site for duration of Contract a hazardous materials log containing all required MSDS. Log shall be open for inspection by Owner, Consultant and all personnel on Site.

3.4 Provide copies of material safety data sheets (MSDS) for any controlled products prior to delivery to the Site.

3.5 Be responsible for all applicable requirements of the regulations.

3.6 Before commencing any Work on Site, attend the pre-construction meeting and provide the Consultant with a proposal as to how hazardous materials will be stored and dispensed on Site. In addition, specifically outline the measures which will be undertaken to prevent damage or injury in the event of an accidental spill.

3.7 Provide “Handling Procedure for Hazardous Materials”.

4 JOINT HEALTH AND SAFETY COMMITTEE

4.1 The Contractor shall be responsible for the establishment and operation of the Joint Health and Safety Committee as required by the Occupational Health and Safety Act.

5 DELIVERABLES

5.1 The Contractor shall deliver to the Consultant:

.1 The Contractor's Occupational Health and Safety Policy.

.2 The Contractor's safety program to implement the Occupational Health and Safety Policy for the Contract, which will effectively prevent and control accidents for the Contract.

.3 A copy of all communications with, and including all orders by, the Ministry of Labour or other occupational health and safety enforcement authority.

.4 A copy of all accident/injury investigation reports, not just the WSIB Form 7. Each report must contain a statement of actions that will be taken to prevent a recurrence.

.5 A copy of all inspection reports made by the Contractor in compliance with the employer's responsibility under the Occupational Health and Safety Act.

.6 A copy of all safety information pertaining to the Contract made and furnished by the Contractor's own "Safety Personnel" or outside consultants/advisers engaged for the purpose of inspecting the workplace for occupational health and safety.

.7 A verification that all workers in the employment of the Contractor on Site, have had a WHMIS training or refresher course within the last twelve months.

.8 A verification that all workers in the employ of the Contractor have had "Explosive Activated Tool Training" on the type of tools being used.

.9 A verification that the instruction manuals are on Site for all tools and equipment being used.

.10 A copy of the most recent workers compensation experience rating account, i.e. CAD-7, NEER, and/or an insurance carrier's experience rating account.

.11 Statistical information for the purpose of determining injury frequency and severity rates (hours worked, first-aid injuries, medical aid injuries, lost time injuries, restricted workday injuries, near-miss accident/incident and significant occurrence data), in a timely manner as required by the Owner/Consultant.

.12 The immediate reporting to the Owner/Consultant of all instances that are defined in the Occupational Health and Safety Act as "Notices of Injuries" and "Occurrences" and any occasion that a worker exercises their "Right to Refuse Unsafe Work".

5.2 The Consultant reserves the right to require additional or amended deliverables pertaining to safety during the duration of the Work at no additional cost to the Owner.

5.3 Items specified above shall be delivered to the Consultant prior to the Contractor commencing Work on the Site.

6 DUE DILIGENCE

6.1 The Contractor acknowledges that it has read and understands the measures and procedures relating to occupational health and safety as prescribed above. The Contractor acknowledges and understands its duties as therein set out and hereby expressly undertakes and agrees to comply with all such requirements and standards in their entirety and at the Contractor's expense.

6.2 The Contractor further agrees to fully cooperate with all health and safety requirements, rules, regulations, standards, and criteria set out in the Contract Documents, which agreement is in furtherance of the Contractor's duties and responsibilities under occupational health and safety legislation.

6.3 The Contractor agrees that if, in the opinion of the Consultant or Owner, the health and safety of a person or persons is endangered or the effective operation of the system put in place to ensure the health and safety of workers on the Site is not being implemented, the Consultant or Owner may take such action as it deems necessary and appropriate in the circumstances, including, without limitation, the following:

.1 Require the Contractor to remedy the condition forthwith at its own expense;

.2 Require that the Site be shut down in whole or in part until such time as the condition has been remedied;

.3 Remedy the problem and the Owner shall back-charge the Contractor for the cost of such remedial work, together with an appropriate overhead factor as determined by the Owner in its sole discretion; and

.4 Terminate the Contract without further liability in the event the Contractor fails to comply with these provisions.

7 SITE SAFETY PERSONNEL

7.1 In the event the Consultant deems it necessary, because of the Work, the Contractor shall assign a "Competent Safety Person" to assist the Contractor's representative in the discharging of safety responsibility, at no additional cost to the Owner.

END OF SECTION

1 GENERAL

1.1 Be responsible for inspection and testing as required by the Contract Documents, statutes, regulations, by-laws, standards or codes or any other jurisdictional authority. Give the Consultant timely notice of the readiness for inspection, date and time for such inspection for attendance by the Consultant.

1.2 Verify by certification that specified products meet the requirements of reference standards specified in the applicable specification sections.

1.3 Conduct testing, balancing and adjusting of equipment and systems specified in applicable mechanical and electrical specifications sections by independent testing company.

2 INSPECTION AND TESTING BY THE OWNER

2.1 The Consultant, on behalf of the Owner may appoint an independent inspection and testing company to carry out inspection and testing of the Work for conformance to the Contract Documents. Such costs for inspection and testing will be paid by the Owner. However, any additional inspection and testing due to non-conformance to the Contract Documents shall be at the Contractor's expense.

2.2 A list of inspection and testing agencies shall be submitted by the Contractor for approval by the Owner and Consultant. Inspection and testing services will be tendered by the Contractor and the results submitted to the Consultant for review and approval.

2.3 Inspections and testing by the independent inspection and testing company will be promptly made. Uncover for examination any Work covered up prior to inspection or without approval of the Consultant. Make good such Work at no cost to the Owner.

2.4 The Owner may inspect and test Products during manufacture, fabrication, shop testing, installation, construction and testing phases of the Contract. The Consultant will ascertain the quantity and quality of testing to be performed. Inspection and testing may be performed at the place of manufacture/fabrication, storage, or at the Site as designated by the Consultant. Where inspection and testing is done either during manufacture, fabrication, or at Site, ensure that proper facilities and assistance are provided.

3 INSPECTION AND TESTING

3.1 Source and Field Quality Control specified in Other Sections:

.1 This Section includes requirements for performance of inspection and testing specified under Source Quality Control and Field Quality Control in other Sections of the specifications.

.2 Do not include in work of this Section responsibilities and procedures that relate solely to an inspection and testing company's functions that are specified in another Section which is paid for directly by the Owner. Such information is included in this Section for Contractor's information only.

3.2 Do not limit responsibility for ensuring that products and execution of the work meet Contract requirements, and inspection and testing required to this end, to specified inspection and testing.

4 QUALIFICATIONS OF INSPECTION AND TESTING COMPANIES

4.1 Inspection and testing companies to be certified by the Standards Council of Canada (SCC) or Canadian Council of Independent Laboratories (CCIL).

4.2 Companies engaged for inspection and testing shall provide equipment, methods of recoding and evaluation, and knowledgeable personnel to conduct tests precisely as specified in reference standards.

4.3 If requested, submit affidavits and copies of certificates of calibration made by an accredited calibrator to verify that testing equipment was calibrated and its accuracy ensured within the previous twelve months.

5 RESPONSIBILITIES OF THE CONTRACTOR

5.1 Be responsible for quality control methods and procedures to ensure performance of the work in accordance with the Contract Documents.

6 RESPONSIBILITIES OF INSPECTION AND TESTING COMPANIES

6.1 Determine from specifications and Drawings the extent of inspection and testing required for Work of the Contract. Subcontractors shall notify Consultant of any omissions or discrepancies in the work inspected and/or tested.

6.2 Perform applicable inspection and testing described in the Specifications and as may be additionally directed.

6.3 Provide competent inspection and testing personnel when notified by the Contractor that applicable work is proceeding. Inspection personnel shall cooperate with the Consultant and Contractor to expedite the Work.

6.4 Subcontractors shall notify the Consultant and Contractor of deficiencies and irregularities in the Work immediately when they are observed in the course of inspection and testing.

6.5 Inspection and testing companies shall not perform or supervise any of the Contractor's work, and shall not authorize:

.1 Performance of work that is not in strict accordance with the Contract Documents.

.2 Approval or acceptance of any part of the Work.

7 **INSPECTION AND TESTING PROCEDURES**

7.1 Perform specified inspection and testing only in accordance with specified reference standards, or as otherwise approved.

7.2 Observe and report on compliance of the Work to requirements of Contract Documents.

7.3 Ensure that inspectors are on site or at fabricator's operations for full duration of critical operations, and as otherwise required to determine that the Work is being performed in accordance with the contract Documents.

7.4 Identify samples and sources of materials.

7.5 Review and report on progress of the work. Report on count of units fabricated and inspected at fabricator's operations.

7.6 Observe and report on conditions of significance to work in progress at time of inspection or at fabricator's operations. Include where applicable and if critical to the work in progress:

.1 Time and date of inspection.

.2 Temperature of air, materials, and adjacent surfaces.

.3 Humidity of air, and moisture content of materials and adjacent materials.

.4 Presence of sunlight, wind, rain, snow and other weather conditions.

7.7 Include in reports all information critical to inspection and testing.

7.8 Ensure that only materials from the work and intended for use therein are tested.

7.9 Determine locations for work to be tested.

8 **TOLERANCES FOR INSTALLATION OF WORK**

8.1 Unless specifically indicated otherwise, all work of all contractor and subcontractors' work shall be installed plumb, level, square and straight.

8.2 Unless acceptable tolerances are otherwise specified in specification sections or are otherwise required for proper functioning of equipment, site services, and mechanical and electrical systems:

.1 "Plumb and level" shall mean plumb or level within 1 mm in 1 m.

.2 "Square" shall mean not in excess of 10 seconds lesser or greater than 90 degrees.

.3 "Straight" shall mean within 1 mm under a 1 m long straightedge.

.4 "Flush" shall mean within:
.1 6 mm for exterior concrete, masonry, and paving materials.
.2 1 mm for interior concrete, masonry, tile and similar surfaces.
.3 0.05 mm for other interior surfaces.

8.3 Allowable tolerances shall not be cumulative.

9 REFERENCE STANDARDS

9.1 Perform inspection and testing in accordance with Standards quoted and as required by procedures described in specified reference standards that are applicable to the work being inspected and tested.

10 DEFECTS

10.1 Defective products, materials and workmanship found at any time prior to Contract Completion will be rejected regardless of previous inspections, testing, and reviews of the Work. Inspections, testing, and reviews shall not relieve the Contractor from their responsibility but are a precaution against oversight or error. Remove and replace defective and rejected products, materials, systems, and workmanship. Be responsible for delays and expenses caused by rejection.

11 MOCK UPS

11.1 Where required by Contract Documents construct, unless indicated herein, mock-ups of work on Site, in size and at location directed by Consultant.

11.2 Construct mock-ups prior to start of affected work. Allow sufficient time for Consultant’s review. Work affected by mock-ups may not commence prior to acceptance of mock-ups.

11.3 Construct mock-ups to include all related specified materials and workmanship. Make revisions as directed by Consultant, in accordance with the intent of the Contract Documents, until mock-ups are acceptable.

11.4 Mock-ups, reviewed and accepted by Consultant, shall become the standard of quality against which installed work will be measured.

11.5 Mock-ups, by prior arrangement, may be incorporated into finished work if approved by Consultant only.

12 EXTERIOR WALL MOCK-UP

12.1 For exterior wall elements, construct a 1 m^2 (1.0m x 1.0m) mock-up of wall system incorporating all wall components specified. Construct mock-up on Site in a location acceptable to Consultant.

12.2 The mock-up shall include the work of all trades involved in exterior wall elements, complete in all respects including masonry, air/vapour retarders, zinc cladding, aluminium work, sealants, etc., and shall establish a minimum standard for the work of the exterior wall elements, clear up any misunderstandings and point out any possible problems.

12.3 Upon completion of mock-up, and after being notified by the Contractor, Consultant will inspect mock-up and if necessary, prepare and issue a list of deficiencies. Once mock-up has been accepted, it will form the minimum standard of quality for exterior wall elements.

12.4 Mock-up will not form part of the work and will be independent of building. Remove and dispose of mock-up from Site during final clean-up, or when directed by Consultant.

13 DOCUMENTS ON SITE

13.1 Maintain at job site, one copy of each of the following:

.1 Contract Documents including Drawings, Specifications, Addenda, and other modifications to the Contract.

.2 'Reviewed' or 'Reviewed as Modified' Shop Drawings.

.3 Project Construction and Shop Drawing Schedules.

.4 Site Instructions and Change Orders.

.5 Field Test Reports.

.6 Reports by Authorities having Jurisdiction.

.7 Building and other applicable permits.

.8 Daily log including:
- .1 Weather conditions.
- .2 Excavation conditions
- .3 Start and finish date of each Trade Contractor.
- .4 Erection and removal dates of formwork.
- .5 Date, quantities and particulars of each concrete pour.
- .6 Dates and quantities and particulars of roofing and waterproofing work.
- .7 Visits to the Site by Owner, Consultants, Jurisdictional Authorities, Testing and Inspection companies, and material and equipment supplier representatives.

.9 Material Safety Data Sheet pursuant to WHMIS (Occupational Health & Safety Act).

.10 As-built drawings recording as-built conditions, instructions, changes for structure, equipment, wiring, plumbing, etc., as called for in Section 01 78 39 and Divisions 22 and 26, prior to being concealed.

.11 Copies of applicable codes.

13.2 The above material shall be made available to the Consultant at their request.

14 BUILDING ENVELOPE

14.1 Requirements specified herein apply to all elements of the exterior building envelope.

14.2 Continuity of air barrier/vapour retarder and insulation components is critical and must be maintained at all locations. Where different systems meet, ensure proper interface and continuity between adjacent components by implementing suitable construction sequences and by using compatible materials only.

14.3 Maximum air leakage shall be 0.10 L/(s$\cdot$m^2) when measured with a warm-side relative humidity of 27-55% at 21^{0}C and a measured air pressure difference of 75Pa.

14.4 Anchor exterior cladding components to structure in manner suitable to accommodate structural deflection and creep and to withstand loads from expected temperature gradients. Design anchorage to withstand expected wind loads, positive and negative, in accordance with applicable regulations.

14.5 Ensure that air spaces within exterior building components are firestopped in accordance with applicable regulations.

14.6 Ensure that air spaces on the outside of vertical air barrier/vapour retarder (walls), window systems, and curtain wall systems are constructed with adequate drainage provisions to the exterior.

14.7 Owner may complete a thermographic scan upon completion of the building envelope. Contractor will be responsible to correct identified thermal anomalies.

15 DRAINAGE

15.1 Layout and construct work to ensure that positive drainage is provided to floor drains, ditches, site drains and catch basins, as set in their final position, preventing undrained areas and ponding.

15.2 Ensure that allowable construction tolerances and structural deflection do not cause ponding of water.

15.3 Report to Consultant in writing prior to executing work affected, in case adequate drainage cannot be provided.

END OF SECTION

1 GENERAL

1.1 Provide Labour, Products, equipment, services, tools and Supervision to ensure that Work complies with minimum acceptable standards of materials and performance of Work in accordance with codes and standards referenced in the Specification.

1.2 Consider contract forms, codes, Specifications, standards, manuals, and installation and application instructions referred to in these specifications to be the latest published editions at the date of submission of the bid unless otherwise stated in the Specifications or otherwise required by the authorities having jurisdiction.

2 BY-LAWS, PERMITS, AND FEES

2.1 The Building Code - Ontario Regulation 332/12, including all amendments and updates current as of the date of Application for Building Permit identified on the official stamped & issued Building Permit drawing set, shall govern the construction of the Work. Any changes to the Building Code which take effect after the application for building permit, but prior to completion of construction, which are required by law to be incorporated, shall be added by way of Change Order to the Contract.

2.2 Comply with all By-Laws and regulations of authorities having jurisdiction. These codes and regulations constitute an integral part of the Contract Documents..

2.3 If required, pay for construction damage deposit required by authorities having jurisdiction.

2.4 Where permits, licences, and inspection fees are required by authorities having jurisdiction for specific trade functions, they shall be obtained by particular subtrade responsible for that work.

2.5 Arrange for inspection, testing of Work and acceptance required by the authorities having jurisdiction. Be responsible for necessary preparations, provisions and pay all associated costs.

2.6 Be responsible for ensuring that no work is undertaken which is conditional on permits, approvals, reviews, licences, fees, until all applicable conditions are met. No time extension will be allowed for delay in obtaining necessary permits.

2.7 Any additional work or changes to the materials due to Work not complying with the Ontario Building Code and Regulations as indicated by the Building Inspector shall be changed. All costs involved shall be borne by Contractor.

2.8 Obtain permit required to work on Municipal rights of way. Provide damage deposits for sidewalks, roads and services work, as applicable.

2.9 Give notice of completion of project prior to occupancy, as required by applicable legislation.

3 RIGHT OF WAY PERMIT

3.1 The Site Servicing Sub-Contractor and/or General Contractor will be required to obtain approval from the Transportation Services Division for any work within the public right-of-way.

3.2 In order to obtain approval for work in the Municipality's right-of-way the Site Servicing Sub-Contractor and/or General Contractor will be required to provide up to date stake out information for most construction related work.

3.3 The Site Servicing Sub-Contractor and/or General Contractor is required to obtain building location and access permits prior to constructing this project. Other permits associated with construction activities (such as hoarding, piling/shoring, etc.) may also be required.

4 SITE SERVICING CONNECTIONS

4.1 The Site Servicing Sub-Contractor and/or General Contractor will be required to make an application to the Municipality's Water Division for the installation of any proposed services within the right-of-way after acceptance of the stormwater management report and site servicing plan.

5 CONSTRUCTION MANAGEMENT PLAN

5.1 The Site Servicing Sub-Contractor and/or General Contractor will be required to provide the Municipality with a Construction Management Plan outlining the following:

.1 Dust/mud control on and offsite;

.2 Location of truck loading points, trailer parking;

.3 Location of temporary material storage areas;

.4 Access/truck routing;

.5 Provision of hoarding, temporary fencing & covered walkways;

.6 Location and extent of aerial crane operations; and

.7 Parking for construction trades;

6 OFF-STREET VEHICULAR LOADING AND PARKING FACILITIES AND ACCESS/DRIVEWAYS

6.1 Provide and maintain off-street vehicular loading and parking facilities and access driveways in accordance with the approved plans and drawings, to the satisfaction of the Municipality.

6.2 All on-site driveways and parking areas must be surfaced and maintained with asphalt, concrete or interlocking stone.

7 FACILITIES FOR THE LANDSCAPING OF THE LANDS OR THE PROTECTION OF ADJOINING LANDS

7.1 The Site Servicing Sub-Contractor and/or General Contractor shall maintain the sod covered portion within the Municipality's Right-of-Way fronting and/or flanking the site in accordance with the approved plans and drawings to the satisfaction of the Municipality.

8 EXISTING PUBLIC SERVICE LINES

8.1 Where existing public services are indicated to be removed and/or relocated, perform Work in compliance with authorities having jurisdiction.

8.2 The Site Servicing Sub-Contractor and/or General Contractor is required to make good public roads, walkways and curbs soiled or damaged due to construction to the requirements of local authorities.

9 CODES

9.1 Reference is made to standards in the specifications to establish minimum acceptable standards of materials, products and workmanship. Ensure that materials, products and workmanship meet or exceed requirements of the reference standards specified.

9.2 In the event of conflict between documents specified herein, execute the Work in accordance with the most stringent requirements.

10 STANDARDS

10.1 Where a material or product is specified in conjunction with a referenced standard, do not supply the material or product if it does not meet the requirements of the standard. Supply another specified material or product, or an acceptable material or product of other approved manufacture which does meet the requirements of the standard, at no additional cost to the Owner.

10.2 Where no standard is referred to, provide materials, products and workmanship which meet requirements of the applicable standards of the Canadian Standards Association, Canadian General Standards Board, Ontario Provincial standard specifications (OPSS), Ontario Provincial Standard Drawings (OPSD) and the applicable building code. References to "Measurement for Payment" and "Basis of Payment" in OPSS standard documents are not applicable to this Contract.

10.3 If there is question as to whether a material, product or system is in conformance with applicable standards, the Consultant reserves the right to have such materials, products or systems tested to prove or disprove conformance. The cost for such

testing will be paid by the Owner in the event of conformance with contract Documents or by the Contractor in the event of non-conformance.

10.4 Where application, installation and workmanship standards are cited, it is intended that referenced standards form the basis for minimum requirements of the specified item and specifications supplement the standards unless specified otherwise.

10.5 Matters may be dealt with in part by these specifications which are also dealt with, under the same or similar headings in cited standard. It is not intended that these specifications take the place of the standards but supplement them, unless specified otherwise.

10.6 Where reference is made to manufacturer's directions, instructions or specifications they shall include full information on storing, handling, preparing, mixing, installing, erecting, applying, or other matters concerning the materials pertinent to their use and their relationship to materials with which they are incorporated.

10.7 Where standards, specifications, associations, and regulatory bodies are listed in the Specifications by their abbreviated designations. These are but not limited to the following:

AA	The Aluminum Association
AAMA	Architectural Aluminum Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AFBMA	Anti-Friction Bearing Manufacturer's Association
AIEE	American Institute of Electrical Engineers
AISI	American Iron and Steel Institute
AMCA	Air Movement and Control Association
AMEU	Association of Municipal Electric Utilities
ANSI	American National Standards Institute
ARI	Air-Conditioning and Refrigeration Institute
ASA	American Standards Association
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing and Materials
AWMAC	Architectural Woodwork Manufacturers Association of Canada
AWWA	American Water Works Association
CEMA	Canadian Electrical Manufacturer's Association
CGA	Canadian Gas Association
CGSB	Canadian General Standards Board
CISC	Canadian Institute of Steel Construction
CMHC	Canadian Mortgage and Housing Corporation
CMPA	Canadian Paint Manufacturers Association
COFI	Council of Forest Industries of British Columbia
CRCA	Canadian Roofing Contractors Association
CSA	Canadian Standards Association

CSSBI	Canadian Sheet Steel Building Institute
CWB	Canadian Welding Bureau
CWC	Canadian Wood Council
EEMAC	Electrical and Electronic Manufacturers Association Canada
FM	Factory Mutual
IEEE	Institute of Electrical and Electronic Engineers
MFMA	Maple Flooring Manufacturers Association
MIL	Military Standards
MSS	Manufacturer's Standardization Society
MTO	Ministry of Transportation Ontario
NAAMM	National Association of Architectural Metal Manufacturers
NFPA	National Fire Protection Association
NEMA	National Electrical Manufacturer's Association (U.S.A.)
NLGA	National Lumber Grades Authority
NRC	National Research Council of Canada
OCBA	Ontario Concrete Block Association
OHESC	Ontario Hydro Electrical Safety Code
OPSS	Ontario Provincial Standard Specification
PEI	Porcelain Enamel Institute
PDI	Plumbing Drainage Institute
PHA	Public Health Act
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SSPC	Steel Structures Painting Council
TEMA	Tubular Exchange Manufacturer's Association
TTMAC	Terrazzo, Tile and Marble Association of Canada
UL	Underwriters Laboratories Inc. (U.S.)
ULC	Underwriters Laboratories of Canada

11 FIRE RATINGS, ASSEMBLIES AND SEPARATIONS

11.1 Where a material, component, assembly, or separation is required to be fire rated, the fire rating shall be as determined or listed by one of the following testing authorities acceptable to the authorities having jurisdiction:

.1 Underwriters' Laboratories of Canada.

.2 Underwriters' Laboratories Inc.

.3 Factory Mutual Laboratories.

.4 The National Research Council of Canada.

.5 The National Board of Fire Underwriters.

.6 Intertek Testing Services.

11.2 Where reference is made to only one testing authority an equivalent fire rating as determined or listed by another of the aforementioned testing authorities is acceptable

if approved by authorities having jurisdiction. Obtain and submit such approval of authorities, in writing when requesting acceptance of a proposed equivalent rating or test design.

11.3 Fire rated door assemblies shall include doors, frame, anchors, and hardware and shall bear label of fire rating authority showing opening classification and rating.

11.4 Material having a fire hazard classification shall be applied or installed in accordance with fire rating authorities printed instructions.

11.5 Fire rated assemblies shall be constructed in accordance with applicable fire test report information issued by fire rating authority. Deviation from fire test report will not be allowed.

11.6 Construct fire separations as continuous, uninterrupted elements except for permitted openings. Extend fire rated walls and partitions from floor to underside of structural deck above.

11.7 Fire separations may be pierced by openings for electrical and similar service outlets provided such boxes are non-combustible and are tightly fitted and sealed with a ULC approved sealant for the assembly being sealed.

11.8 Construction that abuts on or is supported by a non-combustible fire separation shall be constructed so that its collapse under fire conditions will not cause the collapse of the fire separation.

11.9 Do not use combustible members, fastenings, attachments and similar items to anchor electrical, mechanical or other fixtures to fire separations.

11.10 At penetration through fire rated walls, ceilings or floors, completely seal voids with ULC approved firestopping material; full thickness of the construction element. In locations that require a smoke seal, provide appropriate ULC approved system installed in accordance with the manufacturer's recommendations.

END OF SECTION

1 TEMPORARY CONTROLS

1.1 Hoarding and barriers:

.1 Before commencing operations, supply, erect and maintain hoarding around entire perimeter of Site. Paint outside of hoarding in a colour selected by the Owner and mark with "POST NO BILLS" signs.

.2 Provide temporary enclosures as required to protect the building in its entirety or in its parts, against the elements, to maintain environmental conditions required for work within the enclosure, and to prevent damage to materials stored within.

.3 Provide lockable gates through hoarding and barriers for access to Site by workers and vehicles.

1.2 Prevent unauthorized entry to the Site. Barricade, guard or lock access points to the satisfaction of the Owner and post "NO TRESPASSING" signs.

1.3 Provide hoarding, barriers and covered walkways required by governing authorities for public safety, public rights-of-way and for access to buildings. Snow fencing is not allowed as protection for sidewalk.

1.4 Install signs for the movement of people around Work Site as required and directed by the Owner.

1.5 Provide secure, rigid guide rails and barricades around deep excavations, open shafts, open stair wells, open edges of floors and roofs as required for protection of Work, workers, and the public.

1.6 Remove hoarding, barriers, building enclosures, guide rails and barricades upon Contract Completion unless otherwise noted on the Contract Drawings or as directed by the Owner.

2 SERVICE AND UTILITY SYSTEMS

2.1 Consult with utility companies and other authorities having jurisdiction to ascertain the locations of existing services on or adjacent to site.

2.2 Information as to the location of existing services, if shown on the Drawings, does not relieve the Contractor of his responsibility to determine the exact number and location of existing services.

2.3 Give proper notices of new services as may be required. Make arrangements with authorities and utilities for service connections required.

2.4 Pay any charges levied by utilities or authorities for work carried out by them in connection with this Contract, unless specified otherwise.

2.5 Operate and maintain all utility systems affected by work of this Contract, until the building or specific portions thereof have been accepted by the Owner.

2.6 Report existing unknown services encountered during excavation to Consultant for instructions; cut back and cap or plug unused services. Be responsible for the protection of all active services encountered and for repair of such services if damaged.

3 SCAFFOLDING AND HOISTS

3.1 Select, operate, and maintain scaffolding, hoisting equipment and cranes as may be required.

3.2 Do not erect or operate equipment that will endanger existing structures, local municipalities hydro installations, or traffic signals.

3.3 Design and construct scaffolding in accordance with CAN/CSA S269.2-M or updated version.

4 TEMPORARY WORKS

4.1 Installation and Removal: Provide temporary utilities, facilities and controls in order to execute the Work expeditiously. Remove from Site all such Work after use.

4.2 Arrange for connections with appropriate utility company and pay all costs for installation, maintenance, and removal.

4.3 Arrange for connections with Owner and pay all costs for installation, maintenance, and removal.

4.4 Be responsible for the careful and reasonable use of Owner supplied water and power.

4.5 Temporary Power and Lighting Systems:

.1 Supply, install and maintain electrical power and necessary electrical equipment including overhead and underground feeders, transformers, motors, starters, panels, protective devices and equipment. Connections will be made available to any part of the Work within distance of a 30 m extension.

.2 Provide temporary lighting inside and outside structure of adequate intensity to illuminate construction activities. Provide temporary pedestrian lighting for sidewalk areas affected by the Work.

.3 Supply and install the type and quantity of minimum lighting equipment in each location to ensure adequate, continual illumination 24 hours per day, 7 days per week for the following:

.1 Emergency evacuation, safety and security throughout the Project at intensity levels required by jurisdictional authorities.

.2 General lighting for performance of the Work throughout the Project, evenly distributed, and at intensities to ensure that proper installations and applications are achieved.

.3 Performance of finishing trades in area as required evenly distributed, and of an intensity of at least 50 Lux.

.4 In locations approved by the Owner. install and support the electrical plant, distribution and temporary lighting systems including service equipment and local hydro authority meter energized by the local hydro circuits. Installations shall be approved by the Consultant and shall be carried out in a neat manner to avoid interference with the application of the finished material and to facilitate removal when the installed permanent lighting system is in operation.

.5 Make all necessary arrangements for and pay all costs for a temporary electrical service of sufficient capacity to supply temporary lighting, operation of power tools, cranes and equipment for all construction, implementation, and inspection and testing purposes. Supply and install necessary temporary cables and other electrical equipment and make all temporary connections as required.

.6 Temporary power distribution wiring shall comply with Ontario Hydro Electrical Safety Code. Obtain inspection certificates for temporary electrical work.

.7 Maintain the lighting systems in operation during the life of the Contract. Replace burned or missing lamps immediately.

.8 Upon Contract Completion, remove electrical plant and temporary lighting from the Site.

4.6 Water Supply:

.1 Provide and pay for a continuous supply of potable water for construction use. Provide as a minimum one water connection on each floor level.

.2 Provide and maintain all temporary lines, extensions and hoses as required. Remove all temporary connections and lines on completion of the Work and make good any damage.

4.7 Temporary Heating:

.1 Provide temporary heating required during construction period, including attendance, maintenance, and fuel.

.2 Construction heaters used inside buildings must be vented to the outside or be flameless type. Solid fuel salamanders are not permitted.

.3 Maintain temperatures of minimum 10^{o}C in areas where construction is in progress unless otherwise indicated in the Contract Documents. Protect exposed and adjacent services from freezing. Repair at no cost to the Owner any such services, buildings or other utilities disrupted by freezing.

.4 Ventilate heated areas and keep structures free from exhaust combustion gases.

.5 The permanent heating system of the building or portions thereof may be used when available only upon written permission by Owner. If permission to use heating system is obtained:

.1 Before using air handling systems, ensure that dust/debris is removed from the premises and install temporary filters to prevent construction dust/debris from entering via return air or intake openings. keep unused ducts sealed to prevent entry of dust/debris. Replace filters frequently during construction.

.2 On competition of work remove temporary filters and install new filters in accordance with Division 23. After temporary use of air handling system is complete and before turning over system to Owner, vacuum internally to ensure all dust/debris is removed.

4.8 Elevators: Elevators may not be used by construction personnel (if an elevator is proposed for this project).

4.9 Temporary Telephone and facsimile: Provide and pay for separate telephones and facsimile services, for local call only, as required for own use and use of the Consultant and Owner. Long distance call shall be paid by party making call.

4.10 Sanitary Facilities: Provide sanitary facilities in accordance with occupational health and safety requirements in the place of the Work. Use of Owner's existing sanitary facilities or new sanitary facilities is not allowed.

5 PROTECTION

5.1 Protection of Public Area: Protect surrounding private and public property from damage during performance of the Work.

5.2 Take all necessary precautions to prevent damage to work affected by temperature, water, weather, and other environmental conditions.

5.3 Protection of Building Finishes and Equipment:

.1 Provide protection for existing structure, finished, and partially finished building finishes, waterproofing systems, and equipment during performance of the Work.

.2 Cover Owner's equipment and plant within the Site with 6 mil PVC sheet, or equal, taped to make it dust-tight. Equipment and existing work moved or altered to facilitate construction, movement of Products or equipment shall be stored, protected with dust-tight covers, and subsequently returned to its original location.

.3 Obtain approval from the Consultant prior to the installation of temporary supporting devices into existing roof, ceiling, or wall members for the erecting of equipment or machinery. Repair roof, ceiling, and wall members used for this purpose to the satisfaction of the Consultant.

.4 Provide necessary screens, covers and hoarding as required.

.5 Provide temporary weather tight, dust tight, and lockable partitions within the building where work is performed. Provide weather tight closures to unfinished door and window openings, top of shafts and other openings in floors and roofs.

.6 Any Products or equipment damaged while carrying out the Work shall be restored with new Products or equipment matching the original equipment. Damage shall include harm resulting from all construction work, such as falling objects, wheel and foot traffic, failure to remove debris, operation of machinery and equipment, and scaffolding and hoisting operations.

.7 Protect finished surfaces of new work from damage by restriction of access or by use of physical means suitable to the material and surface location. Where construction operations must be performed or traffic routed over finished floors, lay 6 mm plywood coverings tightly fitted and secured over surface in such areas.

5.4 Fire Protection:

.1 Take precautions to prevent fires. Provide and maintain temporary fire protection equipment of a type appropriate to the hazard anticipated in accordance with authorities having jurisdiction, governing codes, regulations, by-laws and to the satisfaction of the Consultant and insurance authorities.

.2 Excessive storage of flammable liquids and other hazardous materials is not allowed on Site. Flammable liquids must be handled in approved containers. Remove combustible wastes frequently.

.3 Inspect temporary wiring, drop cords, extension cables for defective insulation or connections frequently.

.4 Open burning of rubbish is not permitted on the Site.

.5 Handle, transport, store, use and dispose of gasoline, benzine or other flammable materials with good and safe practice as required by authorities having jurisdiction.

.6 Provide fire extinguishers of the non-freezing chemical type in each temporary building, enclosure and trailer. Use only fire-proofed tarpaulins.

.7 A fire watch shall be required for each of the following activities regardless of the number, duration or size of the activity in operation:
.1 any open flame activities (e.g., soldering and welding);
.2 shutdown of fire detection system;
.3 shutdown of sprinkler system.

5.5 Maintain adequate cover over services as required by Utility Authorities.

5.6 Report any discharge of a contaminant to the Authorities having jurisdiction.

6 TEMPORARY BUILDINGS

6.1 Provide, and maintain until contract completion, a temporary office as required for work, large enough to accommodate site administrative activities and site meeting, complete with lighting, heating, and air conditioning equipment to maintain 21 ^{0}C. Ventilation, telephone, facsimile machine on a separate line, copier (not combination fax/copier), table and chairs. Do not store materials, tools and/ or equipment in meeting area; keep clean and tidy.

6.2 For all trailers and temporary buildings, provide wood stairs, platform, and boardwalk, painted and repainted as required with non-skid abrasive paint.

6.3 Do not locate any buildings, structures or equipment in a manner that interferes with surveys along the control line and reference line tangents.

6.4 Remove temporary buildings upon Contract Completion. Restore area(s) to match the existing surrounding area.

7 PEST CONTROL

7.1 Be responsible for providing control measures, restraining procedures, and treatments to prevent infestation and spread of insects, rodents and other pests deemed to be present at Site and/or noticed during course of the Work. Carry out fumigation, pest control procedure, and posting of warning signs, notices including contents of such notices in accordance with requirements of Pesticides Act and any other authorities having jurisdictions. Pesticides used shall be in accordance with Canada Pest Control Products Act, and provincial and municipal regulations.

8 FIRST-AID FACILITIES

8.1 Provide site equipment and medical facilities necessary to supply first-aid service to injured personnel in accordance with regulations of the Workmen’s Compensation Act. Maintain facilities for duration of Contract.

9 USE OF NEW PERMANENT SERVICE & EQUIPMENT

9.1 Do not use any new permanent service or equipment without Owner’s written approval.

9.2 Where permission is granted to use permanent services and equipment provide competent people to operate services and equipment; inspect frequently and maintain facilities in proper operating condition at all times.

9.3 Permanent services and equipment shall be turned over to the Owner in “as new” and perfect operating condition.

9.4 Use of permanent systems and equipment as temporary facilities shall not affect the warranty conditions and warranty period for such systems and equipment. Make do allowance to ensure that Owner will receive full benefits of equipment manufacturers warranty after project takeover.

10 PROJECT IDENTIFICATION (ARCHITECT'S SIGN)

10.1 If required, obtain approvals from jurisdictional authorities for temporary signs.

10.2 Prior to submitting the first claim for payment, provide minimum 8' x 16' x 5/8" aluminum/foam panel composite sign, complete with aluminum framing, supports, and foundations. Graphics, in electronic format, for sign to be provided by Consultant. Sign background and rear face of sign shall be white. Submit a sign sketch for Consultant's approval before fabrication. Sign shall be executed with exhibit lettering produced by a professional sign manufacturer/painter. Locate sign as directed by Consultant.

10.3 Maintain sign in good condition for duration of work. Clean periodically. Remove immediately after Substantial Performance of the Contract, or at Completion of Contract as defined in applicable lien legislation as directed by the Consultant.

10.4 No other signs or advertisements, other than warning signs, or signs required by law, are permitted on site, without Owner's consent.

11 SITE MAINTENANCE

11.1 Maintain the Site and adjacent premises in a clean and orderly condition, free from debris and other objectionable matter. Immediately remove rubbish and surplus Products, equipment, and structures from the Site. If the Site is not cleaned (within 48 hours after the Contractor has been instructed to do so), the Consultant may clean the Site and retain the cost from monies due, or to become due, to the Contractor.

11.2 When the Work is substantially performed, remove surplus Products, tools, construction machinery and equipment not required for the performance of the remaining Work.

12 SITE STORAGE AND OVER LOADING

12.1 Confine the Work and operations of employees to limits indicated by the Contract Documents. Do not unreasonably encumber the Site with Products.

12.2 Products shall be stored only in areas designated or approved by the Consultant, and shall not be left lying on streets, sidewalks, boulevards or elsewhere within public view. Products which the Consultant may permit to be stored elsewhere than in the Contractor's storage areas shall be neatly stacked or otherwise disposed of and shall be so maintained.

12.3 Fabrication shops shall not be set up within the structure except as directed by or with the permission of the Consultant.

12.4 Do not load or permit to be loaded any part of the Work with a weight or force that it is not calculated to bear safely. Be solely responsible and liable for damages resulting from violation of this requirement. Provide temporary support as strong as permanent support.

12.5 Do not cut, drill, or sleeve load bearing members unless shown on drawings or otherwise approved by the Consultant in writing for each location.

12.6 Site storage and loading requirements to be in accordance with the Ontario Occupational Health and Safety Act and Regulations for Construction Projects.

13 PUBLIC CONVENIENCE AND SAFETY

13.1 Maintain sidewalks at and adjacent to the Site in a safe condition throughout the Contract. Promptly remove ice and snow.

13.2 Keep haul routes free at all times from Products spilled on highway or street surfaces and clean highways and streets of deposits due to performance of the Work to the satisfaction of the Consultant and the highway and street authorities. Clean highways and streets within 24 hours of Consultant's instruction.

13.3 The Consultant may inspect haul routes, the Site, and adjacent premises daily and may halt operations, withhold payment or carry out such additional operations as necessary, deducting the cost from monies due, or to become due, to the Contractor.

14 ACCESS AND EGRESS TO SITE

14.1 Where construction requirements demand, construct access roads capable of withstanding construction equipment and haul traffic. Maintain access roads in good condition at all times. Remove access roads prior to completion of the Work unless otherwise noted and restore area as shown on the Contract Drawings.

15 PUBLIC TRAFFIC FLOW

15.1 Provide and maintain flag persons, Police Officers, traffic signals, barricades and illumination as required by Authorities having jurisdiction and/or as necessary to perform the Work and protect the public.

16 PUBLIC UTILITIES AND SERVICES

16.1 Verify limitations imposed on project work by presence of utilities and services, and ensure no damage occurs to them.

16.2 Notify service authorities concerned so that they protect, remove, relocate, or discontinue them, as they may require.

16.3 Make arrangements and pay for connection charges for services required for project work.

16.4 Locate poles, pipes, conduit, wires, fill pipes, vents, regulators, meters, and sanitary services work in inconspicuous locations. If not shown on Drawings, verify location of service work with Consultant before commencing installation.

17 **ROADS, CURBS, GUTTERS, AND WALKS**

17.1 Include all curb cuts and making good of existing curbs, walks and paving on Municipal property to provide fully paved and finished approaches to requirements of authorities having jurisdiction.

18 **CONSTRUCTION PARKING**

18.1 Parking may be permitted on Site provided it does not disrupt the performance of Work , Site safety or the movement of vehicular or pedestrian traffic and is acceptable to the Consultant.

19 **SITE VISITORS**

19.1 During the progress of the Work, afford access to visitors duly authorized by the Consultant and facilitate inspections or tests they may desire to make. Record site visitors in log book maintained on site.

19.2 Ensure Site visitors wear appropriate safety apparel.

20 **EROSION AND SEDIMENTATION CONTROL**

20.1 Control drainage on site to prevent flooding, erosion and run-off onto adjacent properties as a result of construction operations.

20.2 Dispose of water containing silt in suspension in accordance with requirements of jurisdictional authorities.

20.3 Conform to sedimentation and erosion control requirements of the conservation and/or municipal authority having jurisdiction. Provide and maintain until completion of work or until directed by Consultant to be removed, sediment control devices at catch basins, drainage courses and at other locations on site as directed. Comply with requirements of the local Conservation Authority.

20.4 Provide storm drain inlet protection consisting of a sediment control barrier or an excavated ponding area around storm drain inlet or curb inlet; add bracing where necessary to withstand high flow volumes and depth. Inspect inlet protection after each rainfall and repair damage. Sweep up accumulated sediment and dispose of in a controlled area. Remove inlet protection after area has been stabilized with permanent vegetation.

20.5 Prevent tracking of mud and dirt from site onto paved roads. Provide stabilized vehicle access/egress points, constructed of coarse granular material. Place additional granular material as required to maintain access/egress points in proper working order. Clean mud and dirt from paved roads at end of each day by shoveling or sweeping and subsequent washing. Dispose of mud dirt in a controlled disposal area.

21 TEMPORARY DRAINAGE AND DEWATERING

21.1 Drainage lines and gutters shall be kept open at all times. No flow of water shall be directed across or over pavements except through pipes or properly constructed troughs. Keep all portions of Work properly and efficiently drained during construction and until completion. Be responsible for all disturbances, dirt and damage which may be caused by or result from water backing up or flowing over, through, from or along any part of Work, or due to operations which may cause water to flow elsewhere.

21.2 Keep trenches and other excavations free of water at all times. Employ adequate means to remove water in a manner that will prevent loss of soil and maintain the stability of excavation.

21.3 Dispose of such water in a manner that will not be dangerous to public health, private property or to any portion of Work completed or under construction, nor which causes an impediment to the use of streets by the public.

21.4 Drainage of trenches or other excavation through newly laid storm drainage pipe will be allowed only with the express permission of the authority having jurisdiction.

21.5 When drainage is directed to existing catch basins, regularly inspect and clean such catch basins of debris and sediment.

22 SNOW REMOVAL

22.1 Allow no accumulation of ice and snow on Site, and on roof deck when roofing operations are scheduled to take place.

22.2 Remove snow from access road, Site circulation paths and elsewhere as required to permit access to Work, parking and uninterrupted construction progress.

23 POLLUTION (DUST, DEBRIS, AND NOISE) CONTROL

23.1 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.

23.2 Keep premises free of waste material.

23.3 Arrange and pay for removal of all waste generated by the work in manner acceptable to authorities having jurisdiction.

23.4 Limit noise levels in accordance with requirements of authorities having jurisdiction.

23.5 Maintain temporary erosion and pollution control features installed under this contract.

23.6 Control emissions from equipment to local authorities' emission requirements.

23.7 Prevent abrasive-blasting and other extraneous materials from contaminating air beyond application area, by providing temporary enclosures.

24 **TREE PROTECTION**

24.1 Within Contractor's assigned work and storage areas and adjacent to designated access routes, protect existing trees and other plants scheduled to remain. Provide minimum 1.8 m high chain link fencing outside of dripline of trees or groups of trees and other plants.

24.2 Leave fenced areas undisturbed; do not use areas for storage, stockpiling, or any other purpose. Do not dump or flush any contaminants in areas of tree feeder roots.

24.3 Do not attach rigging cables to trees.

24.4 Where limbs or portions of plants are required to be removed to accommodate new work, they shall be removed in accordance with accepted arboricultural practice.

24.5 Where root systems of protected trees adjacent to construction are exposed or damaged, they shall be neatly trimmed, and the area backfilled with suitable material to prevent desiccation.

24.6 Where necessary give plants an overall pruning to restore the balance between roots and top growth and/or to restore appearance.

24.7 Except at locations where specific procedures are included in Contract Documents do not alter grades around existing trees/plants without first obtaining Consultant's consent and directions.

END OF SECTION

1 SPECIFIED PRODUCTS

1.1 Work of this Contract is based on Products specified by:

.1 Manufacturer's catalogued trade names and/or;

.2 References to standards (i.e. CAN, CGSB, CSA, ASTM) or;

.3 Prescriptive Specifications or;

.4 Performance Specifications.

1.2 When one or more manufacturer's trade name is specified for a Product, any one of the specified Products will be acceptable. Products by other manufacturers are subject to the Consultant's acceptance as an equivalent substitution in accordance with the specified requirements of substitutions.

1.3 When more than one manufacturer's catalogued trade name Product is specified along with a referenced standard, any one of the specified Products will be acceptable on condition the Product complies with the referenced standard.

1.4 When a Product is specified by reference to a standard only, the Contractor may select any Product that meets or exceeds the specified standard for the intended purpose. The onus shall be on the Contractor to establish that such Products meet the reference standard requirements. Products exceeding minimum requirements established by reference standards will be accepted for the Work if such Products are compatible with the Work with which they are incorporated.

1.5 When a Product is specified by prescriptive or performance Specification, any Product meeting or exceeding the Specification will be accepted.

1.6 When a Product is specified by reference to a standard or by prescriptive or performance Specification, upon request of the Consultant, obtain from the manufacturer, an independent testing laboratory report showing that the Product meets or exceeds the specified requirements.

1.7 Unless otherwise indicated in the Specifications, maintain uniformity of manufacture for any particular or like item throughout the Work.

2 SUBSTITUTIONS

2.1 Requests for substitutions will not be accepted prior to the Notification of Award. Substitutions will be considered by the Consultant provided that:

.1 The proposed substitutions have been investigated and complete data are submitted which clearly includes highlighting all aspects that meet the specifications. Consultant will only review data submitted. Incomplete data will be grounds for non-acceptance.

.2 Data relating to changes in the Contract Schedule, if any, and relation to other Work have been submitted.

.3 Same warranty is given for the substitution as for the original Product specified.

.4 All claims are waived for additional costs related to the substitution which may subsequently arise.

.5 Installation of the accepted substitution is co-ordinated into the Work and that full responsibility is assumed when substitutions affect other work. Make any necessary changes required to complete the Work. Revisions to the drawings for incorporation of the substitutions shall be made by the Consultant and all costs associated with the revisions shall be borne by the Contractor.

2.2 Substitutions to methods or process described in the Specifications or drawings, may be proposed for the consideration of the Consultant. Ensure that such substitutions are in accordance with the following requirements:

.1 Time spent by the Consultant in evaluating the substitution shall not be the basis for a claim by the Contractor for extensions to the Contract Time.

.2 Clearly indicate how the proposed substitutions would be advantageous to the Owner or in the opinion of the Contractor would improve the operation of the installation.

.3 Be responsible for substitutions to methods or processes concerning such Work and ensure that the warranty covering all parts of the Work will not be affected.

.4 The cost of all changes in the work of Other Contractors, necessitated by the substituted methods or processes, if accepted, is borne by the Contractor.

.5 The substituted methods or processes fit into space allotted for the specified methods or processes. Revisions to the drawings for incorporation of the substitutions shall be made by the Consultant and all costs associated with the revisions shall be borne by the Contractor.

2.3 Substitutions will not be considered if:

.1 They are indicated or implied on shop drawings or Product data without formal request.

.2 Acceptance will require substantial revision of the Specifications and Drawings.

2.4 Do not substitute Products or methods or processes into the Work unless such substitutions have been specifically approved for the Work by the Consultant.

2.5 Approved substituted Products shall be subject to the Consultant's inspection and testing procedures. Approved substituted Products shall only be installed after receipt of the Consultant's written approval.

2.6 The Contract Price will be adjusted accordingly to any and all credits arising from the substitutions mentioned above.

3 APPROVAL OF PRODUCTS AND INSTALLATION METHODS

3.1 Wherever in the Specifications it is specified that Products and installation methods shall meet approval of Authorities having Jurisdiction, underwriters, the Consultant, or others, such approval shall be in writing.

4 PRODUCT DELIVERY CONTROL

4.1 It is the responsibility of the Contractor to ensure that the supplier or distributor of materials specified, or alternatives accepted, which he intends to use, has materials on the site when required. The Contractor shall obtain confirmed delivery dates from the supplier.

4.2 The Contractor shall contact the Consultant immediately upon receipt of information indicating that any material or item, will not be available on time, in accordance with the original schedule, and similarly it shall be the responsibility of all subcontractors and suppliers to so inform the Contractor.

4.3 The Consultant reserves the right to receive from the Contractor at any time, upon request, copies of actual purchase or work orders of any material or products to be supplied for the work.

4.4 If materials and products have not been placed on order, the Consultant may instruct such items to be placed on order, if direct communication in writing from the manufacturer or prime suppliers is not available indicating that delivery of said material will be made in sufficient time for the orderly completion of the Work.

4.5 The Consultant's review of purchase orders or other related documentation shall in no way release the Contractor, or his subcontractors and suppliers from their responsibility for ensuring the timely ordering of all materials and items required, including the necessary expediting, to complete the work as scheduled in accordance with the Contract Documents.

4.6 In the event of failure to notify the Consultant at commencement of Work and should it subsequently appear that Work may be delayed for such reason, the Consultant reserves the right to direct the Contractor to take the following measures at no increase in Contract Price:

.1 Substitute more readily available Products of similar or better quality and character, or

.2 Temporarily install another Product until such time as the specified Product becomes available, at which time the temporarily installed product shall be removed and the specified Product installed.

5 TRADEMARKS AND LABELS

5.1 Permanent labels, trademarks and nameplates on Products are not acceptable in the finished Work, except where required by authorities having jurisdiction, for operating instructions, or when located in service rooms.

5.2 Remove trademarks and labels by grinding, if necessary, painting out where the particular surface is being painted, or if on plated parts, replace with new plain plated or non-ferrous metal parts.

6 DELIVERY, STORAGE, HANDLING AND PROTECTION

6.1 Be responsible for handling and delivery of Products. Protect Products from damage during handling, storage and installation. Deliver store and handle items in accordance with manufacturer's instructions and as specified. Be responsible for all costs of delivery, loading and off-loading, and for transportation back to its origin for correction, if required, due to damage or defect. Reject materials and Products delivered to the Site which are damaged.

6.2 Manufacture, pack, ship, deliver, and handle Products so that no damage occurs to structural qualities and finish appearance, nor in any other way which is detrimental to their function and appearance.

6.3 Ensure that Products, while transported, are not exposed to an environment which would increase their moisture content beyond the maximum specified.

6.4 Organize delivery of materials, Products and equipment to, and removal of debris and equipment from, the site and surrounding property.

6.5 Schedule early delivery of Products to enable Work to be executed without delay. Before delivery, arrange for receiving at the Place of the Work.

6.6 Coordinate mechanical and electrical equipment and apparatus deliveries with the manufacturers and suppliers such that equipment and apparatus is delivered to the site when it is required, or so that it can be stored within the building and protected from the elements.

6.7 Shop assemble work for delivery to site in size easily handled and to ensure passage through building openings.

6.8 Deliver packaged Products, in original unopened wrapping or containers, with manufacturer's seals and labels intact.

6.9 Label packaged products to describe contents, quantity, and other information as specified.

6.10 Labels attesting that materials conform to specified reference standards will be acceptable as verification that contents meet specified requirements. In the absence of labels, submit affidavits to validate conformance of Product to reference standards, as requested by the Consultant.

6.11 Label fire-rated Products to indicate Underwriters' Laboratories approval.

6.12 Handle and store materials and products in such a manner that no damage is caused to the materials and products, the Work, the site and surrounding property.

6.13 Do not obstruct or disrupt local traffic flow during construction period.

6.14 Allocate an area within the limits of the Work acceptable to the Owner for storage of Products brought to the site by all trades. Keep storage area tidy at all times and do not use other parts of the property for storage. Arrange and pay for off-site storage when required.

6.15 Locate products on site in a manner to cause minimal interference with the Work and building activities.

6.16 Store Products off the ground, in a manner to prevent damage, adulteration, deterioration and soiling to the Products, other building components, assemblies, other products, the structure, the site and surrounding property, and in accordance with manufacturer's instructions when applicable.

6.17 Store packaged or bundled Products in original and undamaged condition complete with written application instructions. Keep manufacturer's seals and labels intact. Do not remove from packaging or bundling until required in the Work.

6.18 Do not place or store materials and Products in corridors, public areas, streets, lanes, passageways or similar locations.

6.19 Store Products so as not to create any overloading conditions to any part of the building, structure, falsework, form work and scaffolding.

6.20 Store Products subject to damage from weather in weatherproof enclosures.

6.21 Store cementitious Products clear of earth or concrete floors, and away from walls.

6.22 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.

6.23 Store sheet materials and lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.

6.24 Store and handle flammable liquids and other hazardous materials in approved safety containers and as otherwise prescribed by safety authorities. Store no flammable liquids or other hazardous material in bulk within the Work.

6.25 Store and mix paints in a heated and ventilated room or area assigned for this purpose. Keep this room or area locked when unattended. Remove oily rags and other combustible debris from the Place of the Work daily. Take every precaution necessary to prevent spontaneous combustion.

6.26 Protect prefinished metal surfaces by protective coatings or wrappings until time of final clean-up specified in Section 01 74 00. Protection shall be easily removable under work of Section 01 74 00 without damage to finishes. Do not permit strippable tape or coatings to become baked on surfaces which they protect.

6.27 Touch-up damaged factory finished surfaces to Consultant's satisfaction. Use primer and paint to match original.

6.28 Protect glass and other finishes against heat, slag and weld splatter by provision on adequate shielding. Do not apply Visible markings to surfaces exposed to view in finished state or that receive transparent finishes.

6.29 Protect surfaces of completed work exposed to view from staining, disfigurement, and all other damage by restriction of access or by use of physical means suitable of the material and surface location.

6.30 Adequately protect trowelled concrete floors from damage. Take special measure when moving heavy loads or equipment on them.

6.31 Keep finished concrete floors free from oils, grease or other material likely to damage or discolour them or affect bond of applied finishes. Once building is enclosed, keep floors as dry as possible after curing.

6.32 Protect finished flooring from pedestrian traffic with reinforced kraft paper as a minimum, secured in place and with joints sealed by reinforced pressure sensitive tape. Maintain protection in place until contract completion.

6.33 Protect finished flooring from continuing construction work and delivery of products with plywood panels of minimum 6 mm thickness with joints between panels sealed with reinforced pressure sensitive tape. Maintain protection in place until work and deliveries are complete.

6.34 Make good or replace damaged materials to the satisfaction of the Consultant.

6.35 Hazardous Materials Information:

.1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and provision of material safety data sheets (MSDS) in accordance with jurisdictional authorities.

.2 Deliver copies of Material Safety Data Sheets (MSDS) to the Consultant on all Products intended for use in the Work and designated as a "controlled product."

7 MANUFACTURER'S INSTRUCTIONS

7.1 Unless otherwise indicated in the Specifications, fabricate, install, apply, connect, install, erect, use, clean, and condition Products in accordance with manufacturer's instructions except where more stringent requirements are specified. Do not rely on labels or enclosures provided with Products. Obtain written instructions directly from manufacturers.

7.2 Notify the Consultant in writing, of conflicts between the Specifications and manufacturer's instructions, so that the Consultant may establish the course of action. If requested, make a copy of those instructions available at the site.

7.3 In cases of improper installation or erection of Products, due to failure in complying with these requirements, the Consultant may direct removal and re-installation at no increase in Contract Price.

8 WORKMANSHIP

8.1 Do not employ any unfit person or anyone unskilled in their required duties. The Consultant reserves the right to require the dismissal from the Place of the Work, workers deemed incompetent, careless, insubordinate, or otherwise objectionable.

8.2 Decisions as to the quality or fitness of workmanship in cases of dispute rest solely with the Consultant, whose decision is final.

8.3 Give particular attention to finished dimensions and elevations of the Work. Make finished Work fit indicated spaces accurately. Make finished Work flush, plumb, true to lines and levels and accurate in all respects.

8.4 In finished areas, conceal pipes, ducts, conduit and wiring in floors, walls, ceilings, chases, or behind furring except were indicated otherwise.

8.5 Ensure that service poles, fill-pipes, vents, regulators, meters and similar service installations are located in inconspicuous locations. If not indicated on drawings, verify location of service installations with Consultant prior to commencing installation.

8.6 Ensure that integrity of fire separations is maintained where they are penetrated.

8.7 Finish access panels and doors to match adjacent wall and/or ceiling finish unless otherwise specified or indicated.

8.8 Keep surfaces, on which finished materials will be applied, free from grease, oil, and other contamination which would be detrimental in any way to the application of finish materials.

8.9 Enforce fire prevention methods at site. Do not permit fires, open flame heating devices or accumulation or debris. Use flammable materials only if all safety precautions are taken. Provide and maintain in working order ULC labelled fire extinguishers of types suitable for fire hazard in each case, and locate them in prominent location and to approval of jurisdictional authorities.

8.10 Where flammable materials are being applied, ensure that adequate ventilation is provided, spark-proof equipment is used, and smoking and open flames are prohibited.

9 **DIMENSIONS**

9.1 Check all dimensions at the site before fabrication and installation commences and report discrepancies to the Consultant.

9.2 Where dimensions are not available before fabrication commences, ensure that dimensions required are agreed upon between the parties concerned.

9.3 Prior to commencing work, ensure that clearances required by jurisdictional authorities can be maintained.

9.4 Wall thicknesses and openings shown on the drawings may be nominal only; ascertain actual sizes at the site.

9.5 Verify dimensions of shop fabricated portions of the Work at the site before shop drawings and fabrications are commenced. The Owner will not accept claims for extra expense by reason of non-compliance with this requirement.

9.6 Fabricate and erect manufactured items, shop fabricated items, and items fabricated on or off site, to suit site dimensions and site conditions.

9.7 In areas where equipment is to be installed, check dimensional data on equipment to ensure that area and equipment dimensions are compatible with necessary access and clearance provided. Ensure that equipment supplied is dimensionally suitable for space provided.

9.8 The mechanical and electrical drawings are intended to show approximate locations of mechanical apparatus, fixtures, equipment, piping and duct runs, electrical apparatus, fixtures, outlets, equipment, units, and conduit in diagrammatic form and wherein the mechanical and electrical items are not dimensioned, consider their locations to be approximate. Check the drawings and confer with the Consultant to settle the actual locations of these items as may be required to suit aesthetic and site conditions. Such relocation shall be done without change to the Contract Price.

9.9 Leave areas clear where space is indicated to be reserved for future equipment, including access to such future equipment.

9.10 Whether shown on the Drawings or not, leave adequate space and provision for servicing of equipment and removal and reinstallation of replaceable items such as motors, coils and tubes.

10 RELOCATION OF MECHANICAL AND ELECTRICAL ITEMS

10.1 The Owner and the Consultant reserve the right to relocate outlets at a later date, but prior to installation, without additional cost to Owner, assuming that the relocation per outlet does not exceed 3000 mm from the original location. No credits will be anticipated where relocation per outlet of up to and including 3000 mm reduces materials, products and labour.

10.2 Should relocations per outlet exceed 3000 mm from the original location the Contract Price will be adjusted in accordance with the provisions for changes in the Contract Documents.

10.3 Alter the location of pipes and other equipment, without additional cost to the Owner, if approved, provided the change is made before installation.

10.4 Make necessary changes, due to lack of coordination, as required and when approved, at no additional cost, to accommodate structural and building conditions.

11 EXPANSION, CONTRACTION, AND DEFLECTION

11.1 Conform to manufacturer's recommended installation temperatures. If items, components, assemblies, systems, and finishes are installed at temperatures different from operation or service temperatures, make provisions for expansion and contraction in service as acceptable to manufacturer and consultant. Repair all resulting damage should expansion and contraction provisions provide inadequate.

11.2 Make provisions for expansion and contraction due to temperature changes within components, Products and assemblies, and between adjacent components, Products and assemblies, and due to building movements including but not limited to creep, column shortening, deflection, sway and twist. Ensure provisions for expansion, contraction and building movements prevent damages from occurring to and within components, Products and assemblies.

11.3 Make adequate allowance at wall and partition heads for deflection of the structure above. Determine requirements from Consultant where additional information is required. Where partitions butt to underside of floor assembly, or structural framing, the clearance shall be based on the span of the members supporting the floor or structural framing. In making such allowance use methods which maintain the integrity of the wall or partition as a sound, and/or fire barrier.

11.4 Make provisions in pipes, plenums, ducts, and vessels containing air and fluids as is necessary to prevent damage due to fluid and air induced pressure, surges and vibrations, to pipes, plenums, ducts and vessels and to adjacent components, assemblies and construction to which pipes, ducts, plenums and vessels are attached or pass through.

12 DIELECTRIC SEPARATION

12.1 Ensure that a dielectric separator is provided in a permanent manner over entire contact surfaces to prevent electrolytic action (galvanic corrosion) between dissimilar materials. Similarly, prevent corrosion to aluminium in contact with alkaline materials such as contained in cementitious materials.

13 PRODUCTS AT SOUND ATTENUATING PARTITIONS

13.1 Avoid sound transfer at sound attenuating partitions by careful location and treatment of mechanical and electrical equipment, ducts, grilles, diffusers, electrical outlets and boxes, and similar items. Where electrical boxes are back-to-back, serving each side, locate them at least 250 mm apart laterally and, if interconnected, use flexible connections.

14 FASTENINGS

14.1 Include in the work of each section necessary fastenings, anchors, inserts, attachment accessories, and adhesives. Where installation of devices is in work or other sections, deliver and locate devices in ample time for installation.

14.2 Do not install fibre, plastic or wood plugs or blocking for fastenings in masonry, concrete, or metal construction, unless specified or indicated on drawings.

14.3 Install work with fastenings or adhesives in sufficient quantity to ensure permanent secure anchorage of materials, construction, components and equipment under static conditions, and to resist building thermal movement, creep and vibration.

14.4 Provide metal fastenings and accessories in same material, texture, colour, sheen and finish as metal on which they occur, unless indicated otherwise.

14.5 Prevent electrolytic action between dissimilar metals and materials.

14.6 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior Work, and where attached to, or contained within, exterior walls and slabs, unless stainless steel or other material is specified. Leave steel anchors bare where cast in concrete.

14.7 Space anchors within their load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.

14.8 Conceal fasteners where indicated. Keep exposed fastenings to a minimum, space evenly and in an organized symmetrical pattern.

14.9 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

14.10 Powder Actuated Fastenings:

.1 Do not use powder actuated fasteners for the support of ceilings.

.2 Do not use powder actuated fastenings on any portion of the Work, unless written consent for a specific use is obtained from the Consultant.

.3 Only low velocity tools will be permitted under any condition. Operators to be qualified and to be in possession of a valid operator's certificate.

15 **ADJUSTING**

15.1 Ensure that all components of assemblies fit snugly, accurately and in true planes, and that moving parts operate positively and freely, without binding and scraping.

15.2 Verify that work functions properly and adjust it accordingly to ensure satisfactory operation. Lubricate Products as recommended by manufacturer.

END OF SECTION

1 DEMONSTRATION AND INSPECTION OF PRODUCTS AND SYSTEMS

1.1 Arrange for a demonstration of systems and operating Products upon the 100% completion of their installation and prior to certification for Substantial Performance.

1.2 Include in the arrangements for the attendance of the Consultant, Owner, jurisdictional authorities, and personnel assigned by the Owner for the operation of the systems and/or Products.

1.3 Demonstrations shall be conducted by the Subcontractor responsible for the installation of the systems and/or Product, assisted by representatives of the manufacturer or supplier. All personnel conducting the demonstration shall be completely knowledgeable of all conditions of the operating, functioning and maintenance of the systems and/or Products.

1.4 Owner's representative will acknowledge the successful completion of each demonstration on a form provided by the Contractor. The form shall be agreed to by the Owner, Consultant and Contractor prior to demonstration and testing.

1.5 Submit copies of letters from manufacturers of Systems and/or Products before making application for certificate of Substantial Performance to verify that the Products has been installed and connected correctly, and that it is operating in a satisfactory manner. The certification shall be based upon inspection and testing of the Products by competent technical personnel. Include in letter of certification the names of personnel conducting the testing and inspection, the methods of inspection utilized, and the location in the building of the Products certified.

1.6 Following submission of letters of certification and their acceptance by the Owner, the owner shall have the right to use the Products on a trial basis and for instructing their personnel in its use.

2 FINAL INSPECTIONS AND CLOSE OUT

2.1 Submit proposed closeout procedures and schedule of inspection to Owner & Consultant for approval before final demonstrations and inspections commence.

2.2 Submit layout and survey requirements required by Owner and Authorities having jurisdiction.

2.3 Arrange for, conduct, and document final demonstrations, inspections, close-out, and take-over at completion of the Work in accordance with procedures described in OAA/OGCA TAKE-OVER PROCEDURES, OAA/OGCA Document No. 100. Where "Architect" is referred to in Document No. 100 it shall mean Consultant.

3 CERTIFICATE OF COMPLIANCE

3.1 Submit Certificates of Compliance, prior to the application for Substantial Performance, for each of the following items.

.1 An affidavit relative to the use of lead-free solder for all domestic water lines, regardless of location.

.2 Products for which Material Safety Data Sheets have been submitted and accepted.

.3 Other Work/Products identified in the Contract Documents as requiring a Certificate of Compliance.

3.2 Each Certificate of Compliance shall indicate names and addresses of the project, the Owner, the date of issue, product description including name, number, manufacturer, with a statement verifying that the Work/Product installed meets specified requirements and, if applicable, complies with the submitted and accepted Material Safety Data Sheets.

3.3 Each Certificate of compliance shall be issued on the subcontractor's letterhead, properly executed, under whose work the prospective Work/Product has been provided.

3.4 Each Certificate of Compliance shall be endorsed by the Contractor with his authorized stamp/signature. Ensure that submissions are made to allow sufficient time for review without delaying progress of scheduled completion.

END OF SECTION

1 LAYOUT AND SURVEY

1.1 Existing grades, lines, and site conditions shown on drawings were taken from survey information established by persons engaged directly by the Owner. The accuracy of survey information is not the Consultant's responsibility. The Contractor will establish location of property lines.

1.2 Be responsible for setting out the Work. Prior to setting out the Work, verify dimensions and elevations shown on the Contract Documents and report to the Consultant any unsatisfactory conditions that may adversely affect the proper completion of the Work.

1.3 Set up and maintain permanent reference points and be responsible for the accuracy of such reference points. Establish lines and levels required for the performance of the Work.

1.4 Accurately set out the Work from levels and lines. Where Work of this Contract is dependent upon grades and elevations of existing structures or facilities, such grades or elevations shall take precedence over those determined by reference to established elevations. Advise the Consultant of any discrepancies.

1.5 During any activity of the Work, employ a Land surveyor licensed to practice in the place of Work to layout and check all features, including but not limited to the following:

.1 Lay out building on the Site.

.2 Establish a permanent benchmark, or markers as widely separated as possible.

.3 Establish and maintain temporary benchmarks set in suitable locations.

.4 Provide general dimensions, lines and elevations required by Subcontractors.

.5 Verify elevations of floor and roof levels as construction proceeds and relate to benchmark datum.

.6 Verify that present or known future restrictions are not violated by construction on the site or lines of traverse to all public utilities.

.7 Correlate geodetic elevation of benchmark datum with elevations in use by public utilities adjacent to Project.

.8 Verify accuracy of site dimensions shown on Drawings.

.9 Provide a survey to verify location of footings immediately adjacent to property lines before construction of footings proceeds.

.10 Provide a survey to verify location of building related to property lines when foundation walls are completed to grade level.

.11 Provide a survey prior to placement of asphalt and concrete paving to confirm that grades conform to grades indicated on drawings.

.12 Provide a survey to verify location of completed building on Site.

1.6 Examine, preserve, and protect established benchmarks. Re-establish a lost or displaced benchmark by a Land Surveyor licensed to practice in the place of Work at no cost to the Owner. Accept responsibility for setting out the Work.

1.7 In the event of a discrepancy between the Owner and the Contractor regarding horizontal and/or vertical alignment conditions, that are beyond allowable specified tolerance, the Owner may engage the services of an independent Land Surveyor. The surveyor shall investigate the disputed condition and the results of the independent investigation shall determine the bearer of costs for this service, being either the Owner or the Contractor.

1.8 If the Contractor is found to be in error, all costs incurred to correct the condition shall be assumed by the Contractor.

END OF SECTION

1 PROGRESS CLEANING

1.1 Remove from finish work, spatters, droppings, soil, labels, and debris, before they set up.

1.2 Ensure that only cleaning materials are used which are recommended for the purpose by both the manufacturer of the surface to be cleaned and of the cleaning material.

1.3 Maintain building work areas "broom clean" at least on a daily basis but shall also be done immediately before finishing work.

1.4 No waste material may be burned or buried at site. Remove as often as required to avoid accumulation, no less than, at the end of each working day.

1.5 Remove packaging materials and debris from the site immediately after product and equipment is unwrapped or uncrated.

1.6 Ensure that volatile fluid wastes are not disposed of in storm or sanitary sewers, in open drain courses, or anywhere on site.

1.7 Do not allow waste material and debris to accumulate in an unsightly or hazardous manner. Sprinkle dusty accumulations with water. Provide containers in which to collect waste material and debris. Dispose of hazardous products in accordance with requirements of jurisdictional authorities.

1.8 Conform to Regulatory Requirements article, in Quality Requirements, Section 01 40 00.

1.9 Ensure that cleaning operations are scheduled to avoid deposits, of dust or other foreign matter on surfaces during finishing work and until wet or tacky surfaces are cured.

1.10 Provide instructions for final cleaning of finishing work, and for inclusion in Maintenance and Operating Manuals.

2 FINAL CLEANING

2.1 Before final inspection, replace glass and mirrors broken, damaged, and etched during construction, or which are otherwise defective.

2.2 In addition to requirements for progress cleaning, Work shall include final cleaning by skilled cleaning specialists on completion of construction.

2.3 Remove temporary protections and make good defects before commencement of final cleaning.

2.4 Final cleaning shall remove dust, stains, paint spots, soil, grease, fingerprints, and accumulations of construction materials, interior and exterior to the building for all new work throughout new and existing Building. Work shall be done in accordance with manufacturer's instructions for each material. This work shall include:

.1 Washing of exterior paved surfaces, and of interior stone, brick, and concrete floors.

.2 Cleaning and polishing of glass, mirrors, porcelain, enamel, and finish metals.

.3 Vacuum cleaning of ceilings, walls, and floors.

.4 Cleaning and polishing of terrazzo and ceramic and/or quarry tile floors.

.5 Cleaning of resilient flooring.

.6 Buffing of resilient flooring followed by two light coats of wax, each buffed.

.7 Washing clean of glazed wall surfaces.

.8 Cleaning of hardware, mechanical fixtures, plumbing fixtures, lighting fixtures, cover plates, and equipment, including polishing of their finish metal, porcelain, vitreous, and glass components.

.9 Cleaning of windows and entrances, both interior and exterior surfaces.

2.5 Maintain cleaning until Owner has taken possession of building or portions thereof.

END OF SECTION

1 GENERAL

1.1 Hand over to the Consultant three (3) copies of a comprehensive operations and maintenance manual and material suitable for the Owner's maintenance employees. Manuals shall cover all Products supplied and installed under the Contract.

1.2 Submit draft of the operation and maintenance manuals for the Owner's review at least 15 days before testing systems and equipment. Incorporate alterations and additions, as found to be necessary during testing, and prepare the final version of the manual from the corrected draft.

1.3 Submit final version of operation and maintenance manuals prior to Contract Completion.

1.4 Testing of systems and equipment will not be deemed to be complete until the requisite number of copies of the final version of the manuals has been handed over to the Owner.

1.5 If standard literature is incorporated into the operations and maintenance manual, any irrelevant information shall be deleted, or suitably noted.

1.6 The manuals shall have sufficient detail in order that the Owner can totally maintain the equipment without outside help.

1.7 Submit all material in English.

2 FORMAT

2.1 Organize data in the form of an instructional manual. (The Owner may accept a digital copy of all data in PDF format)

2.2 Binders: Commercial quality, 219 x 279 mm, maximum "D" ring size.
See above exemption in 2.1, if Owner accepts digital copy.

2.3 When multiple binders are used, correlate data into related consistent groupings.

2.4 Cover: Identify each binder with type or printed title "Contract Record Documents"; list title of Contract, identify subject matter of contents.

2.5 Arrange content by systems or process flow, under Section numbers and sequence of Table of Contents.

2.6 Provide tabbed fly leaf for each separate Product and system, with typed description of Product and major component parts of equipment.

2.7 Text: Manufacturer's printed data, or typewritten data on 20-pound paper.

2.8 Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

3 **CONTENTS**

3.1 Operation and maintenance manuals shall contain the following minimum information and data:

.1 Table of contents: Provide title of Contract; names, addresses, and telephone numbers of Consultants and Contractor with name of responsible parties; schedule of Products and systems, indexed to content of the volume.

.2 For each Product or system: List names, addresses and telephone numbers of Subcontractors, suppliers and service representatives, including local source of replacement supplies and parts including telephone numbers.

.3 Warranties: Warranties are between the Contractor and Owner. Warranties shall include, as a minimum:
- .1 Description of warranty coverage.
- .2 Date warranty starts (being date of Contract Completion).
- .3 Date warranty expires.
- .4 Contact name, address and phone number (the Contractor shall also be responsible for advising the Owner of changes in contact information during the warranty period).
- .5 Equipment and components performance curves.
- .6 Hydro certificates.

.4 Reports: For each Product or system provide the following:
- .1 Manufacturer's certified reports
- .2 Factory test reports.
- .3 Field testing reports.

.5 Details of design, construction and/or fabrication features, component function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of any portion or feature of the installation.

.6 Technical data, Product data, supplemented by bulletins, component illustrations, detailed views, technical descriptions of items and parts lists.

.7 Schematics, interconnection lists: Manuals shall be complete with schematic and wiring diagrams, wiring interconnection lists and diagrams fully cross referenced and coordinated, printed circuit board layouts including the component identification, component parts list with electronic substitution equivalent. Provide cross referenced components lists and sequence of operations.

.8 Trouble shooting and fault location guide: Instructions to facilitate quick return of malfunctioning equipment to operation.

.9 Routine servicing and preventative maintenance schedule for Products and/or estimated hours required for routine servicing and preventative maintenance tasks.

.10 List of recommended spare parts and recommended quantity of each item to be stocked based on spare part availability and re-order time.

.11 Complete set of reviewed shop drawings.

.12 Product data: Mark each sheet to clearly identify specific Products and component parts, and data applicable to installation; delete inapplicable information.

.13 Drawings: Supplement Product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams and as required in the Specifications.

.14 Typed text: As required to supplement Product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions and as required in the Specification.

4 DRAWINGS

4.1 Prepare all required drawings on CAD, using Autocad/Revit. Autocad/Revit version to suite Owner’s CAD/Revit requirements.

4.2 Prepare CAD drawings to meet the requirements of the Owners or Consultant’s CAD/Revit Standards and Procedures.

4.3 Supply and hand over to the Consultant, one original photographic reproduction for each final drawing prepared under this Contract, including but not limited to circuit drawings, equipment layout drawings, and shop drawings.

4.4 Prior to Contract Completion, supply and hand over to the Consultant, one complete set of CAD Drawing Files in Autocad/Revit format on compact disk (CD), or USB stick, or electronic means (zip file), for each final drawing prepared under this Contract and one complete 11" x 17" hard copy set, including but not limited to circuit drawings, equipment layout drawings, and shop drawings.

4.5 Text files shall be written in word processing program acceptable to Owner.

5 TRANSMITTAL

5.1 Forward storage media to the Owner through the Consultant with a transmittal form. Transmittal shall contain the list of file names contained on the storage media.

5.2 Data forwarded to the Owner shall contain the following files in addition to the design information:

.1 Library parts/cells used in the design files.

.2 Level convention used for each design file.

.3 Plotting instructions used to prepare hard copies including colour tables, pen tables and plot scale.

.4 Working units of the design files.

.5 Font library, if the standard is not used.

END OF SECTION

1 PROGRESS RECORDS

1.1 Maintain on site, permanent written records of daily progress of the Work. Records shall be always open to review by Consultant and Owner and a copy shall be furnished to the Consultant on a weekly basis.

1.2 Records shall show dates of commencement, progress and completion of various trades and items of work. Particulars pertaining to number of employees of various trades and type and quantity of equipment employed daily, temperature, protection methods and other such data shall be noted.

2 AS-BUILT DRAWINGS

2.1 Authorized deviations from drawings shall be marked in red accurately on one set of drawing prints in a neat, legibly printed manner and shall be dated. Prior to final inspection, neatly transfer the recorded information to a second set of drawing prints of the most recent revision to the drawings and submit both sets to the Consultant.

2.2 Maintain as-built drawings up to date as Work progresses. Status of maintained as-built drawings may be considered as a condition for validation of applications for payment.

2.3 Identify each as-built drawing as "As-Built Copy" and maintain the as-built drawings in good condition. Make as-built drawings available to the Consultant at all times.

2.4 As-built drawings shall include accurate dimensioned record of deviations and changes in Work from drawings.

2.5 As-built drawings shall be signed and dated by Contractor.

2.6 Submit as-built drawing to Consultant for review and make corrections as directed by Consultant.

2.7 Record accurately all deviations in the Work.

2.8 Accurately record locations of concealed structure, mechanical and electrical services, and similar Work not clearly in view, the location of which is required for maintenance, alteration Work and future additions. Do not conceal such Work until the location has been recorded.

2.9 Accurately record locations of equipment bases, anchors, concrete pads and roof curbs, sleeves, piping, conduits, ducts, maintenance holes and valves, etc. located either below, outside or within structure.

2.10 Where piping, conduits and ducts are underground, underfloor, embedded in concrete or otherwise in inaccessible locations, accurately record with respect to structure column lines or walls and elevations with respect to finished floor levels or grades referenced to the centre line of components.

2.11 Accurately record any components which will be in inaccessible locations for Consultant's review before the component is covered, or buried, or made inaccessible.

2.12 CAD or REVIT drawings of Contract Drawings can be obtained/purchased from Architect at a cost of $1,500 plus HST per set of consultants individual set of plans as determined by the Architect.
Floor plans, elevations and sections are considered as 3 separate sets of plans.

2.13 Clearly and prominently mark each drawing “AS-BUILT DRAWING prepared by _____ (name of Contractor)”

END OF SECTION

1 GEOTECHNICAL INFORMATION

1.1 A copy of the following detailed geotechnical information is appended to this Document:

.1 Report On
Geotechnical Investigation
Proposed Fire Station # 4
Alternative Location At The East Side Of The Property
Located At 6365 14th Line, Alliston, Ontario
Prepared by: Sirati & Partners Consultants Ltd.
Report No. SP19-463-10-A1-R4
Dated: August 30, 2023

1.2 This geotechnical information records properties of subsurface conditions and recommendations for the design of foundations, pavements and soil remediation as outlined in the information provided.

1.3 The geotechnical information by its nature, cannot reveal all conditions that exist or can occur on the Site. Should subsurface conditions be found to vary substantially from the report, immediately notify Consultant in writing and await instructions.

1.4 Contractor shall not be entitled to extra payment or extension of Contract Time for work, which is required, and which is reasonably inferable in the geotechnical information as being necessary.

1.5 In case of discrepancies between recommendations contained in geotechnical information and requirements of Contract Documents, the latter shall govern. Advise Consultant in writing of any discrepancies discovered.

2 REPORT

2.1 A copy of the following report is appended to this Document:

.1 Storm Water Management Design Brief
New Development Drainage System
6365 14th Line
New Tecumseth, Ontario
Prepared by: Hallex Engineering Ltd.
Dated: September 13, 2023 - Rev 4.

2.2 The report, by its nature, cannot reveal all conditions that exist or can occur on the site. Should conditions be found to vary substantially from the report, immediately notify Consultant in writing and await instructions.

2.3 Contractor shall not be entitled to extra payment or extension of Contract Time for work, which is required, and which is reasonably inferable in the report as being necessary.

END OF DOCUMENT

REPORT ON
GEOTECHNICAL INVESTIGATION
PROPOSED FIRE STATION # 4

ALTERNATIVE LOCATION AT THE EAST SIDE OF THE PROPERTY
LOCATED AT 6365 14TH LINE, NEW TECUMSETH, ONTARIO
NORTH PART LOT 8 CONCESSION 13, PART 1 & 3 OF 51R26286

Prepared for:

THE CORPORATION OF THE TOWN OF NEW TECUMSETH

Prepared By:

SIRATI & PARTNERS CONSULTANTS LTD

Geotechnical Hydrogeological & Environmental Solutions

Project: SP19-463-10-A1-R4
August 30, 2023

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APPENDIX D: LIMITATIONS OF REPORT

1. INTRODUCTION

Sirati & Partners Consultants Ltd. (SIRATI) was retained by The Corporation of the Town of New Tecumseth (the Client) to undertake a geotechnical investigation for the proposed Fire Station No. 4 at the easterly portion of the property at 6365 14th Line in New Tecumseth, Ontario (the site or subject site) with the legal description of North Part Lot 8 Concession 13, Part 1 & 3 of 51R26286.

Copies of the proposed site plan and tentative borehole location plan prepared by Alaimo Architecture Inc. (titled "ALT. BH. LOCATIONS EAST SIDE" dated 2019-09-06), were provided to SIRATI.

SIRATI initially conducted a preliminary geotechnical investigation for the Fire Station proposed to be located on the westerly side of the property, the results of which were reported as:

Ref. 1: "Draft Report on Preliminary Geotechnical Investigation, Proposed Fire Station, 6365 14th Line, New Tecumseth, Ontario", SP19-463-10-R1 Dated November 12, 2019.

Due to the unfavorable site condition revealed during the field investigation, the Client decided to relocate the proposed development to the easterly portion of the property. This geotechnical investigation report will address geotechnical concerns pertinent to the proposed fire station construction on the easterly portion of the site, as well as a gravel access road on the westerly portion of the site.

The proposed new fire station #4 consists of a station building that has a single storey, slab-on-grade structure, new access road, parking spots, driveways, storage shed and parking stalls. It is understood that a stormwater management pond is proposed to be constructed south of the property. However, at the time of preparing this proposal no information about the pond was provided to SIRATI.

The purpose of the geotechnical investigation was to determine the subsurface conditions at twenty-three (23) borehole locations selected by the Client. This report summarizes the findings of geotechnical investigation, recommendations and design parameters as required for the proposed development.

In addition to the borehole investigations, SIRATI carried out slug tests in the installed monitoring wells, as well as Guelph permeameter tests, the results of which are presented in this report.

This report supersedes previous draft geotechnical investigation referenced above and is provided based on the terms of reference presented herein and, on the assumption, that the design will be in accordance with the applicable codes and standards. If there are any changes in the design features relevant to the geotechnical analyses, or if any questions arise concerning the geotechnical aspects of the codes and standards, this office should be contacted to review the design. It may then be necessary to carry out additional borings and reporting before the recommendations of this office can be relied upon.

The site investigation and recommendations follow generally accepted practice for geotechnical consultants in Ontario. The format and contents are guided by client specific needs and economics and do not conform to generalized standards for services. Laboratory testing for most part follows ASTM or CSA Standards or modifications of these standards that have become standard practice.

This report has been prepared for the Corporation of the Town of New Tecumseth and their Architect and designers. Third party use of this report without Sirati & Partners Consultants Limited (SIRATI) consent is prohibited. The limitations presented in **Appendix D** form an integral part of the report and they must be considered in conjunction with this report.

2. FIELD AND LABORATORY WORK

Twenty-three (23) boreholes were drilled at the site to depths ranging from 3.5 m to 12.5 m. The boreholes were drilled with hollow/solid stem continuous flight auger equipment by a drilling sub-contractor under the direction and supervision of SIRATI personnel. Samples were retrieved at regular intervals with a 50 mm O.D. split-barrel sampler driven with a hammer weighing 624 N and dropping 760 mm in accordance with the Standard Penetration Test (SPT) method. The field work was carried out in accordance with the ASTM D 1586-11 test method "The Standard Method of Standard Penetration Testing (SPT)".

All soil samples were logged in the field and returned to SIRATI's laboratory in King City for detailed examination by the project engineer and subsequent laboratory testing.

As well as visual examination in the laboratory, all the soil samples were tested for moisture content. Six (6) representative soil samples were subjected to grain size and hydrometer analyses and (2) soil sample was subjected to Atterberg limit test. The soil laboratory test results are presented on the respective borehole logs and in Drawing Nos. 26 to 28 (pending).

Water level observations were made during drilling and in the open boreholes upon completion of the drilling operations. Monitoring wells were installed at three (3) borehole locations (BH105, BH114 and BH121) for long-term (stabilized) groundwater level monitoring.

The elevations at the drilled borehole locations were surveyed by SIRATI personnel using differential GPS system and varied from 220.1 m to 222.9 m.

3. SUBSURFACE CONDITIONS

The borehole locations are shown on Drawing 1. Notes on sample descriptions and the general features of fill material and glacial till are presented on Drawing 1A. Detailed subsurface conditions are presented on the Borehole Logs, Drawings 2 to 25. The soil and groundwater conditions are summarized as follows. The borehole logs related to the investigation carried out on the western portion of the property are presented in **Appendix B**.

3.1 SOIL CONDITIONS

Topsoil: A surficial layer of topsoil was encountered in BHs 101, 103, 104, 106 through 113, 115 through 118, 120 and 121. The thickness of topsoil was measured to vary from 75 mm to 400 mm, at the above borehole locations. The thickness of the topsoil in each borehole is presented in the respective borehole logs.

It should be noted that the thickness of the topsoil explored at the borehole locations may not be representative for the entire site and should not be relied on to calculate the amount of topsoil to be stripped off the site.

Pavement: A total of three boreholes, BH119, BH122, and BH123 were advanced through the existing asphalt pavement, connecting 14th line to the Town Depot, south of the property. The boreholes revealed a pavement structure consisting of 75 mm asphalt, underlain by 100 mm to 200 mm of granular fill.

Variable Fill: A layer of fill material was encountered directly below the topsoil or pavement layer in all boreholes. Fill material generally consists of silty sand, sandy silt, silt, sand and clayey silt to silty clay with trace topsoil inclusion.

The fill material extends between 1.5 to 2.3 mbgs. The measured SPT 'N' values in the fill material ranged from 2 to 16 blows for 300 mm sampler penetration, indicating its loosely to moderately compacted state. Higher blow counts were, however, observed in the granular base/subbase material for the boreholes advanced from the existing road.

The thickness of the fill material in each borehole is presented in the respective borehole logs. It should be noted that the thickness of the fill material explored at the borehole locations may not be representative for the entire site and should not be relied on to calculate the amount of fill to be excavated at the site.

Cohesive Soil Layer: A layer of cohesive soils comprising silty clay and clayey silt was locally observed in BH105 and BH109 from 6.1 m to 7.6 m and in BH110 from 4.6 m to 6.1 m. The SPT 'N' values were recorded ranging between 6 and 12 blows per 300 mm penetration, indicating a firm to stiff consistency of the soil.

Cohesionless Soil Deposit: Cohesionless soil deposit consisting of silty sand, sandy silt, silt and sand were encountered underlaying the fill material and cohesive soil layer. Lenses of cohesionless soils were also encountered within the till deposits.

The SPT 'N' values were recorded ranging between 5 and 31 blows per 300 mm penetration, indicating a loose to dense condition of the soil.

Glacial Till Deposit: The glacial till deposit consisting silty clay till and silty sand till were encountered underlaying the cohesionless soil deposits. All boreholes were terminated in glacial till deposit.

During the split spoon sampling, the SPT 'N' values were recorded in glacial deposit ranging from 6 to 92 blows per 300 mm penetration and at some locations greater than 50 blows per 300 mm penetration (in multiple boreholes), indicating a firm to hard/loose to very dense consistency/compactness.

3.2 GROUNDWATER CONDITIONS

During drilling, ingress water entering the open boreholes was observed at several borehole locations resulting in soil caving in the walls of the unlined boreholes Wet layers were encountered at depths ranging from 1.8 m to 3 m.

The stabilized groundwater table observed on October 15, in the monitoring wells at 2.5 m depth before existing grade, corresponding to elevations ranging from 217.6 m to 217.7 m, as listed on **Table 1**. This is in general agreement with the groundwater elevation observed in the two monitoring wells within the western portion of the property, where the water level was measured to be at 218.0 m to 218.1 m on August 8, 2019.

Table 1: Groundwater Levels Observed in Monitoring Wells

BH/MW No.	Date of Drilling	Date of Observation	Depth of Groundwater below existing ground (m)	Elevation of Groundwater (m)
BH/MW-105	October 2, 2019	October 15, 2019	2.5	217.6
BH/MW-114	October 2, 2019	October 15, 2019	2.5	217.7
BH/MW-121	October 2, 2019	October 15, 2019	2.5	217.6

It should be noted that the groundwater levels can vary and are subject to seasonal fluctuations in response to major weather events.

4. DISCUSSION AND RECOMMENDATIONS

It is understood that the proposed development consists of a single story, slab-on-grade structure with adjoining driveways and parking lot. This geotechnical investigation report is based on the factual data collected during the field investigation.

4.1 ROADS & PAVEMENT

The investigation has shown that the natural subgrade soil below the surficial fill, pavement and/or topsoil is fine-grained silt or sand. Both are highly frost susceptible. Given that the groundwater level is at about elevation 217.6 m and the final road grade will be at about elevation 220.6, a 3 m capillary rise in the natural soil is quite possible. For this reason, the total pavement structure thickness needs to be about 1000 mm (total of all layer thicknesses), representing about 70-75% of the average frost penetration depth for the Alliston area.

The following pavement structure design is recommended to accommodate the heaviest of fire- trucks and associated equipment (rear axle of 64,000 lbs.):

- 50 mm HL3 surface course (92% of MRD)
- 120 mm HL8 binder course – in 2 layers 60 mm each (92% of MRD)
- 200 mm Granular A base course (100% SPMDD or 98% Modified PMDD)
- 630 mm Granular B or equivalent sub-base course (98% SPMDD) that could include recycled materials if in stock or available nearby, or a basal layer of 300 mm of coarsely graded sand placed on the natural subgrade overlain with 330 mm of compacted Granular B prior to placing the Granular A.

If there is assurance that the heaviest equipment will not use the pavement, the binder course (HL8) thickness can be reduced to 100 mm, such as for rear axles of maximum 50,000 lbs.

As this is a Fire Station, and equipment must travel where it must, without regard for which route is heavy-duty and which is not, it makes logical sense to adopt the above design for all routes and parking areas. The extra cost of 20 mm of binder course is a non-issue when compared with pavement service life and less frequent need for maintenance, from a life cycle cost point of view.

The recommended grade of asphalt cement is PG64-28.

All materials should satisfy OPSS requirements for quality, placement, compaction and finished surface smoothness.

Tack coating should be applied to all exposed asphaltic concrete surfaces that have cooled down to ambient temperature prior to placing the next course. Power washing or brooming (as appropriate) is recommended to remove dirt prior to tack coat applications.

Gravel Access Roads:

It is understood that a gravel access road is going to be constructed south of the proposed Fire Station, providing access to the soccer fields. The following pavement structure is recommended for the proposed gravel road:

- 200 mm Granular ‘A’ or equivalent (100 % SPMDD)
- 500 mm Granular ‘B’ or equivalent (98% SPMDD)

New Access Road to the Town Depot:

A new paved road is proposed to be constructed west of the property, approximately along BHs 3, 17 and 19, connecting the Town Depot to 14th Line. The following pavement structure is recommended for the proposed new road:

- 40 mm HL3 Asphaltic Concrete (92% of MRD)
- 80 mm HL8 Asphaltic Concrete (92% of MRD)
- 200 mm Granular 'A' (100% SPMDD)
- 400 mm Granular 'B' (100% SPMDD)

These values may need to be adjusted according to the Town of New Tecumseth Standards. The pavement structure recommended above assumes that the subgrade has sufficient bearing capacity to accommodate the applied pavement structure and local traffic. The site subgrade and weather conditions (i.e. if wet) at the time of construction may necessitate the placement of thicker granular sub-base layer in order to facilitate construction. Furthermore, heavy construction equipment may have to be kept off the newly prepared road subgrade before the placement of asphalt and/or immediately thereafter, to avoid damaging the subgrade by heavy truck traffic.

Existing Access Road: The existing pavement structure explored at the three (3) borehole locations, BHs 119, 122 and 123, is inadequate to support the heavy-duty traffic accessing the Town Depot. The pavement structure deficiencies are as follows:

- HMA thickness is deficient throughout the roadway
- Granular base and sub-base thickness are deficient throughout the roadway
- Subgrade condition was found to be loose at BH121 location

Reconstruction of existing access road is required, if the roadway is to be used for heavy traffic. The road makeup provided above for fire routes could be used for reconstruction. The drainage ditching on either side of shoulders need to be improved such that base course and sub-base course daylight into the ditch side slopes.

4.1.1 Stripping, Sub-excavation and Grading

The site should be stripped of all topsoil, wet, loose, weathered/disturbed soils and any organic or otherwise unsuitable soils to the full depth of the roads, both in cut and fill areas.

Following stripping, the site should be graded to the subgrade level and approved. The subgrade should then be proof-rolled, in the presence of the Geotechnical Engineer, by at least several passes of a heavy compactor having a rated capacity of at least 10 tons. Any soft spots thus exposed should be removed and replaced by select fill material, similar to the existing subgrade soil and approved by the Geotechnical Engineer. The subgrade should then be recompacted from the surface to at least 98% of its Standard Proctor Maximum Dry Density (SPMDD). The final subgrade should be cambered or otherwise shaped properly to facilitate rapid drainage and to prevent the formation of local depressions in which water could accumulate.

Proper cambering and allowing the water to escape towards the sides (where it can be removed by means of subdrains) is considered to be beneficial. Otherwise, any water collected in the granular sub-base materials could be trapped thus causing problems due to softened subgrade, differential frost heave, etc. For the same reason damaging the subgrade during and after placement of the granular materials by heavy construction traffic should be avoided. If the moisture content of the local material cannot be maintained at ±2% of the optimum moisture content, imported granular material must be used.

Any fill required for re-grading the site or backfill should be select, clean material, free of topsoil, organic or other foreign and unsuitable matter. The fill should be placed in thin layers and compacted to at least 95% of its SPMDD. The degree of compaction should be increased to 98% within the top 1.0 m of the subgrade, as per City Standards. The compaction of the new fill should be checked by frequent field density tests.

4.1.2 Construction

Once the subgrade has been inspected and approved, the granular base and sub-base course materials should be placed in layers not exceeding 200 mm (uncompacted thickness) and should be compacted to at least 100% of their respective SPMDD. The grading of the material should conform to current OPS Specifications.

The placing, spreading and rolling of the asphalt should be in accordance with OPS Specifications or, as required by the local authorities.

Frequent field density tests should be carried out on both the asphalt and granular base and sub-base materials to ensure that the required degree of compaction is achieved.

4.1.3 Drainage

The Town of New Tecumseth requires the installation of full-length subdrains on all roads. The subdrains should be properly filtered to prevent the loss of (and clogging by) soil fines.

All paved surfaces should be sloped to provide satisfactory drainage towards catch basins. As discussed in Section 4.1.1, by means of good planning any water trapped in the granular sub-base materials should be drained rapidly towards subdrains or other interceptors.

4.1.4 Roadway Shoulder

Provide at least 1m wide granular shoulders when placing the sub-base and base course for new paved and gravel roadway sections and the granular courses to be daylighted into the roadside ditches. The roadway shoulder serves several essential functions. Primarily, it supports the edge of the traveled portion of the roadway. Another important function is to provide a safety area for drivers to regain control of vehicles, if forced to leave the roadway surface. The shoulder also plays an important role in

drainage, carrying water further away from the roadway surface towards the fore slope and into the ditch.

In order to perform all of these functions, roadway shoulder shape is critical. The shoulder should meet the edge of the roadway at the same elevation. In other words, the shoulder should begin no higher or no lower than the edge of the roadway.

4.2 SEWERS

As a part of the site development, a network of new storm and sanitary sewers is to be constructed.

4.2.1 Trenching

It is expected that the trenches will be dug through fill and native soil deposits. The groundwater was observed in the monitoring wells at 217.6 m to 217.7 mASL on October 15, 2019 on the eastern portion of the property and 218.0 to 218.1 on August 8, 2019 on the two monitoring wells installed in the western portion of the property. For any trenching below the groundwater level, water table must be lowered to 1.0 m below the lowest excavation level, using point wells to facilitate the construction to be carried out in the 'dry' condition.

All excavations must be carried out in accordance with the most recent Occupational Health and Safety Act (OHSA). In accordance with OHSA, the cohesionless soil deposit can be classified as Type 3 Soil above the groundwater table and Type 4 Soil below the groundwater table. The fill material can be classified as Type 4 Soil. Cohesive till material can be classified as Type 2 Soil.

4.2.2 Bedding

The boreholes show that, in their undisturbed state, native soils will provide adequate support for the sewer pipes and allow the use of Class A bedding. However, normal Class B type bedding can be used as an alternative, provided the ground water table is lowered at least 1.0 m below the lowest excavation level. The recommended minimum thickness of granular bedding below the invert of the pipes is 150 mm. The thickness of the bedding may, however, have to be increased depending on the pipe diameter. The bedding material should consist of well-graded granular material such as Granular 'A' or equivalent. After installing the pipe on the bedding, a granular surround of approved bedding material, which extends at least 300 mm above the obvert of the pipe, or as set out by the local Authority, should be placed.

To avoid the loss of soil fines from the subgrade, uniformly graded clear stone should not be used unless, below the granular bedding material, a suitable, approved filter fabric (geotextile) is placed. The geotextile should extend along the sides of the trench and should be wrapped all around the poorly graded bedding material.

4.2.3 Backfilling of Trenches

Based on visual and tactile examination, and the measured moisture contents of the soil samples, the onsite excavated soils from above the groundwater table will generally need to be brought to ±2% of the optimum moisture content whether by adding water or aerating. Soils excavated from below the groundwater table may require aeration prior to their use as backfill material.

The backfill should be placed in maximum 200 mm thick layers at or near (±2%) their optimum moisture content, and each layer should be compacted to at last 95% SPMDD. Unsuitable materials such as organic soils, boulders, cobbles, frozen soils, etc. should not be used for backfilling. Otherwise imported selected inorganic fill will be required for backfilling at this site.

The onsite excavated soils should not be used in confined areas (e.g. around catch basins and laterals under roadways) where heavy compaction equipment cannot be operated. The use of imported granular fill would be preferable in confined areas and around structures, such as catch basins.

4.3 SITE GRADING AND ENGINEERED FILL

In the areas where earth fill is required for site grading purposes, an engineered fill may be constructed below building foundations, roads, boulevards, etc.

Prior to the construction of engineered fill, all topsoil, fill material, wet, loose, weak weathered / disturbed and any other unsuitable materials must be removed in this area. After the removal of all unsuitable materials, the excavation base consisting of native soil deposits must be inspected and approved by a qualified geotechnical engineer prior to any placement of engineered fill. The base of the excavation should be compacted, and proof rolled with heavy compactors (minimum 10,000 kg). During proof rolling, spongy, wet or soft/loose spots should be sub-excavated to stable subgrade and replaced with approved soil, compatible with subgrade conditions, as directed by the geotechnical engineer.

The material for engineered fill should consist of approved inorganic soil, compacted to 100 percent of Standard Proctor Maximum Dry Density (SPMDD). Recommendations regarding engineered fill placement are provided in **Appendix A** of this report.

To reduce the risk of improperly placed engineered compacted fill, full-time supervision of the contractor is essential by SIRATI to certify the engineered fill. Please note that SIRATI can only provide certification for material properly placed and compacted under direct supervision. Detailed Engineered fill and inspection requirements to be discussed at the pre-construction meeting with the contractor.

Depending upon the amount of grade raise, there will be consolidation settlement of the underlying soils. Additionally, there will be settlement of the engineered fill under its own weight, approximately 0.5% of the fill height. A waiting period of 3 to 6 months may be required prior to the construction of any structures on engineered fill. This should be confirmed during the detail design stage, once the

grading plans for the proposed development are available. No waiting time is required when using Granular A or B material for construction of the engineered fill. However, the use of such material could increase the project cost.

4.4 FOUNDATION CONDITIONS

At the time of preparation of this report, no design loading requirements were made available. Based on factual data retrieved from the geotechnical investigation on the proposed building footprint (BH101, BH102, BH105, BH106, BH108, BH110, BH112, and BH113) and the groundwater table encountered at the subject site the following recommendations are made.

4.4.1 Shallow Foundations

The conventional spread/strip footings design may be feasible for the proposed Fire Station Building with slab-on-grade structure at elevations lower than the frost depth. The boreholes show that, provided the foundation soil is undisturbed during the construction, in general, the allowable soil bearing values of 60 kPa to 80 kPa at serviceability limit state (SLS) and 90 kPa to 120 kPa at ultimate limit state (ULS) are feasible in the undisturbed inorganic natural soils, at or below the depths provided in **Table 2** with underside footing at 2.3 m depth below the existing grade and lower.

Positive dewatering will be required prior to the excavation for the strip or spread foundations, otherwise it will result in unstable base and loss of bearing capacity. Groundwater table must be lowered to at least 1m below the lowest founding level.

The foundation base must be inspected by this office prior to pouring concrete. The excavated foundation bases can be covered with 50 mm thick lean concrete slab immediately after inspection and cleaning, in order to avoid disturbance of the founding soil due to construction activity.

It should be noted that the bearing capacities were provided based on the soil and groundwater condition at the borehole locations and as such, variability should be anticipated between the boreholes.

The foundations designed to the specified allowable bearing capacity at the Serviceability Limit State (SLS) are expected to settle less than 25 mm total and 19 mm differential.

All footings exposed to seasonal freezing conditions must have at least 1.6 meters of soil cover for frost protection.

Table 2: Bearing Values and Founding Levels

BH No.	Material	Bearing Capacity at SLS (kPa)	Factored Geotechnical Resistance at ULS (kPa)	Depth Below Existing Ground (m)
BH101	Sand Sand	60 80	90 120	2.3 3.0
BH102	Sand Sand	60 80	90 120	2.3 3.0
BH105	Silty Sand Clayey Silt Till	60 80	90 120	2.3 3.0
BH106	Sandy Silt Silty Clay Till	60 80	90 120	2.3 3.0
BH108	Sand Clayey Silt Till	60 80	90 120	2.3 3.0
BH109	Sand Sand	60 80	90 120	2.3 3.0
BH110	Sand Sand	60 80	90 120	2.3 3.0
BH112	Sand Sand	60 80	90 120	2.3 3.0
BH113	Sand Sand	60 80	90 120	2.3 3.0

4.4.2 Caisson Foundations

As an alternative to shallow foundations, Caissons may be used to support the proposed building foundations. If caisson foundations are used, the caisson contractor should be advised to provide temporary smooth surface liners for sealing off any wet pocket in the fill or cohesionless native soil strata to the relatively impervious cohesive soil.

A net allowable bearing pressure of 900 kPa at Serviceability Limit State (SLS) and 1200 kPa at Ultimate Limit State (ULS) may be used for a caisson founded at the geodetic elevation of 209 mASL. The foundations designed to the specified allowable bearing capacity at the serviceability limit state (SLS) are expected to settle less than 25 mm total and 19 mm differential.

Prior to pouring concrete, the base of each caisson should be inspected by the Geotechnical Engineer.

4.4.3 Helical Piles

Considerations can also be given to helical pile design for the proposed building, extended to competent soil stratum. A qualified design-build contractor should be retained for the design of the helical piles. Provided adequate embedment in the dense to very dense soil deposits, the helical piles could be designed for a compressive bearing capacity of 370 kN to 500 kN at serviceability limit state (SLS) and 500 kN to 670 kN at ultimate limit state (ULS). The tensile bearing capacity of such piles are expected to be within the range of 135 kN to 165 kN at SLS and 150 kN to 215 kN at ULS, per pile.

4.4.4. Foundation Selection

The ground condition at shallow depths generally comprises a layer of fill material, underlain by cohesionless sand and silt deposits in a loose to compact condition and groundwater condition at approximate 2.5 m depth. Given the relatively low bearing capacity of the native soil strata at shallow depths, as well as trenching and dewatering requirements, the use of helical pile foundation, as presented in Section 4.4.3, is considered a viable option in comparison with shallow foundation or caissons and eliminates the need for relatively deep trenching and backfilling and dewatering for foundation construction.

The investigation and comments are necessarily on-going as new information of the underground conditions becomes available. For example, more specific information is available with respect to conditions between boreholes when foundation construction is underway. The interpretation between boreholes and the recommendations of this report must therefore be checked through field inspections provided by SIRATI to validate the information for use during the construction stage.

5. SLAB ON GRADE AND PERMANENT DRAINAGE

The slab-on-grade can be supported on grade provided the base thoroughly proof rolled to detect any soft or unstable areas, which must be removed and replaced with suitably compacted soils, as defined in **Section 4** of this report. Once the required subgrade has been developed, SIRATI recommends that the exposed subgrade be inspected and approved by the Geotechnical Engineer prior to the placement of any granular fill or concrete. A granular layer consisting of at least 300 mm of 19 mm Crusher Run Limestone (CRL) or OPSS Granular A should be installed under the floor slab as a bedding layer. The CRL or the OPSS Granular A should be compacted to 100% of its SPMDD.

A modulus of subgrade reaction 'K_s' of 2.5 to 10 MPa/m may be considered for the design of the slab-on-grade, with consideration of the contact stress and the maximum allowable total settlement and with the correlation of the SPT values observed during the geotechnical investigation program.

However, if higher values of 'K_s' are needed for the design purposes, the wet loose sand layer should be excavated to depth of about 1 m below the fill material layer and replaced with well compacted crushed stone in maximum 300 mm lifts. This practice will provide 'K_s' of 20 MPa/m.

It is considered by SIRATI that completed excavations for floor slabs should not be left open before pouring concrete for any period longer than 24 hours. Particularly, if the floor construction works are being completed during the winter months or wet weather periods. The base of any floor slab excavation that is left exposed longer than 24 hours should be suitably covered and protected from water ponding, and/or protected to prevent degradation of the exposed founding stratum with the construction of a mud mat.

The floor slab should be structurally independent of any load bearing structural elements and should tolerate expected foundation settlements as indicated above.

The perimeter drainage system shown on Drawings 28 is recommended for the slab-on-grade structure. Weeping tile systems on the exterior and underfloor drainage systems, should be appropriately designed to effectively discharge water and eliminate hydrostatic pressure build-ups.

6. HYDRAULIC CONDUCTIVITY AND PERCOLATION RATE ESTIMATES

6.1. SLUG TESTS

For the purpose of estimating the hydraulic conductivity of the screened soils, slug tests or single well response tests were conducted at the Site. These tests were conducted by SIRATI staff on October 15, 2019 at the monitoring wells BH/MW107, BH/MW114 and BH/MW121.

Prior to the test, initial water levels were measured. Considering that the well screens were partly saturated, a falling head method was applied. A datalogger was placed at the bottom of the test wells to record the initial water pressure before the test. A certain amount of potable water (4L) was then added to the test well. The recorded data was then used for estimating the hydraulic conductivity of the screened soils.

Based on the data obtained from the slug tests or single well response tests, the hydraulic conductivity for the screened soils was estimated using the Hvorslev method. Records of the slug tests and the data processing are provided in **Appendix C**.

The results of the estimated hydraulic conductivity are summarized in **Table 3**. As presented above, the estimated hydraulic conductivity ranged from 1.3×10^{-3} cm/s to 1.2×10^{-2} cm/s, with a geometric mean value of 3.6×10^{-3} cm/s.

Table 3 Hydraulic Conductivity Values

Monitoring Well	Screen Depth (mbgs)	Tested Soil Type	Hydraulic Conductivity (cm/s)
BH/MW105	1.5 ~ 3.0	Silty Sand	1.2×10^{-2}
BH/MW114	3.0 ~ 4.6	Sand, some silt	1.3×10^{-3}
BH/MW121	2.3 ~ 3.8	Silty Sand; Sand	2.9×10^{-3}
Geometric Mean			3.6×10^{-3}

6.2 SOIL INFILTRATION TESTS

For the purpose of designing and selecting low-impact development (LID) measures, soil infiltration tests were conducted to assess the soil infiltration capacity at the Site. Soil infiltration tests were conducted by SIRATI staff on October 15, 2019 at locations near boreholes BH107, BH111, BH114, BH117, BH120 and BH121. The approximate infiltration test locations are shown on Figure 1.

The infiltration tests were conducted using a Guelph Permeameter. The Guelph Permeameter is used to accurately measure in-situ hydraulic conductivity or the field saturated hydraulic conductivity (K_{fs}),

which is one of the infiltration test methods recommended by Toronto and Region Conservation Authority (TRCA) to verify native soil infiltration rates for design purposes.

Before the test, a hole of approximately 0.06 m in diameter was hand-augured into the soil to a depth of approximately 0.8 ~ 0.9 m below the ground surface (mbgs). The test was carried out using one-head (5 cm) constant head and 15- or 30-second reading interval. The data obtained was used to interpret the field saturated hydraulic conductivity (K_{fs}), which was then converted into infiltration rate.

Based on the data obtained from Guelph Permeameter tests, the field saturated hydraulic conductivity (K_{fs}) was estimated for the soils at the tested locations. The records of the data process are provided in **Appendix C**.

Following the TRCA's *Low Impact Development Stormwater Management Planning and Design Guides (LID Guides) V.1.0 (2010)*, the soil infiltration rates (I) were calculated based on the estimated hydraulic conductivity. The relationship between infiltration rate (I) and hydraulic conductivity is defined as $K_{fs} = 6 \times 10^{-11} \times I^{3.7363}$, which is described in the LID Guides.

The estimated hydraulic conductivity (K_{fs}) and infiltration rate (I) are presented in the table below.

Test Location	Test Depth (mbgs)	Tested Soil Type	Field Saturated Hydraulic Conductivity (cm/s)	Infiltration Rate (mm/hour)
BH107	0.90	Sand	1.71×10^{-5}	29
BH111	0.85	Sand, trace silt	1.19×10^{-5}	26
BH114	0.80	Sand, trace silt	1.71×10^{-5}	29
BH117	0.80	Sand	6.82×10^{-6}	23
BH120	0.80	Sand, coarse	6.82×10^{-5}	42
BH121	0.80	Sand, coarse	2.05×10^{-5}	30

As shown above, the estimated hydraulic conductivity ranged from 6.82×10^{-6} cm/s to 6.82×10^{-5} cm/s, and the estimated soil infiltration rates ranged from 23 mm/hour to 42 mm/hour.

It should be noted that the infiltration rate used to design an infiltration facility should incorporate a safety factor of between 2.5 and 3.5 when less permeable soil horizons exist within the 1.5 m below the proposed bottom elevation of the proposed infiltration facility.

7. EARTHQUAKE CONSIDERATIONS

Based on the borehole information and according to Table 4.1.8.4.A of OBC 2012, the subject site for the proposed building founded on dense to very dense soils can be classified as "Class D".

8. GENERAL COMMENTS ON REPORT

Sirati & Partners Consultants Limited should be retained for a general review of the final design and specifications to verify that this report has been properly interpreted and implemented. If not accorded

the privilege of making this review, Sirati & Partners will assume no responsibility for interpretation of the recommendations in the report.

The comments given in this report are intended only for the guidance of design engineers. The number of boreholes required to determine the localized underground conditions between boreholes affecting construction costs, techniques, sequencing, equipment, scheduling, etc., would be much greater than has been carried out for design purposes. Contractors bidding on or undertaking the works should, in this light, decide on their own investigations, as well as their own interpretations of the factual borehole results, so that they may draw their own conclusions as to how the subsurface conditions may affect them.

We trust that the information contained in this report is satisfactory. Should you have any questions, please do not hesitate to contact this office.

Yours truly,

SIRATI & PARTNERS CONSULTANTS LIMITED

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LICENSED PROFESSIONAL ENGINEER
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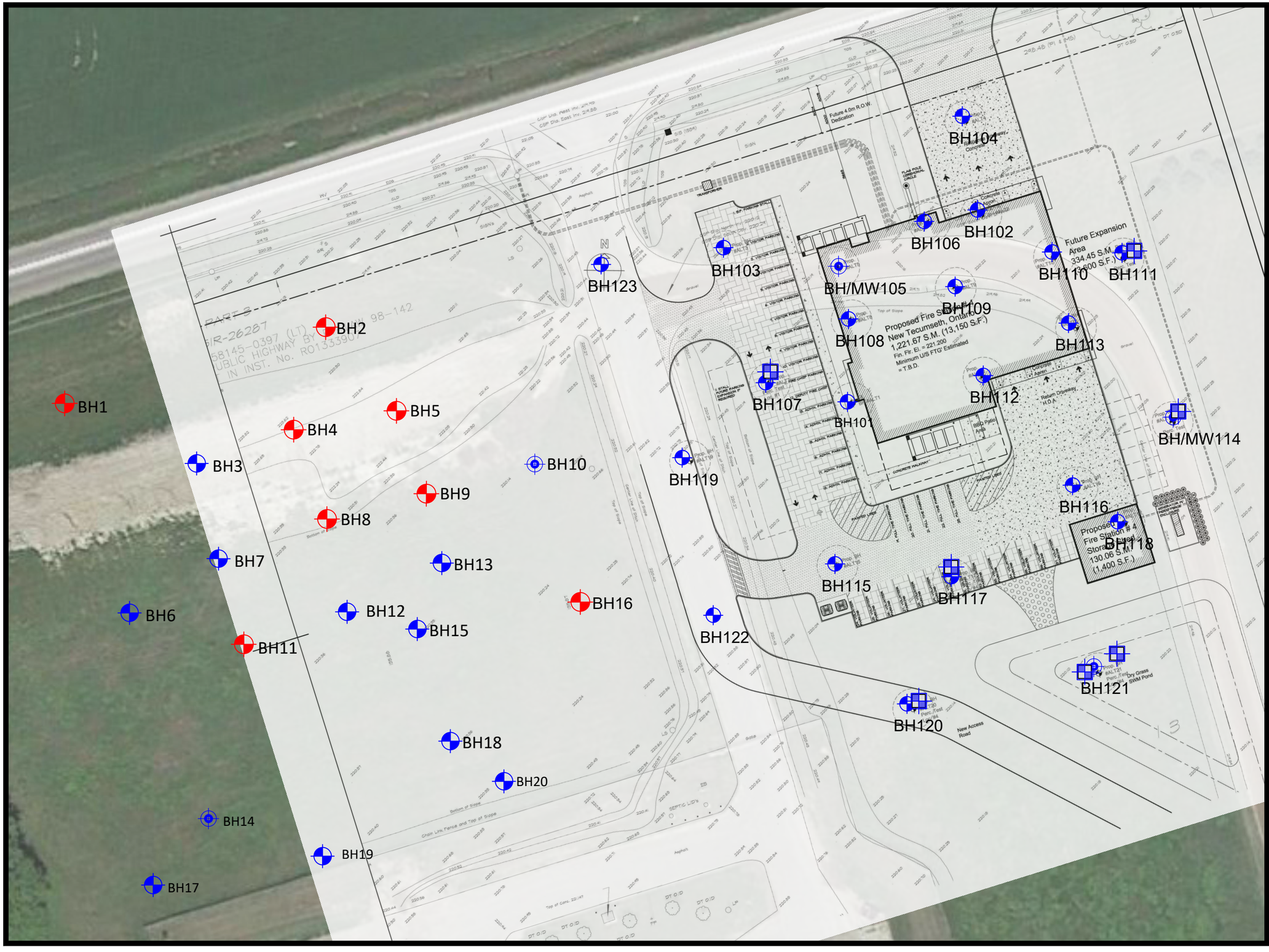
30/08/2023
PROVINCE OF ONTARIO

Drawings



SIRATI & PARTNERS

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Phone# 905 833 1582, Fax# 905 833 5360

North:

Legend:

- Monitoring Well Location
- Borehole Location(Drilled)
- Borehole Location(Not Drilled)
- Guelph Permeameter Test Location

Project Title:
Geotechnical Investigation

Site Location:
6375 14 Line, Alliston, ON

Figure Title:
Boreholes Location Plan-East Side

Scale:	Project Number:
As Shown	SP19-463-00
Date:	**Figure Number:**
November 2019	1

Drawing 1A: Notes on Sample Descriptions

1. All sample descriptions included in this report follow the Canadian Foundations Engineering Manual soil classification system. This system follows the standard proposed by the International Society for Soil Mechanics and Foundation Engineering. Laboratory grain size analyses provided by Sirati & Partners Consultants Limited also follow the same system. Different classification systems may be used by others; one such system is the Unified Soil Classification. Please note that, with the exception of those samples where a grain size analysis has been made, all samples are classified visually. Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems.

ISSMFE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL			COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE		

0.002	0.006	0.02	0.06	0.2	0.6	2.0	6.0	20	60	200

EQUIVALENT GRAIN DIAMETER IN MILLIMETRES

CLAY (PLASTIC) TO	FINE	MEDIUM	CRS.	FINE	COARSE
SILT (NONPLASTIC)	SAND			GRAVEL	

UNIFIED SOIL CLASSIFICATION

2. Fill: Where fill is designated on the borehole log it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description may therefore not be applicable as a general description of site fill materials. All fills should be expected to contain obstruction such as wood, large concrete pieces or subsurface basements, floors, tanks, etc., none of these may have been encountered in the boreholes. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. Fill at this site may have been monitored for the presence of methane gas and, if so, the results are given on the borehole logs. The monitoring process does not indicate the volume of gas that can be potentially generated nor does it pinpoint the source of the gas. These readings are to advise of the presence of gas only, and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill sites; unless specifically stated the fill on this site has not been tested for contaminants that may be considered toxic or hazardous. This testing and a potential hazard study can be undertaken if requested. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common and are generally not detected in a conventional geotechnical site investigation.

3. Till: The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (60 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.

SIRATI & PARTNERS

LOG OF BOREHOLE BH 101

PROJECT: Geotechnical & Hydrogeological Investigation for Fire Station #4 Project

CLIENT: Town of New Tecumseth

PROJECT LOCATION: 6375 14th Line, Alliston, New Tecumseth, ON (East Portion)

DATUM: Geodetic

BH LOCATION: See Drawing 1

DRILLING DATA

Method: Soild Stem Auger

Diameter: 150 mm

Date: Jul/02/2019

REF. NO.: SP19-463-00

ENCL NO.: 2

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
220.1												
0.0 / 219.9	**TOPSOIL:** 230 mm						220					
0.2	**FILL:** clayey silt, trace sand, brown		1	SS	3							
1	becoming sand, trace silt, brown, wet becoming clayey silt, trace sand, brown, wet		2	SS	5		219					
2	**POSSIBLE FILL:** clayey silt, trace sand, light brown, oxidated, wet becoming sand, trace silt, brown, oxidated, wet		3	SS	16		218					
217.8												
2.3	**SAND:** trace silt, brown, wet, compact		4	SS	13							
3	trace to some silt, brown to grey		5	SS	15		217					wet spoon
4	becoming dense		6	SS	32		216					wet spoon
	trace oxidation		7	SS	31							wet spoon
5 / 215.0												
5.1	**END OF BOREHOLE:**											

Note:
1. Borehole caved at 2.7 mbgs.
2. Water was encountered at 1.88 mbgs upon completion of drilling.

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ $^{\varepsilon}$=3% Strain at Failure

SPCL SOIL LOG-1WELL-DRAFT SP19-463-00 - EAST PORTION.GPJ SPCL.GDT 11/21/19

SIRATI & PARTNERS

LOG OF BOREHOLE BH 102

PROJECT: Geotechnical & Hydrogeological Investigation for Fire Station #4 Project

CLIENT: Town of New Tecumseth

PROJECT LOCATION: 6375 14th Line, Alliston, New Tecumseth, ON (East Portion)

DATUM: Geodetic

BH LOCATION: See Drawing 1

DRILLING DATA

Method: Soild Stem Auger

Diameter: 150 mm

Date: Jul/02/2019

REF. NO.: SP19-463-00

ENCL NO.: 3

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION
220.2							
0.0	**FILL:** clayey silt, some sand, trace rootlets, brown, moist		1	SS	6		220
1	becming silty clay, trace sand, brown to light brown, oxidated, very moist		2	SS	4		219
	trace gravel, becoming light brown		3	SS	7		
2 217.9							218
2.3	**SAND:** trace silt, brown, wet, loose		4	SS	8		
3	becoming compact		5	SS	16		217
216.8 3.4	**CLAYEY SILT TILL:** trace sand, grey, moist, very stiff						
216.4 216.8	**SAND:** trace silt, brown, wet,						
4 4.0	compact		6	SS	25		216
	CLAYEY SILT TILL: trace sand, grey, moist, very stiff						
215.6 4.6	**SILTY CLAY TILL:** trace sand, grey, moist, very stiff		7	SS	22		
5							215
6 214.1							
6.1 213.9	**SAND:** trace silt, brown, wet,						
6.3	compact		8	SS	26		214
213.6 6.6	**SILTY CLAY TILL:** trace sand, grey, moist, very stiff						
	END OF BOREHOLE:						

Note:
1. Borehole caved at 2.4 mbgs.
2. Water was encountered at 1.8 mbgs upon completion of drilling.

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH (kPa): ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE; 20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%): 10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

REMARKS AND GRAIN SIZE DISTRIBUTION (%)	GR	SA	SI	CL
wet spoon				
	87	9	4	
wet spoon				
wet spoon				
wet spoon				

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε_f=3% Strain at Failure

SPCL SOIL LOG-1WELL-DRAFT SP19-463-00 - EAST PORTION.GPJ SPCL.GDT 11/21/19

SIRATI & PARTNERS

LOG OF BOREHOLE BH 103

PROJECT: Geotechnical & Hydrogeological Investigation for Fire Station #4 Project

CLIENT: Town of New Tecumseth

PROJECT LOCATION: 6375 14th Line, Alliston, New Tecumseth, ON (East Portion)

DATUM: Geodetic

BH LOCATION: See Drawing 1

DRILLING DATA

Method: Soild Stem Auger

Diameter: 150 mm

Date: Oct/03/2019

REF. NO.: SP19-463-00

ENCL NO.: 4

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION
220.2 / 0.0	**TOPSOIL:** 100 mm						
0.1	**FILL:** silty sand, trace gravel, trace rootlets, brown, moist		1	SS	16		220
			2	SS	8		
218.7							219
1.5	**SILT:** trace sand, brown, oxidated, wet, loose		3	SS	9		
217.9							218
2.3	**SAND:** trace to some silt, brown, oxidated, wet, compact		4	SS	13		
217.2							
3.0	**SILTY CLAY TILL:** trace sand, greyish brown, moist, stiff		5	SS	15		217
216.8							
3.5	**END OF BOREHOLE:**						

Note:
1. Borehole was open and dry upon completion of drilling.

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH (kPa) (20 40 60 80 100)
- ○ UNCONFINED
- ● QUICK TRIAXIAL
- + FIELD VANE & Sensitivity
- × LAB VANE

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L

WATER CONTENT (%) (10 20 30)

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

REMARKS AND GRAIN SIZE DISTRIBUTION (%)

GR SA SI CL

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES

+ 3, × 3: Numbers refer to Sensitivity

○ ε=3% Strain at Failure

SPCL SOIL LOG-1WELL-DRAFT SP19-463-00 - EAST PORTION.GPJ SPCL.GDT 11/21/19

SIRATI & PARTNERS

LOG OF BOREHOLE BH 104

PROJECT: Geotechnical & Hydrogeological Investigation for Fire Station #4 Project

CLIENT: Town of New Tecumseth

PROJECT LOCATION: 6375 14th Line, Alliston, New Tecumseth, ON (East Portion)

DATUM: Geodetic

BH LOCATION: See Drawing 1

DRILLING DATA

Method: Soild Stem Auger

Diameter: 150 mm

Date: Oct/03/2019

REF. NO.: SP19-463-00

ENCL NO.: 5

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
220.2												
220.0 / 0.1	**TOPSOIL:** 76 mm											
	FILL: sandy silt, trace rootlets, light brown, moist		1	SS	6		220					
1	**POSSIBLE FILL:** sandy silt, brown, moist		2	SS	5		219					
218.7												
1.5	**SILT:** trace sand, trace clay, greyish brow, very moist, compact		3	SS	11		218					
2												
217.9												
2.3	**SAND:** trace silt, greyish brown, wet, loose		4	SS	9							wet spoon
3												
217.2												
3.0	**SILTY CLAY TILL:** grey, moist, very stiff		5	SS	21		217					
216.7												
3.5	**END OF BOREHOLE:**											

Note:
1. Borehole caved at 0.3 mbgs.

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH 105

PROJECT: Geotechnical & Hydrogeological Investigation for Fire Station #4 Project

CLIENT: Town of New Tecumseth

PROJECT LOCATION: 6375 14th Line, Alliston, New Tecumseth, ON (East Portion)

DATUM: Geodetic

BH LOCATION: See Drawing 1

DRILLING DATA

Method: Hollow Stem Auger

Diameter: 200 mm

Date: Oct/02/2019

REF. NO.: SP19-463-00

ENCL NO.: 6

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
220.1								
0.0	**FILL:** silty sand, trace gravel, brown, moist		1	SS	16		220	
1	**POSSIBLE FILL:** silt, trace sand, brown, moist		2	SS	4		219	
218.6								
1.5	**SILTY SAND:** greyish brown, very moist, compact		3	SS	14		218	
2	wet		4	SS	21			wet spoon
217.1								
3.0	**CLAYEY SILT TILL:** trace sand, grey, very moist, firm		5	SS	9		217	9 33 40 18
4	becoming stiff		6	SS	10		216	
5			7	SS	14		215	
214.0								
6.1	**SILTY CLAY:** trace sand, grey, very moist, firm		8	SS	6		214	
7							213	
212.5								
7.6	**SILTY SAND TILL:** trace gravel, trace clay, grey, wet, loose		9	SS	9		212	
8								
9	becoming very dense		10	SS	63		211	
10								

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH (kPa) (20 40 60 80 100)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%) (10 20 30)

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

SPCL SOIL LOG-1WELL-DRAFT SP19-463-00 - EAST PORTION.GPJ SPCL.GDT 11/21/19

Continued Next Page

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+3, ×3: Numbers refer to Sensitivity

○ ε=3% Strain at Failure

LOG OF BOREHOLE BH 105

PROJECT: Geotechnical & Hydrogeological Investigation for Fire Station #4 Project

CLIENT: Town of New Tecumseth

PROJECT LOCATION: 6375 14th Line, Alliston, New Tecumseth, ON (East Portion)

DATUM: Geodetic

BH LOCATION: See Drawing 1

DRILLING DATA

Method: Hollow Stem Auger

Diameter: 200 mm

Date: Oct/02/2019

REF. NO.: SP19-463-00

ENCL NO.: 6

SOIL PROFILE (m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	SILTY SAND TILL: trace gravel, trace clay, grey, wet, loose(Continued)						210				
209.4											
10.7	**GRAVELLY SAND:** trace silt, grey, wet, compact		11	SS	11		209				
207.7	very dense		12	SS	50/100 mm		208				
12.5	**END OF BOREHOLE:**										

Note:
1. Monitoring well was installed upon completion of drilling. (Please refer to Log of MW 105)

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ε_f=3% Strain at Failure

SPCL SOIL LOG-1WELL-DRAFT SP19-463-00 - EAST PORTION.GPJ SPCL.GDT 11/21/19

SIRATI & PARTNERS

LOG OF BOREHOLE MW 105

PROJECT: Geotechnical & Hydrogeological Investigation for Fire Station #4 Project

CLIENT: Town of New Tecumseth

PROJECT LOCATION: 6375 14th Line, Alliston, New Tecumseth, ON (East Portion)

DATUM: Geodetic

BH LOCATION: See Drawing 1

DRILLING DATA

Method: Hollow Stem Auger

Diameter: 200 mm

Date: Oct/02/2019

REF. NO.: SP19-463-00

ENCL NO.: 7

SOIL PROFILE			SAMPLES						DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT			
(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE	WATER CONTENT (%)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
220.1								20 40 60 80 100	10 20 30			
0.0	Augered from surface to 3 mbgs for MW installation.						220					
							219					
							218					
								W. L. 217.7 m Oct 15, 2019				
217.1												
3.0	**END OF BOREHOLE:**											

Note:
1. Monitoring well was installed next to BH 105.
2. Groundwater level was observed at 2.45 mbgs on October 15, 2019.

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: $+^{3}$, $\times^{3}$: Numbers refer to Sensitivity; ○ ε_{f}=3% Strain at Failure

SPCL SOIL LOG-1WELL-DRAFT SP19-463-00 - EAST PORTION.GPJ SPCL.GDT 11/21/19

SIRATI & PARTNERS

LOG OF BOREHOLE BH 106

PROJECT: Geotechnical & Hydrogeological Investigation for Fire Station #4 Project

CLIENT: Town of New Tecumseth

PROJECT LOCATION: 6375 14th Line, Alliston, New Tecumseth, ON (East Portion)

DATUM: Geodetic

BH LOCATION: See Drawing 1

DRILLING DATA

Method: Soild Stem Auger

Diameter: 150 mm

Date: Oct/03/2019

REF. NO.: SP19-463-00

ENCL NO.: 8

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT (w_P w w_L) WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"							GR SA SI CL
220.2												
0.0 / 219.8	**TOPSOIL:** 400 mm		1	SS	9		220					
0.4	**FILL:** silty sand, trace rootlets, trace gravel, brown, moist											
1	**POSSIBLE FILL:** sandy silt, trace to some clay, light brown, oxidated, very moist		2	SS	3		219					
218.7												
1.5	**SANDY SILT:** trace clay, brownish grey, oxidated, very moist, loose		3	SS	5							
2							218					
217.9												
2.3	**SILTY SAND:** brownish grey, very moist, loose		4	SS	9							wet spoon
3 / 217.2												
3.0	**SILTY CLAY TILL:** trace sand, grey, moist, stiff		5	SS	14		217					4 36 33 27
4												
	becoming very stiff		6	SS	20		216					
5												
							215					
6												
213.6			7	SS	11		214					
6.6	**END OF BOREHOLE:**											

Note:
1. Borehole caved at 4.76 mbgs.

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES: + 3, × 3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

SPCL SOIL LOG-1WELL-DRAFT SP19-463-00 - EAST PORTION.GPJ SPCL.GDT 11/21/19

SIRATI & PARTNERS

LOG OF BOREHOLE BH 107

PROJECT: Geotechnical & Hydrogeological Investigation for Fire Station #4 Project

CLIENT: Town of New Tecumseth

PROJECT LOCATION: 6375 14th Line, Alliston, New Tecumseth, ON (East Portion)

DATUM: Geodetic

BH LOCATION: See Drawing 1

DRILLING DATA

Method: Soild Stem Auger

Diameter: 150 mm

Date: Oct/04/2019

REF. NO.: SP19-463-00

ENCL NO.: 9

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
220.1												
0.0 / 219.7	**TOPSOIL:** 380 mm thick		1	SS	3		220		○			
0.4	**FILL:** sand, trace silt, trace rootlets, light brown, moist											
1	becoming clayey silt, trace sand, trace rootlets, brown, trace oxidation, very moist		2	SS	4		219		○			
218.6												
1.5	**SANDY SILT:** greyish brown, trace oxidation, very moist to wet, compact		3	SS	14				○			wet spoon
2 / 217.8							218					
2.3	**SILTY SAND:** greyish brown, wet, compact		4	SS	13				○			
3												
216.7			5	SS	21		217		○			
3.5	**END OF BOREHOLE:**											

Note:

1. Borehole was open upon completion of drilling.
2. Water was encounetered at 2.4 mbgs upon completion of drilling.

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ε_f=3% Strain at Failure

SPCL SOIL LOG-1WELL-DRAFT SP19-463-00 - EAST PORTION.GPJ SPCL.GDT 11/21/19

SIRATI & PARTNERS

LOG OF BOREHOLE BH 108

PROJECT: Geotechnical & Hydrogeological Investigation for Fire Station #4 Project

CLIENT: Town of New Tecumseth

PROJECT LOCATION: 6375 14th Line, Alliston, New Tecumseth, ON (East Portion)

DATUM: Geodetic

BH LOCATION: See Drawing 1

DRILLING DATA

Method: Soild Stem Auger

Diameter: 150 mm

Date: Oct/03/2019

REF. NO.: SP19-463-00

ENCL NO.: 10

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION
220.2							
220.0 / 0.1	**TOPSOIL:** 75 mm						
	FILL: silty sand, trace topsoil, trace rootlets, light brown, moist		1	SS	13		220
1	becoming clayey silt, trace sand, brown, very moist		2	SS	4		219
218.7							
1.5	**SILTY SAND:** greyish brown, very moist, compact		3	SS	15		
2	becoming wet and loose		4	SS	8		218
217.2							
3.0	**CLAYEY SILT TILL:** trace sand, brownish grey, moist, very stiff		5	SS	19		217
4	becoming very moist and stiff		6	SS	12		216
5							215
6			7	SS	8		214
213.6							
6.6	**END OF BOREHOLE:**						

Note:
1. Borehole caved at 4.46 mbgs.
2. Water was encouneterd at 3.96 mbgs upon completion of drilling.

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH (kPa) (20 40 60 80 100)
- ○ UNCONFINED
- ● QUICK TRIAXIAL
- + FIELD VANE & Sensitivity
- × LAB VANE

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L

WATER CONTENT (%) (10 20 30)

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

REMARKS AND GRAIN SIZE DISTRIBUTION (%)

GR SA SI CL

wet spoon

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ε_f=3% Strain at Failure

SPCL SOIL LOG-1WELL-DRAFT SP19-463-00 - EAST PORTION.GPJ SPCL.GDT 11/21/19

LOG OF BOREHOLE BH 109

PROJECT: Geotechnical & Hydrogeological Investigation for Fire Station #4 Project

CLIENT: Town of New Tecumseth

PROJECT LOCATION: 6375 14th Line, Alliston, New Tecumseth, ON (East Portion)

DATUM: Geodetic

BH LOCATION: See Drawing 1

DRILLING DATA

Method: Hollow Stem Auger

Diameter: 200 mm

Date: Oct/02/2019

REF. NO.: SP19-463-00

ENCL NO.: 11

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS 0.3 m "N"	ELEVATION
220.1					
0.0 / 219.9	**TOPSOIL:** 250 mm				220
0.3	**FILL:** sandy silt, trace rootlets, dark brown, moist	1	SS	10	
1	**POSSIBLE FILL:** clayey silt, trace gravel, trace sand, brow, oxidated, very moist	2	SS	4	219
218.6					
1.5	**SAND:** trace to some silt, greyish brown, oxidated, very moist, compact	3	SS	11	
2					218
	oxidated, very moist	4	SS	15	
3	becoming brownish grey, wet, loose	5	SS	8	217
4					216
215.5					
4.6	**CLAYEY SILT TILL:** trace sand, grey, moist, very stiff	6	SS	18	
5					215
6 / 214.0					
6.1	**SILTY CLAY:** grey, moist, stiff	7	SS	12	214
7					213
212.5					
7.6	**SILTY SAND TILL:** trace cobbles, trace gravel, grey, very moist, compact	8	SS	25	
8					212
9	some clay, becoming very dense	9	SS	67	211
10					

GROUND WATER CONDITIONS

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH (kPa): ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE; 20 40 60 80 100

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L

WATER CONTENT (%): 10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

REMARKS AND GRAIN SIZE DISTRIBUTION (%)

GR SA SI CL

wet spoon 16 63 21

Continued Next Page

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε_f=3% Strain at Failure

SPCL SOIL LOG-1WELL-DRAFT SP19-463-00 - EAST PORTION.GPJ SPCL.GDT 11/21/19

LOG OF BOREHOLE BH 109

PROJECT: Geotechnical & Hydrogeological Investigation for Fire Station #4 Project

CLIENT: Town of New Tecumseth

PROJECT LOCATION: 6375 14th Line, Alliston, New Tecumseth, ON (East Portion)

DATUM: Geodetic

BH LOCATION: See Drawing 1

DRILLING DATA

Method: Hollow Stem Auger

Diameter: 200 mm

Date: Oct/02/2019

REF. NO.: SP19-463-00

ENCL NO.: 11

SOIL PROFILE (m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	SILTY SAND TILL: trace cobbles, trace gravel, grey, very moist, compact(Continued)						210					
11 209.0			10	SS	75/ 250 mm				○			
11.1	**END OF BOREHOLE:** Note: 1. Borehole caved at 10.61 mbgs. 2. Water encountered at 3 mbgs upon completion of drilling.											

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

SPCL SOIL LOG-1WELL-DRAFT SP19-463-00 - EAST PORTION.GPJ SPCL.GDT 11/21/19

SIRATI & PARTNERS

LOG OF BOREHOLE BH 110

PROJECT: Geotechnical & Hydrogeological Investigation for Fire Station #4 Project

CLIENT: Town of New Tecumseth

PROJECT LOCATION: 6375 14th Line, Alliston, New Tecumseth, ON (East Portion)

DATUM: Geodetic

BH LOCATION: See Drawing 1

DRILLING DATA

Method: Soild Stem Auger

Diameter: 150 mm

Date: Oct/03/2019

REF. NO.: SP19-463-00

ENCL NO.: 12

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
220.3											
220.0	**TOPSOIL:** 75 mm										
0.1	**FILL:** sandy silt, dark to light brown, moist		1	SS	10		220				
1	becoming clayey silt, trace sand, brown, very moist		2	SS	2		219				
	POSSIBLE FILL: clayey silt, trace sand, greyish brown, very moist		3	SS	6						
2											
218.0							218				
2.3	**SAND:** trace silt, greyish brown, very moist to wet, compact		4	SS	11						
3	oxidated		5	SS	13		217				wet spoon
4							216				
215.7											
4.6	**CLAYEY SILT:** trace sand, grey, moist, very stiff		6	SS	18						
5							215				
6											
214.2											
6.1	**SILTY CLAY TILL:** trace gravel, grey, moist, very stiff		7	SS	16		214				
213.7											
6.6	**END OF BOREHOLE:**										

Note:
1. Borehole caved at 2.7 mbgs.
2. Water was encountered at 2.7 mbgs upon completion of drilling.

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ε_f=3% Strain at Failure

SPCL SOIL LOG-1WELL-DRAFT SP19-463-00 - EAST PORTION.GPJ SPCL.GDT 11/21/19

LOG OF BOREHOLE BH 111

PROJECT: Geotechnical & Hydrogeological Investigation for Fire Station #4 Project

CLIENT: Town of New Tecumseth

PROJECT LOCATION: 6375 14th Line, Alliston, New Tecumseth, ON (East Portion)

DATUM: Geodetic

BH LOCATION: See Drawing 1

DRILLING DATA

Method: Soild Stem Auger

Diameter: 150 mm

Date: Oct/03/2019

REF. NO.: SP19-463-00

ENCL NO.: 13

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
220.1												
220.0 / 0.1	**TOPSOIL:** 76 mm						220					
	FILL: sandy silt, trace rootlets, brown, moist		1	SS	10							
1	becoming silty clay, brown, oxidated, very moist		2	SS	3		219					
	POSSIBLE FILL: sandy silt, trace clay, greyish brown, oxidated, very moist		3	SS	6							
2 / 217.8							218					
2.3	**SAND:** trace silt, brown, oxidated, wet, loose		4	SS	9							wet spoon
3	becoming grey, oxidated, wet, compact		5	SS	15		217					
4 / 215.5							216					
4.6	**SILTY CLAY TILL:** grey, moist, very stiff		6	SS	17							
5 / 215.0												
5.1	**END OF BOREHOLE:**											

Note:
1. Borehole caved at 0.6 mbgs.
2. Water was encountered at 0.33 mbgs upon completion of drilling.

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ε_f=3% Strain at Failure

SPCL SOIL LOG-1WELL-DRAFT SP19-463-00 - EAST PORTION.GPJ SPCL.GDT 11/21/19

SIRATI & PARTNERS

LOG OF BOREHOLE BH 112

PROJECT: Geotechnical & Hydrogeological Investigation for Fire Station #4 Project

CLIENT: Town of New Tecumseth

PROJECT LOCATION: 6375 14th Line, Alliston, New Tecumseth, ON (East Portion)

DATUM: Geodetic

BH LOCATION: See Drawing 1

DRILLING DATA

Method: Soild Stem Auger

Diameter: 150 mm

Date: Oct/04/2019

REF. NO.: SP19-463-00

ENCL NO.: 14

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"							GR SA SI CL
220.2												
0.0 / 219.8	**TOPSOIL:** 400 mm		1	SS	8		220					
0.4	**FILL:** sandy silt, light brown, trace oxidation, very moist											
1	**POSSIBLE FILL:** sandy silt, light brown, trace oxidation, very moist		2	SS	4		219					
218.7												
1.5	**SILT:** trace sand, brownish grey, trace oxidation, very moist, loose		3	SS	9							
2 / 217.9							218					
2.3	**SAND:** trace silt, brownish grey, oxidated, wet, compact		4	SS	11							
3	trace to some silt, trace clay, grey		5	SS	14		217					wet spoon 1 47 46 6
4 / 215.6							216					
4.6	**SILTY CLAY TILL:** trace sand, grey, moist, stiff to very stiff		6	SS	18							
5							215					
6			7	SS	14		214					
213.7												
6.6	**END OF BOREHOLE:**											

Note:
1. Borehole caved at 3.96 mbgs.
2. Water was encountered at 3.35 mbgs upon completion of drilling.

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; $\circ^{\varepsilon=3\%}$ Strain at Failure

SPCL SOIL LOG-1WELL-DRAFT SP19-463-00 - EAST PORTION.GPJ SPCL.GDT 11/21/19

LOG OF BOREHOLE BH 113

PROJECT: Geotechnical & Hydrogeological Investigation for Fire Station #4 Project

CLIENT: Town of New Tecumseth

PROJECT LOCATION: 6375 14th Line, Alliston, New Tecumseth, ON (East Portion)

DATUM: Geodetic

BH LOCATION: See Drawing 1

DRILLING DATA

Method: Hollow Stem Auger

Diameter: 200 mm

Date: Oct/02/2019

REF. NO.: SP19-463-00

ENCL NO.: 15

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
220.2								
0.0 / 219.8	**TOPSOIL:** 400 mm		1	SS	6		220	
0.4	**FILL:** silty sand, trace rootlets, brown, moist							
1	**POSSIBLE FILL:** clayey silt, trace sand, light brown, moist		2	SS	4		219	
218.7								
1.5	**SAND:** trace to some silt, greyish brown, moist, compact		3	SS	17		218	
2	oxidated, wet, loose		4	SS	8			wet spoon 60 34 6
3	becoming compact							
217.0			5	SS	15		217	
3.2	**CLAYEY SILT TILL:** trace sand, grey, moist, stiff							
4							216	
			6	SS	21			
5							215	
6	No recovery		7	NR	22		214	
7							213	
212.6								
7.6	**SILTY SAND TILL:** trace cobbles, trace gravel, trace clay, grey, very moist, loose		8	SS	6			
8							212	
9	becoming dense							
210.9			9	SS	30		211	
9.3	**CLAYEY SILT TILL:** trace to some sand, trace gravel, grey, moist, hard							
10								

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH (kPa) (20 40 60 80 100)
○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L

WATER CONTENT (%) (10 20 30)

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

Continued Next Page

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ $^{\varepsilon}$=3% Strain at Failure

LOG OF BOREHOLE BH 113

PROJECT: Geotechnical & Hydrogeological Investigation for Fire Station #4 Project

CLIENT: Town of New Tecumseth

PROJECT LOCATION: 6375 14th Line, Alliston, New Tecumseth, ON (East Portion)

DATUM: Geodetic

BH LOCATION: See Drawing 1

DRILLING DATA

Method: Hollow Stem Auger

Diameter: 200 mm

Date: Oct/02/2019

REF. NO.: SP19-463-00

ENCL NO.: 15

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH (kPa)	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT / WATER CONTENT (%)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"							GR SA SI CL
209.5	**CLAYEY SILT TILL:** trace to some sand, trace gravel, grey, moist, hard(Continued)						210					
10.7	**SILTY SAND TILL:** trace cobbles, trace gravel, trace clay, grey, moist, very dense		10	SS	92		209		○			
207.8			11	SS	50/76 mm		208		○			
12.4	**END OF BOREHOLE:** Note: 1. Borehole caved at 11.83 mbgs.											

SHEAR STRENGTH (kPa): ○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE & Sensitivity, × LAB VANE

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; $\circ^{\varepsilon=3\%}$ Strain at Failure

LOG OF BOREHOLE BH 114

PROJECT: Geotechnical & Hydrogeological Investigation for Fire Station #4 Project

CLIENT: Town of New Tecumseth

PROJECT LOCATION: 6375 14th Line, Alliston, New Tecumseth, ON (East Portion)

DATUM: Geodetic

BH LOCATION: See Drawing 1

DRILLING DATA

Method: Soild Stem Auger

Diameter: 150 mm

Date: Oct/03/2019

REF. NO.: SP19-463-00

ENCL NO.: 16

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
220.2												
0.0	**FILL:** sandy silt, trace clay, brown, oxidated, moist		1	SS	16		220					
1			2	SS	4		219					
218.7												
1.5	**SANDY SILT:** brown, oxidated, very moist, compact		3	SS	12		218					
2												
217.9												
2.3	**SAND:** some silt, greyish brown, very moist, compact		4	SS	11	▽						wet spoon
3	trace silt, greyish brown, trace oxidation, very moist		5	SS	22		217					
4							216					
215.6												
4.6	**CLAYEY SILT TILL:** grey, moist, very stiff		6	SS	27							
5												
215.2												
5.1	**END OF BOREHOLE:**											

W. L. 217.7 m
Oct 15, 2019

Note:

1. Borehole caved at 3.56 mbgs.
2. Monitoring well was installed upon completion of drilling.
3. Groundwater level was observed at 2.54 mbgs on October 15, 2019.

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ε_f=3% Strain at Failure

SPCL SOIL LOG-1WELL-DRAFT SP19-463-00 - EAST PORTION.GPJ SPCL.GDT 11/21/19

SIRATI & PARTNERS

LOG OF BOREHOLE BH 115

PROJECT: Geotechnical & Hydrogeological Investigation for Fire Station #4 Project
CLIENT: Town of New Tecumseth
PROJECT LOCATION: 6375 14th Line, Alliston, New Tecumseth, ON (East Portion)
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Soild Stem Auger
Diameter: 150 mm
Date: Oct/04/2019

REF. NO.: SP19-463-00
ENCL NO.: 17

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
220.1												
0.0 / 219.7	**TOPSOIL:** 380 mm		1	SS	10		220		○			
0.4	**FILL:** sand, trace silt, trace rootlets, light brown, moist											
1	becoming clayey silt, trace sand, brown, oxidated, very moist		2	SS	4		219		○			
	becoming greyish brown, oxidated, very moist		3	SS	4				○			wet spoon
2 / 217.8							218					
2.3	**SAND:** trace to some silt, greyish brown, wet, loose		4	SS	9				○			
3	becoming compact		5	SS	23		217		○			
4							216					
	becoming grey		6	SS	18				○			
5 / 215.0												
5.1	**END OF BOREHOLE:**											

Note:

1. Borehole caved at 3.86 mbgs.

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: + 3, × 3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

SPCL SOIL LOG-1WELL-DRAFT SP19-463-00 - EAST PORTION.GPJ SPCL.GDT 11/21/19

LOG OF BOREHOLE BH 116

PROJECT: Geotechnical & Hydrogeological Investigation for Fire Station #4 Project

CLIENT: Town of New Tecumseth

PROJECT LOCATION: 6375 14th Line, Alliston, New Tecumseth, ON (East Portion)

DATUM: Geodetic

BH LOCATION: See Drawing 1

DRILLING DATA

Method: Soild Stem Auger

Diameter: 150 mm

Date: Oct/04/2019

REF. NO.: SP19-463-00

ENCL NO.: 18

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
220.2								
0.0 / 219.9	**TOPSOIL:** 300 mm							
0.3	**FILL:** silt, trace sand, light brown, moist		1	SS	7		220	
1	**POSSIBLE FILL:**silt, trace sand, trace clay, brown, very moist		2	SS	4		219	
218.7								
1.5	**SILT:** trace sand, greyish brown, very moist, loose		3	SS	9		218	
2								
217.9								
2.3	**SAND:** trace to some silt, greyish brown, wet, compact		4	SS	10			wet spoon
3	trace silt		5	SS	23		217	
216.8								
3.5	**END OF BOREHOLE:**							

Note:
1. Borehole was open upon completion of drilling.
2. Water was encountered at 3 mbgs upon completion of drilling.

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH (kPa) (20 40 60 80 100)
○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%) (10 20 30)

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ $^{\varepsilon}$=3% Strain at Failure

SPCL SOIL LOG-1WELL-DRAFT SP19-463-00 - EAST PORTION.GPJ SPCL.GDT 11/21/19

SIRATI & PARTNERS

LOG OF BOREHOLE BH 117

PROJECT: Geotechnical & Hydrogeological Investigation for Fire Station #4 Project

CLIENT: Town of New Tecumseth

PROJECT LOCATION: 6375 14th Line, Alliston, New Tecumseth, ON (East Portion)

DATUM: Geodetic

BH LOCATION: See Drawing 1

DRILLING DATA

Method: Soild Stem Auger

Diameter: 150 mm

Date: Oct/04/2019

REF. NO.: SP19-463-00

ENCL NO.: 19

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
220.2												
220.0 / 0.1	**TOPSOIL:** 75 mm											
	FILL: silty sand, trace topsoil, trace rootlets, light brown, moist		1	SS	3		220					
1	**POSSIBLE FILL:** silt, trace sand, light brown, oxidated. very moist		2	SS	3		219					
218.7												
1.5	**SANDY SILT:** greyish brown, oxidated, very moist, loose		3	SS	8		218					
2												
217.9												
2.3	**SAND:** trace to some silt, greyish brown, wet, loose		4	SS	7							wet spoon
3	trace silt, compact		5	SS	14		217					
216.7												
3.5	**END OF BOREHOLE:**											

Note:
1. Borehole was open upon completion of drilling.
2. Water was encountered at 2.4 mbgs upon completion of drilling.

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε_f=3% Strain at Failure

SPCL SOIL LOG-1WELL-DRAFT SP19-463-00 - EAST PORTION.GPJ SPCL.GDT 11/21/19

SIRATI & PARTNERS

LOG OF BOREHOLE BH 118

PROJECT: Geotechnical & Hydrogeological Investigation for Fire Station #4 Project

CLIENT: Town of New Tecumseth

PROJECT LOCATION: 6375 14th Line, Alliston, New Tecumseth, ON (East Portion)

DATUM: Geodetic

BH LOCATION: See Drawing 1

DRILLING DATA

Method: Soild Stem Auger

Diameter: 150 mm

Date: Oct/04/2019

REF. NO.: SP19-463-00

ENCL NO.: 20

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
220.2												
0.0 / 219.9	**TOPSOIL:** 300 mm											
0.3	**FILL:** sandy silt, light brown ,trace rootlets, moist		1	SS	5		220		○			
1	some clay, trace rootlets, oxidated, very moist		2	SS	4				○			
218.7							219					
1.5	**SANDY SILT:** trace gravel, trace clay, greyish brown, very moist, compact		3	SS	10				○			
2 / 217.9							218					
2.3	**SILTY SAND:** greyish brown, trace oxidation, wet, loose		4	SS	8				○			
3	becoming brownish grey, compact		5	SS	16		217		○			wet spoon
4 / 215.6							216					
4.6	**SILT:** trace sand, trace clay, grey, wet, compact		6	SS	15				○			
5 / 215.2												
5.1	**END OF BOREHOLE:**											

Note:
1. Brehole caved at 3.35 mbgs.
2. Water was encountered at 3 mbgs upon completion of drilling.

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

SPCL SOIL LOG-1WELL-DRAFT SP19-463-00 - EAST PORTION.GPJ SPCL.GDT 11/21/19

SIRATI & PARTNERS

LOG OF BOREHOLE BH 119

PROJECT: Geotechnical & Hydrogeological Investigation for Fire Station #4 Project
CLIENT: Town of New Tecumseth
PROJECT LOCATION: 6375 14th Line, Alliston, New Tecumseth, ON (East Portion)
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Soild Stem Auger
Diameter: 150 mm
Date: Oct/03/2019

REF. NO.: SP19-463-00
ENCL NO.: 21

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
220.8												
220.7 / 0.1	**ASPHALT:** 76 mm thick											
220.6 / 0.2	**GRANULAR FILL:** sand and gravel, 125 mm thick		1	SS	18				○			
	FILL: silty sand, trace gravel, greyish brown, moist											
	oxidated		2	SS	11		220		○			
1	becoming sandy silt, greyish brown, trace oxidation		3	SS	3		219		○			
2 / 218.5												
2.3	**SILTY SAND:** greyish brown, trace oxidation, wet, compact		4	SS	11		218		○			wet spoon
3 / 217.8												
3.0 / 217.3	**SAND:** trace silt, brownish grey, trace oxidation, wet, loose		5	SS	5				○			
3.5	**END OF BOREHOLE:**											

Note:
1. Borehole was open upon completion of drilling.

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: $+^{3}$, $\times^{3}$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

SPCL SOIL LOG-1WELL-DRAFT SP19-463-00 - EAST PORTION.GPJ SPCL.GDT 11/21/19

LOG OF BOREHOLE BH 120

PROJECT: Geotechnical & Hydrogeological Investigation for Fire Station #4 Project

CLIENT: Town of New Tecumseth

PROJECT LOCATION: 6375 14th Line, Alliston, New Tecumseth, ON (East Portion)

DATUM: Geodetic

BH LOCATION: See Drawing 1

DRILLING DATA

Method: Soild Stem Auger

Diameter: 150 mm

Date: Oct/04/2019

REF. NO.: SP19-463-00

ENCL NO.: 22

SOIL PROFILE (m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
220.2								
0.0 / 219.9	**TOPSOIL:** 300 mm						220	
0.3	**FILL:** silty sand, light brown, moist		1	SS	8			
1	becoming clayey silt, trace sand, brownish grey, oxidated, very moist **POSSIBLE FILL:** silt, trace sand, trace clay, brownish grey, very moist		2	SS	4		219	
			3	SS	10			
2 / 217.9							218	
2.3 / 217.2	**SILT:** some sand, grey, trace oxidation, very moist to wet, compact		4	SS	14			wet spoon
3.0 / 216.7	**SAND:** trace silt, grey, oxidated, wet, compact		5	SS	25		217	
3.5	**END OF BOREHOLE:**							

Note:
1. Borehole caved at 3.16 mbgs.
2. Water was encountered at 2.7 mbgs upon completion of drilling.

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH (kPa): ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE; 20 40 60 80 100

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L

WATER CONTENT (%): 10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

GROUNDWATER ELEVATIONS

Measurement: 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; $\circ^{\varepsilon=3\%}$ Strain at Failure

SPCL SOIL LOG-1WELL-DRAFT SP19-463-00 - EAST PORTION.GPJ SPCL.GDT 11/21/19

LOG OF BOREHOLE BH 121

PROJECT: Geotechnical & Hydrogeological Investigation for Fire Station #4 Project

CLIENT: Town of New Tecumseth

PROJECT LOCATION: 6375 14th Line, Alliston, New Tecumseth, ON (East Portion)

DATUM: Geodetic

BH LOCATION: See Drawing 1

DRILLING DATA

Method: Soild Stem Auger

Diameter: 150 mm

Date: Oct/04/2019

REF. NO.: SP19-463-00

ENCL NO.: 23

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
220.1												
220.0 / 0.1	**TOPSOIL:** 76 mm						220					
	FILL: silty sand, trace rootlets, brown, moist		1	SS	8				○			
1	**POSSIBLE FILL:** sandy silt, trace clay, light brown, oxidated, moist		2	SS	4		219		○			
218.6												
1.5	**SILT:** trace sand, trace clay, grey, oxidated, very moist, loose		3	SS	6				○			
2 / 217.8							218					
2.3	**SILTY SAND:** grey, oxidated, very moist, loose		4	SS	9		W. L. 217.6 m Oct 15, 2019		○			
3 / 217.1												
3.0	**SAND:** trace silt, greyish brown, wet, compact		5	SS	18		217		○			wet spoon
4 / 215.5							216					
4.6	**CLAYEY SILT TILL:** trace sand, grey, very moist, firm silt seams		6	SS	6				○			
5 / 215.1												
5.1	**END OF BOREHOLE:**											

Note:
1. Borehole caved at 4.46 mbgs.
2. Water was encountered 3.35 mbgs upon completion of drilling.
3. Monitoring well was installed upon completion of drilling.
4. Groundwater level was observed at 2.5 mbgs on October 15, 2019.

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: +³, ×³: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

SPCL SOIL LOG-1WELL-DRAFT SP19-463-00 - EAST PORTION.GPJ SPCL.GDT 11/21/19

SIRATI & PARTNERS

LOG OF BOREHOLE BH 122

PROJECT: Geotechnical & Hydrogeological Investigation for Fire Station #4 Project

CLIENT: Town of New Tecumseth

PROJECT LOCATION: 6375 14th Line, Alliston, New Tecumseth, ON (East Portion)

DATUM: Geodetic

BH LOCATION: See Drawing 1

DRILLING DATA

Method: Soild Stem Auger

Diameter: 150 mm

Date: Oct/03/2019

REF. NO.: SP19-463-00

ENCL NO.: 24

ELEV / DEPTH (m)	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS "N" 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
220.9												
220.8	**ASPHALT:** 76 mm thick											
220.7 / 0.2	**GRANULAR FILL:** sand and gravel, 100 mm thick		1	SS	19							
	FILL: silty sand, trace cobbles, trace gravel, brown, moist											
1	becoming sandy silt, grey, moist		2	SS	13		220					
	becoming clayey silt, trace gravel, trace sand, brown, oxidated, very moist		3	SS	3							
2 / 218.6							219					
2.3	**SAND:** trace silt, greyish brown, oxidated, very moist, compact		4	SS	16							
3	becoming wet		5	SS	11		218					wet spoon
217.4												
3.5	**END OF BOREHOLE:**											

Note:
1. Borehole caved at 3.16 mbgs.

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ 6=3% Strain at Failure

SPCL SOIL LOG-1WELL-DRAFT SP19-463-00 - EAST PORTION.GPJ SPCL.GDT 11/21/19

SIRATI & PARTNERS

LOG OF BOREHOLE BH 123

PROJECT: Geotechnical & Hydrogeological Investigation for Fire Station #4 Project

CLIENT: Town of New Tecumseth

PROJECT LOCATION: 6375 14th Line, Alliston, New Tecumseth, ON (East Portion)

DATUM: Geodetic

BH LOCATION: See Drawing 1

DRILLING DATA

Method: Soild Stem Auger

Diameter: 150 mm

Date: Oct/03/2019

REF. NO.: SP19-463-00

ENCL NO.: 25

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION
220.7							
220.6 / 0.1	**ASPHALT:** 76 mm thick						
220.4 / 0.3	**GRANULAR FILL:** sand and gravel, 200 mm thick		1	SS	39		
	FILL: sand and gravel, brown, moist						220
1	**POSSIBLE FILL:** sandy silt, brown,very moist		2	SS	10		
219.2							
1.5	**SANDY SILT:** greyish brown, very moist, very loose		3	SS	4		219
2	becoming brownish grey, oxidated, loose		4	SS	8		218
217.7							
3.0	**SILTY SAND:** brownish grey, oxidated, wet, compact		5	SS	21		
217.2							
3.5	**END OF BOREHOLE:**						

Note:
1. Borehole was open and dry upon completion of drilling.

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH (kPa) (20 40 60 80 100)
- ○ UNCONFINED
- ● QUICK TRIAXIAL
- + FIELD VANE & Sensitivity
- × LAB VANE

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L

WATER CONTENT (%) (10 20 30)

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

REMARKS AND GRAIN SIZE DISTRIBUTION (%)

GR SA SI CL

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES

+ 3, × 3: Numbers refer to Sensitivity

○ ε=3% Strain at Failure

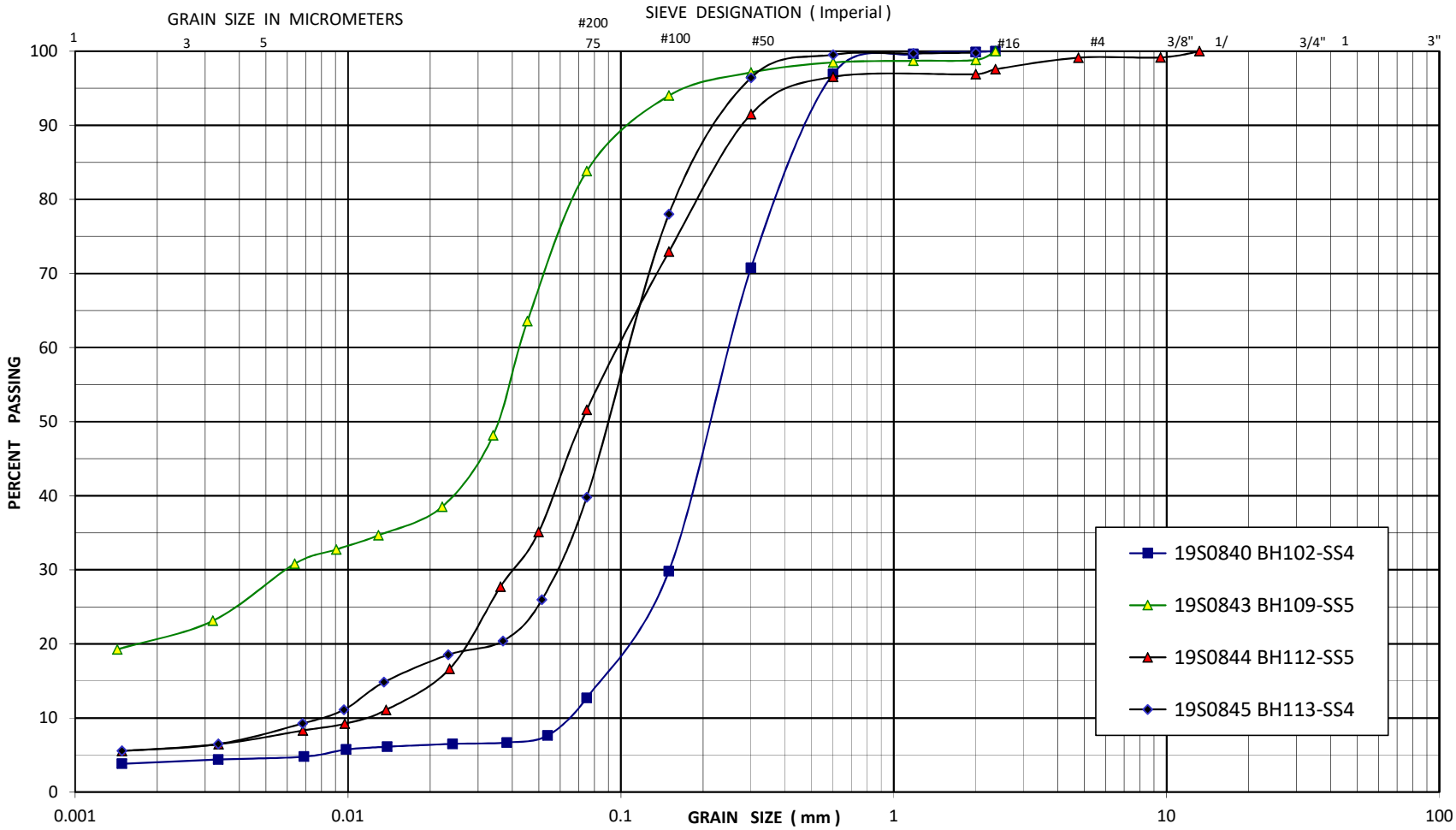
SPCL SOIL LOG-1WELL-DRAFT SP19-463-00 - EAST PORTION.GPJ SPCL.GDT 11/21/19

SIRATI & PARTNERS

GRAIN SIZE DISTRIBUTION

UNIFIED SOIL CLASSIFICATION SYSTEM

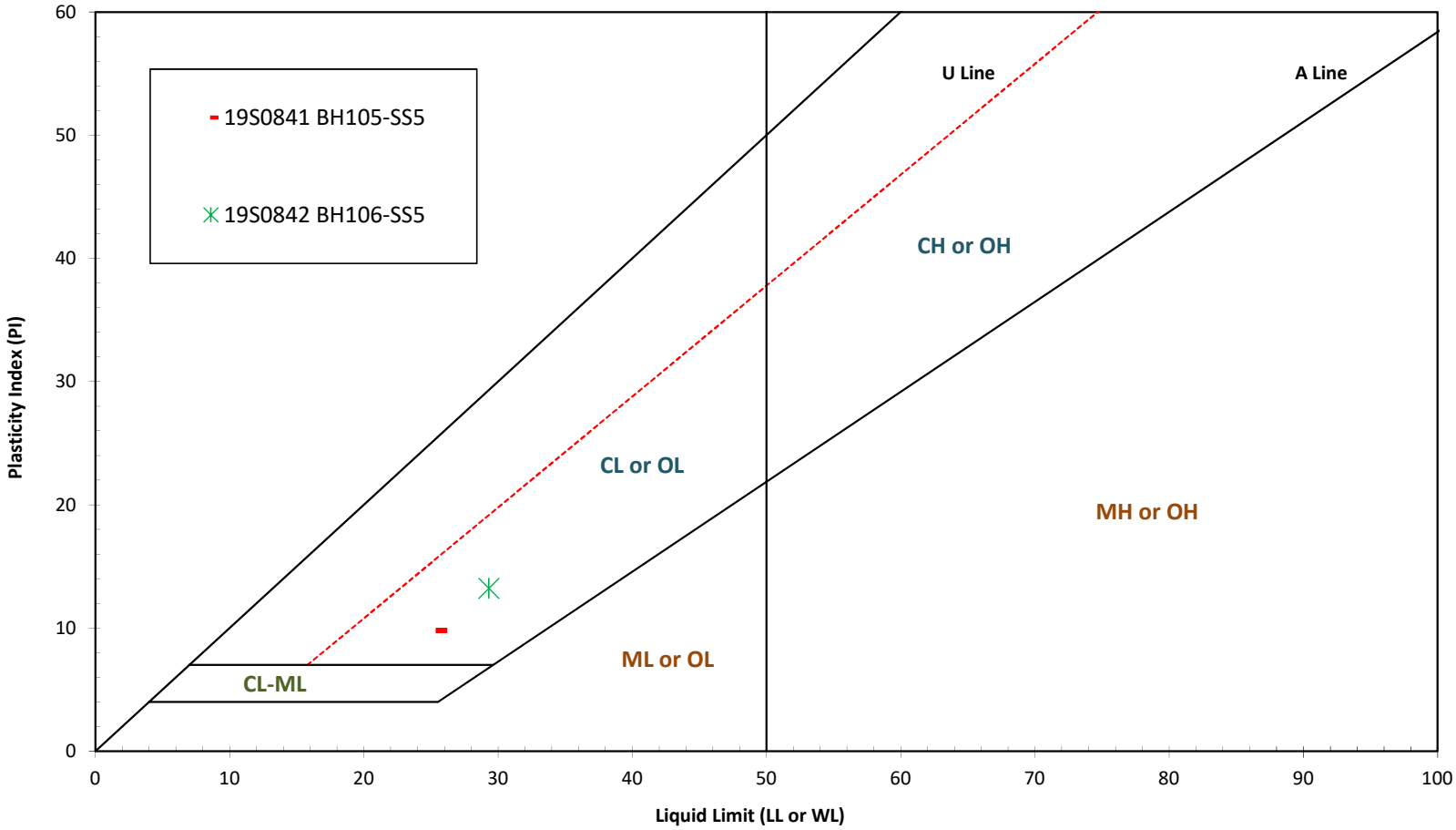
CLAY AND SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	Fine	Coarse



Project No.	:	SP19-463-10
Date	:	14 November 2019
Figure No.	:	26

Atterberg's Limits Test Report

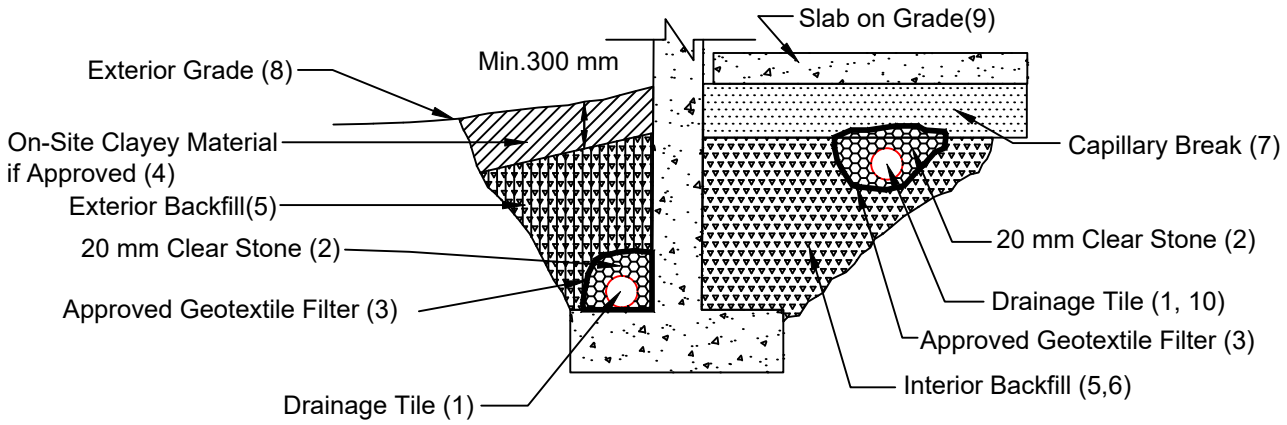
ASTM D4318-10



SIRATI & PARTNERS

Geotechnical Hydrogeological & Environmental Solutions

Date	:	14 November 2019
Project No.	:	SP19-463-10
Figure No.	:	27



EXTERIOR FOOTING

Notes

1. Drainage tile to consist of 100 mm (4") diameter weeping tile or equivalent perforated pipe leading to a positive sump or outlet.
2. 20 mm (3/4") clear stone - 150 mm (6") top and side of drain. If drain is not on footing, place100 mm (4 inches) of stone below drain .
3. Wrap the clear stone with an approved geotextile filter (Terrafix 270R or equivalent).
4. The on-site clayey material, if approved, can be used as backfill in the upper 300 mm.
5. The interior and exterior fill adjacent to foundation walls should be OPSS Granular 'B' Type **I**. Compact to at least 98% SPMDD.
6. Do not use heavy compaction equipment within 450 mm (18") of the wall. Do not fill or compact within 1.8 m (6') of the wall. Place fill on both sides simultaneously.
7. Capillary break to be at least 200 mm (8") of compacted clear 20 mm (3/4") stone or equivalent free draining material. A vapour barrier may be required for specialty floors (consult with architect).
8. Exterior grade to slope away from building at min. 2%.
9. Slab on grade should not be structurally connected to the wall or footing.
10. Underfloor drain invert to be at least 300 mm (12") below underside of floor slab. Drain tile placed in parallel rows 6 to 8 m (12' to 25') centres one way. Place drain on 100 mm (4") clear stone with 150 mm (6") of clear stone on top and sides. Cover stone with filter fabric as noted in (3).
11. Do not connect the underfloor drains to perimeter drains.
12. Review the geotechnical report for specific details.

DRAINAGE AND BACKFILL RECOMMENDATIONS
Slab on Grade Construction With Underfloor Drainage

(not to scale)

GENERAL REQUIREMENTS FOR ENGINEERED FILL

Compacted imported soil that meets specific engineering requirements and is free of organics and debris and that has been continually monitored on a full-time basis by a qualified geotechnical representative is classified as engineered fill. Engineered fill that meets these requirements and is bearing on suitable native subsoil can be used for the support of foundations.

Imported soil used as engineered fill can be removed from other portions of a site or can be brought in from other sites. In general, most of Ontario soils are too wet to achieve the 100% Standard Proctor Maximum Dry Density (SPMDD) and will require drying and careful site management if they are to be considered for engineered fill. Imported non-cohesive granular soil is preferred for all engineered fill. For engineered fill, we recommend use of OPSS Granular 'B' sand and gravel fill material.

Adverse weather conditions such as rain make the placement of engineered fill to the required degree of density difficult or impossible; engineered fill cannot be placed during freezing conditions, i.e. normally not between December 15 and April 1 of each year.

The location of the foundations on the engineered fill pad is critical and certification by a qualified surveyor that the foundations are within the stipulated boundaries is mandatory. Since layout stakes are often damaged or removed during fill placement, offset stakes must be installed and maintained by the surveyors during the course of fill placement so that the contractor and engineering staff are continually aware of where the engineered fill limits lie. Excavations within the engineered fill pad must be backfilled with the same conditions and quality control as the original pad.

To perform satisfactorily, engineered fill requires the cooperation of the designers, engineers, contractors and all parties must be aware of the requirements. The minimum requirements are as follows; however, the geotechnical report must be reviewed for specific information and requirements.

1. Prior to site work involving engineered fill, a site meeting to discuss all aspects must be convened. The surveyor, contractor, design engineer and geotechnical engineer must attend the meeting. At this meeting, the limits of the engineered fill will be defined. The contractor must make known where all fill material will be obtained from and samples must be provided to the geotechnical engineer for review, and approval before filling begins.

2. Detailed drawings indicating the lower boundaries as well as the upper boundaries of the engineered fill must be available at the site meeting and be approved by the geotechnical engineer.

3. The building footprint and base of the pad, including basements, garages, etc. must be defined by offset stakes that remain in place until the footings and service connections are all constructed. Confirmation that the footings are within the pad, service lines are in place, and that the grade conforms to drawings, must be obtained by the owner in writing from the surveyor and Sirati & Partners Consultants Limited. Without this confirmation, no responsibility for the performance of the structure can be accepted by Sirati & Partners Consultants Limited (SIRATI). Survey drawing of the pre-and post-fill location and elevations will also be required.

4. The area must be stripped of all topsoil and fill materials. Subgrade must be proof-rolled. Soft spots must be dug out. The stripped native subgrade must be examined and approved by a SIRA -TI engineer prior to placement of fill.

5. The approved engineered fill material must be compacted to 100% Standard Proctor Maximum Dry Density throughout. Engineered fill should not be placed during the winter months. Engineered fill compacted to 100% SPMDD will settle under its own weight approximately 0.5% of the fill height and the structural engineer must be aware of this settlement. In addition to the settlement of the fill, additional settlement due to consolidation of the underlying soils from the structural and fill loads will occur and should be evaluated prior to placing the fill.

6. Full-time geotechnical inspection by SIRATI during placement of engineered fill is required. Workcannot commence or continue without the presence of the SIRATI representative.

7. The fill must be placed such that the specified geometry is achieved. Refer to the attached sketches for minimum requirements. Take careful note that the projection of the compacted pad beyond the footing at footing level is a minimum of 2 m. The base of the compacted pad extends 2 m plus the depth of excavation beyond the edge of the footing.

8. A bearing capacity of 150 kPa at SLS (225 kPa at ULS) can be used provided that all conditions outlined above are adhered to. A minimum footing width of 500 mm (20 inches) is suggested and footings must be provided with nominal steel reinforcement.

9. All excavations must be done in accordance with the Occupational Health and Safety Regulations of Ontario.

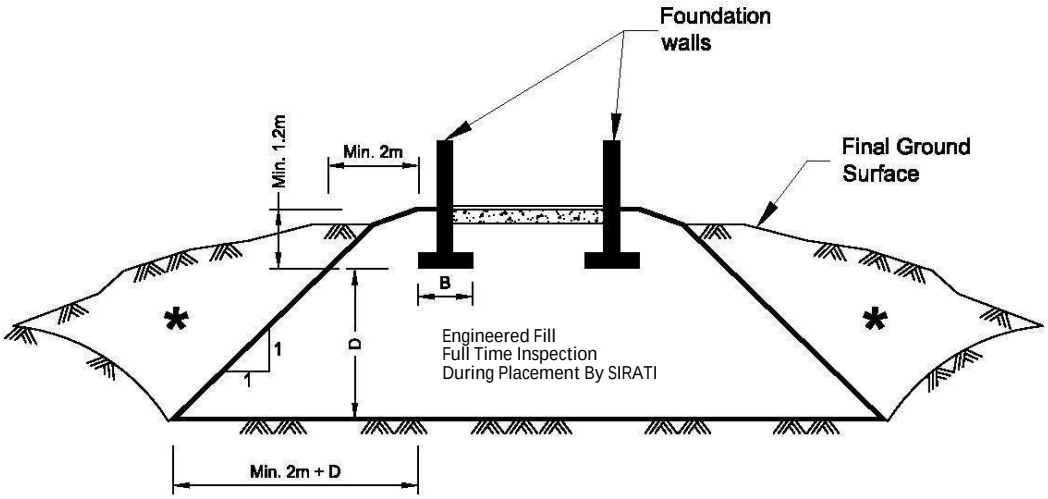
10. After completion of the engineered fill pad a second contractor may be selected to install footings. The prepared footing bases must be evaluated by engineering staff from SIRATI prior tofooting concrete placements. All excavations must be backfilled under full time supervision bySIRATI to the same degree as the engineered fill pad. Surface water cannot be allowed to pond inexcavations or to be trapped in clear stone backfill. Clear stone backfill can only be used with theapproval of SIRATI.

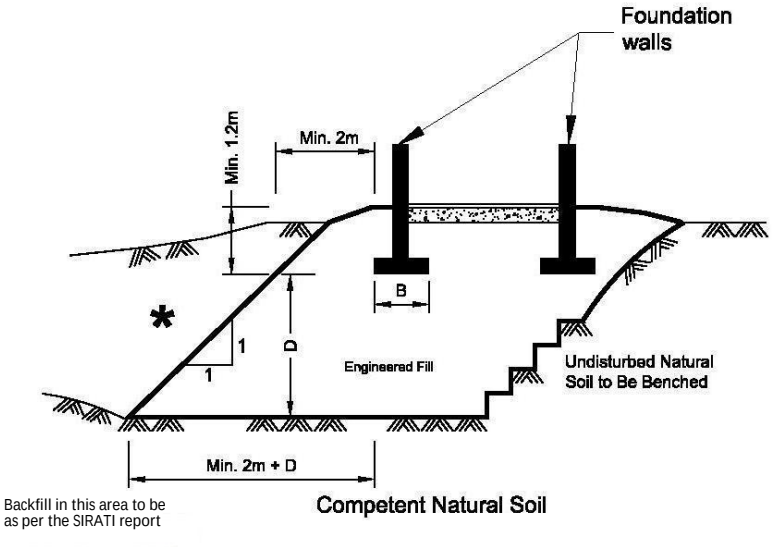
11. After completion of compaction, the surface of the engineered fill pad must be protected from disturbance from traffic, rain and frost. During the course of fill placement, the engineered fill must be smooth-graded, proof-rolled and sloped/crowned at the end of each day, prior to weekends and any stoppage in work in order to promote rapid runoff of rainwater and to avoid any ponding surface water. Any stockpiles of fill intended for use as engineered fill must also be smooth-bladed to promote runoff and/or protected from excessive moisture take up.

12. If there is a delay in construction, the engineered fill pad must be inspected and accepted by the geotechnical engineer. The location of the structure must be reconfirmed that it remains within the pad.

13. The geometry of the engineered fill as illustrated in these General Requirements is general in nature. Each project will have its own unique requirements. For example, if perimeter sidewalks are to be constructed around the building, then the projection of the engineered fill beyond the foundation wall may need to be greater.

14. These guidelines are to be read in conjunction with Sirati & Partners Consultants Limited (SIRA TI) report attached.


Foundation walls
Min. 1.2m
Min. 2m
Final Ground Surface
B
D
1
1
Engineered Fill
Full Time Inspection
During Placement By SIRATI
Min. 2m + D
Competent Natural Soil To Be Confirmed By SIRATI


Foundation walls
Min. 1.2m
Min. 2m
B
D
1
1
Engineered Fill
Undisturbed Natural Soil to Be Benched
Min. 2m + D
Backfill in this area to be as per the SIRATI report
Competent Natural Soil

APPENDIX B

SIRATI & PARTNERS
Geotechnical Hydrogeological & Environmental Solutions

SIRATI & PARTNERS

LOG OF BOREHOLE BH 3

PROJECT: Geotechnical & Hydrogeological Investigation for Fire Station #4 Project

CLIENT: Town of New Tecumseth

PROJECT LOCATION: 6375 14th Line, Alliston, New Tecumseth

DATUM: Geodetic

BH LOCATION: See Drawing 1

DRILLING DATA

Method: Soild Stem Auger

Diameter: 150 mm

Date: Oct/04/2019

REF. NO.: SP19-463-00

ENCL NO.: 2

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS "N" 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
223.3												
0.0	Augered from surface to 3 mbgs						223					The Borehole was advanced from the top of the topsoil stockpile
	FILL: silty sand mixed with topsoil, trac gravel, brown, moist			GRAB			222					
220.3	**TOPSOIL:** trace rootlets, trace silty sand, dark brown, moist			GRAB			221					
3.0	**FILL:** sandy silt mixed with topsoil, trace gravel, dark brown, moist		1	SS	5		220					
219.5												
3.8	**SAND:** some silt, brown, moist, loose		2	SS	8		219					
	trace silt, becoming very moist and compact		3	SS	14							
	becoming wet		4	SS	21		218					
	becoming grey		5	SS	24		217					
216.7												
6.6	**END OF BOREHOLE:**											

Note:
1. Borehole was open and dry upon completion of drilling.

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ $^{\varepsilon}$=3% Strain at Failure

SPCL SOIL LOG /DRAFT SP19-463-00 - WEST PORTION.GPJ SPCL.GDT 11/12/19

SIRATI & PARTNERS

LOG OF BOREHOLE BH 6

PROJECT: Geotechnical & Hydrogeological Investigation for Fire Station #4 Project

CLIENT: Town of New Tecumseth

PROJECT LOCATION: 6375 14th Line, Alliston, New Tecumseth

DATUM: Geodetic

BH LOCATION: See Drawing 1

DRILLING DATA

Method: Solid Stem Auger

Diameter: 150 mm

Date: Jun/06/2019

REF. NO.: SP19-463-00

ENCL NO.: 3

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
220.5												
220.4 / 0.1	**TOPSOIL:** 75 mm											
	POSSIBLE FILL: silty sand, trace silt, trace rootlets, brown, moist		1	SS	4		220					
219.7												
0.8	**SANDY SILT:** trace clay, brown, very moist, very loose		2	SS	4							
219.0							219					
1.5	**SILTY SAND:** trace clay, brown, very moist, loose		3	SS	9							
	brown to grey, wet, compact		4	SS	14		218					
217.5												
3.0	**SAND:** trace silt, brown to grey, wet, compact		5	SS	18		217					
215.9							216					
4.6	**SILTY CLAY TILL:** trace sand, grey, moist, compact		6	SS	13							
215.4												
5.1	**END OF BOREHOLE:**											
	1. Water was encountered at 1.83 mbgs upon completion of drilling. 2. Borehole caved at 2.4 mbgs.											

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ $^{\varepsilon_f}$=3% Strain at Failure

SPCL SOIL LOG /DRAFT SP19-463-00 - WEST PORTION.GPJ SPCL.GDT 11/12/19

SIRATI & PARTNERS

LOG OF BOREHOLE BH 7

PROJECT: Geotechnical & Hydrogeological Investigation for Fire Station #4 Project

CLIENT: Town of New Tecumseth

PROJECT LOCATION: 6375 14th Line, Alliston, New Tecumseth

DATUM: Geodetic

BH LOCATION: See Drawing 1

DRILLING DATA

Method: Solid Stem Auger

Diameter: 150 mm

Date: Jun/06/2019

REF. NO.: SP19-463-00

ENCL NO.: 4

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION
222.5							
0.0 / 222.2	**TOPSOIL:** 300 mm		1	SS	2		222
0.3 / 221.7	**POSSIBLE FILL:** silty sand, trace rootlets, trace grass, trace plastic, dark brown, moist						
0.8	**SANDY SILT:** ttrace clay, race rootlets, brown, moist, loose		2	SS	9		
			3	SS	2		221
			4	SS	12		220
219.5							
3.0	**SAND:** trace silt, grey, wet, very loose		5	SS	3		219
217.9							
4.6	**SILTY CLAY TILL:** trace gravel, trace sand, grey, moist, very stiff		6	SS	16		218
	becoming stiff		7	SS	10		217
	becoming firm		8	SS	5		216
	becoming very moist		9	SS	8		215
							214
							213

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH (kPa): ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE; 20 40 60 80 100

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L

WATER CONTENT (%): 10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

REMARKS AND GRAIN SIZE DISTRIBUTION (%)

GR SA SI CL

Continued Next Page

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES: +3, ×3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

SPCL SOIL LOG /DRAFT SP19-463-00 - WEST PORTION.GPJ SPCL.GDT 11/12/19

LOG OF BOREHOLE BH 7

PROJECT: Geotechnical & Hydrogeological Investigation for Fire Station #4 Project

CLIENT: Town of New Tecumseth

PROJECT LOCATION: 6375 14th Line, Alliston, New Tecumseth

DATUM: Geodetic

BH LOCATION: See Drawing 1

DRILLING DATA

Method: Solid Stem Auger

Diameter: 150 mm

Date: Jun/06/2019

REF. NO.: SP19-463-00

ENCL NO.: 4

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH (kPa)	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT / WATER CONTENT (%)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	SILTY CLAY TILL: trace gravel, trace sand, grey, moist, very stiff(Continued)											
11	trace to some sand, becoming wet, hard		10	SS	54		212					
12	becoming very stiff		11	SS	29		211					
13							210					
208.8							209					
13.7	**SILTY SAND TILL:** trace gravel, trace clay, grey, wet, very dense		12	SS	89/ 250 mm							
14							208					
15												
207.1			13	SS	50/ 125 mm							
15.4	**END OF BOREHOLE:**											
	1. Water was encountered at 1.8 mbgs upon completion of drillling. 2. Borehole caved at 3.35 mbgs.											

SPCL SOIL LOG /DRAFT SP19-463-00 - WEST PORTION.GPJ SPCL.GDT 11/12/19

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^{3}$, $\times^{3}$: Numbers refer to Sensitivity; $\circ^{\varepsilon=3\%}$ Strain at Failure

LOG OF BOREHOLE BH 10

PROJECT: Geotechnical & Hydrogeological Investigation for Fire Station #4 Project

CLIENT: Town of New Tecumseth

PROJECT LOCATION: 6375 14th Line, Alliston, New Tecumseth

DATUM: Geodetic

BH LOCATION: See Drawing 1

DRILLING DATA

Method: Solid Stem Auger

Diameter: 150 mm

Date: Jun/07/2019

REF. NO.: SP19-463-00

ENCL NO.: 5

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION
220.2							
0.0 / 220.0	**TOPSOIL:** 250 mm						
0.3 / 219.4	**POSSIBLE FILL:** silty sand, brown, moist, loose		1	SS	8		
0.8	**SANDY SILT:** trace clay, brown, very moist, very loose		2	SS	2		
	becoming compact		3	SS	11		
217.9							
2.3 / 217.2	**SAND:** trace silt, brown, wet, compact		4	SS	16		
3.0 / 215.6	**SILTY SAND:** brown, wet, compact		5	SS	19		
4.6 / 215.1	**SILTY CLAY TILL:** trace gravel, trace sand, grey, wet, compact		6	SS	23		
5.1	**END OF BOREHOLE:**						

1. Water was encountered at 1.8 mbgs upon completion of drilling.
2. Borehole caved at 2.7 mbgs.
3. Monitorin well was installed upon completion of drilling.

W. L. 218.0 m
Aug 08, 2019

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED
● QUICK TRIAXIAL
+ FIELD VANE & Sensitivity
× LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

REMARKS AND GRAIN SIZE DISTRIBUTION (%)

GR SA SI CL

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ 8=3% Strain at Failure

SPCL SOIL LOG /DRAFT SP19-463-00 - WEST PORTION.GPJ SPCL.GDT 11/12/19

LOG OF BOREHOLE BH 12

PROJECT: Geotechnical & Hydrogeological Investigation for Fire Station #4 Project

CLIENT: Town of New Tecumseth

PROJECT LOCATION: 6375 14th Line, Alliston, New Tecumseth

DATUM: Geodetic

BH LOCATION: See Drawing 1

DRILLING DATA

Method: Hollow Stem Auger

Diameter: 200 mm

Date: Jun/07/2019

REF. NO.: SP19-463-00

ENCL NO.: 6

ELEV / DEPTH (m)	DESCRIPTION	NUMBER	TYPE	BLOWS 0.3 m "N"	ELEVATION
220.2 / 0.0	**TOPSOIL:** 75 mm				
220.1 / 0.1	**POSSIBLE FILL:** silty sand, trace rootlets, dark brown to brown, moist	1	SS	6	220
219.4 / 0.8	**SANDY SILT:** some clay, brown, very moist, very loose	2	SS	4	219
218.7 / 1.5	**SILTY SAND:** trace clay, brown, very moist, loose	3	SS	9	
	brown to grey, wet, compact	4	SS	17	218
217.2 / 3.0	**SAND:** trace cobbles, trace silt, brown, wet, compact	5	SS	21	217
215.6 / 4.6	**SILTY CLAY TILL:** trace gravel, trace sand, grey, moist, stiff	6	SS	11	216
	becoming firm	7	SS	7	215
	becoming wet	8	SS	7	214
		9	SS	7	213
					212
					211

SOIL PROFILE | SAMPLES | GROUND WATER CONDITIONS | ELEVATION | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) | SHEAR STRENGTH (kPa): ○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE & Sensitivity, × LAB VANE (20 40 60 80 100) | PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L | WATER CONTENT (%) (10 20 30) | POCKET PEN. (Cu) (kPa) | NATURAL UNIT WT (kN/m³) | REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

Continued Next Page

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES: +3, ×3: Numbers refer to Sensitivity; ○ε=3%: Strain at Failure

LOG OF BOREHOLE BH 12

PROJECT: Geotechnical & Hydrogeological Investigation for Fire Station #4 Project

CLIENT: Town of New Tecumseth

PROJECT LOCATION: 6375 14th Line, Alliston, New Tecumseth

DATUM: Geodetic

BH LOCATION: See Drawing 1

DRILLING DATA

Method: Hollow Stem Auger

Diameter: 200 mm

Date: Jun/07/2019

REF. NO.: SP19-463-00

ENCL NO.: 6

ELEV / DEPTH (m)	DESCRIPTION	NUMBER	TYPE	BLOWS "N" 0.3 m	ELEVATION
	SILTY CLAY TILL: trace gravel, trace sand, grey, moist, stiff(Continued)				210
	becoming hard	10	SS	93/ 250 mm	
209.2					
11.0	**SANDY SILT TILL:** trace gravel, trace clay, grey, wet, very dense				209
12					
	some cobbles	11	SS	50/ 100 mm	208
13					
					207
206.3		12	SS	50/ 125 mm	
14.0	**END OF BOREHOLE:**				

1. Water was encountered at 1.83 mbgs upon completion of drilling.
2. Borehole caved at 3 mbgs.

STRATA PLOT; GROUND WATER CONDITIONS

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH (kPa) (20 40 60 80 100)
○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%) (10 20 30)

POCKET PEN. (Cu) (kPa); NATURAL UNIT WT (kN/m³)

REMARKS AND GRAIN SIZE DISTRIBUTION (%) — GR SA SI CL

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; $\circ^{\varepsilon=3\%}$ Strain at Failure

SPCL SOIL LOG /DRAFT SP19-463-00 - WEST PORTION.GPJ SPCL.GDT 11/12/19

LOG OF BOREHOLE BH 13

PROJECT: Geotechnical & Hydrogeological Investigation for Fire Station #4 Project

CLIENT: Town of New Tecumseth

PROJECT LOCATION: 6375 14th Line, Alliston, New Tecumseth

DATUM: Geodetic

BH LOCATION: See Drawing 1

DRILLING DATA

Method: Solid Stem Auger

Diameter: 150 mm

Date: Jun/07/2019

REF. NO.: SP19-463-00

ENCL NO.: 7

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION
220.2							
0.0 / 219.7	**TOPSOIL:** 250 mm		1	SS	5		220
0.5 / 219.4	**POSSIBLE FILL:** silty sand, trace cobbles, trace gravel, dark brown, moist						
0.8	**SANDY SILT:** brown, very moist, very loose		2	SS	2		219
	some clay, becoming wet, compact		3	SS	13		
217.2			4	SS	16		218
3.0 / 215.6	**SAND:** trace silt, brown, wet, loose		5	SS	8		217
4.6 / 215.1	**SILTY CLAY TILL:** trace gravel, trace sand, grey, wet, very stiff		6	SS	22		216
5.1	**END OF BOREHOLE:** 1. Water encountered at 2.1 mbgs upon completion of drilling. 2. Borehole caved at 2.7 mbgs.						

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH (kPa) (20 40 60 80 100)
○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%) (10 20 30)

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

REMARKS AND GRAIN SIZE DISTRIBUTION (%)

GR	SA	SI	CL

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: + 3, × 3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

SPCL SOIL LOG /DRAFT SP19-463-00 - WEST PORTION.GPJ SPCL.GDT 11/12/19

SIRATI & PARTNERS

LOG OF BOREHOLE BH 14

PROJECT: Geotechnical & Hydrogeological Investigation for Fire Station #4 Project

CLIENT: Town of New Tecumseth

PROJECT LOCATION: 6375 14th Line, Alliston, New Tecumseth

DATUM: Geodetic

BH LOCATION: See Drawing 1

DRILLING DATA

Method: Solid Stem Auger

Diameter: 150 mm

Date: Jun/06/2019

REF. NO.: SP19-463-00

ENCL NO.: 8

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS "N" 0.3 m	GROUND WATER CONDITIONS	ELEVATION
220.4							
220.3 / 0.1	**TOPSOIL:** 75 mm						
	POSSIBLE FILL: silty sand, some rootlets, trace clay, dark brown, moist		1	SS	4		220
219.6							
0.8	**SANDY SILT:** trace clay, brown, moist, very loose		2	SS	4		219
218.9							
1.5	**SILTY SAND:** trace clay, brown, very moist, loose		3	SS	6		
218.1							
2.3	**SAND:** trace silt, brown, wet, compact		4	SS	11	W. L. 218.1 m Aug 08, 2019	
	becoming loose		5	SS	7		217
217.1							
3.4	**SILTY CLAY TILL:** trace gravel, trace sand, grey, moist, firm						216
	trace sand, stiff		6	SS	12		
							215
			7	SS	13		214
213.8							
6.6	**END OF BOREHOLE:**						
	1. Water encountered at 2.1 mbgs upon copletion of drilling. 2. Borehole caved at 2.7 mbgs. 3. Monitoring well was installed upon completion of drilling.						

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH (kPa) (20 40 60 80 100)
○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%) (10 20 30)

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

REMARKS AND GRAIN SIZE DISTRIBUTION (%)

GR SA SI CL

SPCL SOIL LOG /DRAFT SP19-463-00 - WEST PORTION.GPJ SPCL.GDT 11/12/19

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3, × 3: Numbers refer to Sensitivity

○ ε=3% Strain at Failure

LOG OF BOREHOLE BH 15

PROJECT: Geotechnical & Hydrogeological Investigation for Fire Station #4 Project

CLIENT: Town of New Tecumseth

PROJECT LOCATION: 6375 14th Line, Alliston, New Tecumseth

DATUM: Geodetic

BH LOCATION: See Drawing 1

DRILLING DATA

Method: Solid Stem Auger

Diameter: 150 mm

Date: Jun/07/2019

REF. NO.: SP19-463-00

ENCL NO.: 9

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION
220.3							
220.0 0.0	**TOPSOIL:** 25 mm						
220.0 0.3	**POSSIBLE FILL:** silty sand, trace clay, trace routlets, dark brown, moist		1	SS	5		220
219.5	**SILTY SAND:** brown, moist, loose						
1 0.8	**SANDY SILT:** some clay, brown, moist, very loose		2	SS	4		219
218.8							
1.5	**SILTY SAND:** brown, wet, loose		3	SS	8		
2	compact		4	SS	13		218
217.3							
3.0	**SAND:** trace silt, brown, wet, compact		5	SS	13		217
4							
215.7							216
4.6	**SILTY CLAY TILL:** trace gravel, trace sand, grey, wet, stiff		6	SS	14		
5 215.2							
5.1	**END OF BOREHOLE:**						

1. Water encountered at 1.8 mbgs upon completion of drilling.
2. Borehole caved at 2.7 mbgs.

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

REMARKS AND GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ 8=3% Strain at Failure

SPCL SOIL LOG /DRAFT SP19-463-00 - WEST PORTION.GPJ SPCL.GDT 11/12/19

LOG OF BOREHOLE BH 17

PROJECT: Geotechnical & Hydrogeological Investigation for Fire Station #4 Project

CLIENT: Town of New Tecumseth

PROJECT LOCATION: 6375 14th Line, Alliston, New Tecumseth

DATUM: Geodetic

BH LOCATION: See Drawing 1

DRILLING DATA

Method: Solid Stem Auger

Diameter: 150 mm

Date: Jun/06/2019

REF. NO.: SP19-463-00

ENCL NO.: 10

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION
220.5							
220.4	**TOPSOIL:** 100 mm						
0.1	**POSSIBLE FILL:** silty sand, trace rootlets, dark brown, moist, very loose		1	SS	4		
219.7							
0.8	**SILTY SAND:** trace clay, brown, very moist, loose		2	SS	8		
	becoming compact		3	SS	11		
218.2							
2.3	**SAND:** trace silt, brown, wet, loose to compact		4	SS	9		
217.2			5	SS	10		
3.4	**SILTY CLAY TILL:** trace gravel, trace sand, grey, moist,stiff						
215.4			6	SS	11		
5.1	**END OF BOREHOLE:**						

1. Water was encountered at 1.67 mbgs upon completion of drilling.
2. Borehole caved at 3 mbgs.

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH (kPa) (20 40 60 80 100)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%) (10 20 30)

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

REMARKS AND GRAIN SIZE DISTRIBUTION (%)

GR SA SI CL

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

SPCL SOIL LOG /DRAFT SP19-463-00 - WEST PORTION.GPJ SPCL.GDT 11/12/19

SIRATI & PARTNERS

LOG OF BOREHOLE BH 18

PROJECT: Geotechnical & Hydrogeological Investigation for Fire Station #4 Project

CLIENT: Town of New Tecumseth

PROJECT LOCATION: 6375 14th Line, Alliston, New Tecumseth

DATUM: Geodetic

BH LOCATION: See Drawing 1

DRILLING DATA

Method: Solid Stem Auger

Diameter: 150 mm

Date: Jun/07/2019

REF. NO.: SP19-463-00

ENCL NO.: 11

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
220.4												
220.3 / 0.1	**TOPSOIL:** 75 mm											
	POSSIBLE FILL: silty sand, trace gravel, trace rootlets, dark brown, moist		1	SS	3		220					
219.6												
0.8	**SILTY SAND:** trace clay, brown, very moist, compact		2	SS	5							
218.9							219					
1.5	**SILTY SAND:** trace clay, brown, very moist, compact		3	SS	10							
	becoming wet		4	SS	10		218					
217.4												
3.0	**SAND:** trace silt, brown, wet, loose		5	SS	5		217					
215.8							216					
4.6	**SILTY CLAY TILL:** trace gravel, trace sand, grey, moist, stiff		6	SS	14							
215.3												
5.1	**END OF BOREHOLE:**											

1. Water was encountered at 1.5 mbgs upon completion of drilling.
2. Borehole caved at 2.4 mbgs.

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ $^{\varepsilon}$=3% Strain at Failure

SPCL SOIL LOG /DRAFT SP19-463-00 - WEST PORTION.GPJ SPCL.GDT 11/12/19

LOG OF BOREHOLE BH 19

PROJECT: Geotechnical & Hydrogeological Investigation for Fire Station #4 Project

CLIENT: Town of New Tecumseth

PROJECT LOCATION: 6375 14th Line, Alliston, New Tecumseth

DATUM: Geodetic

BH LOCATION: See Drawing 1

DRILLING DATA

Method: Solid Stem Auger

Diameter: 150 mm

Date: Jun/06/2019

REF. NO.: SP19-463-00

ENCL NO.: 12

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION
220.8							
220.7 / 0.1	**TOPSOIL:** 75 mm **POSSIBLE FILL:** silty sand, trace rootets, dark brown, very moist		1	SS	6		
220.0							
0.8	**SANDY SILT TILL:** trace clay, brown, moist, loose		2	SS	6		220
219.3							
1.5	**SILTY SAND:** brown to grey, very moist, compact		3	SS	13		219
	becoming wet		4	SS	17		
217.8							218
3.0	**SAND:** trace silt, brown, wet, compact		5	SS	11		
217.5							
3.4	**SILTY CLAY TILL:** trace gravel, trace sand, grey, moist, stiff						217
	becoming very stiff		6	SS	17		216
215.7							
5.1	**END OF BOREHOLE:** 1. Water encountered at 1.8 mbgs upon completion of drilling. 2. Borehole caved at 2.7 mbgs.						

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH (kPa) (20 40 60 80 100)
○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%) (10 20 30)

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

REMARKS AND GRAIN SIZE DISTRIBUTION (%)

GR SA SI CL

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; $\circ^{\varepsilon=3\%}$ Strain at Failure

SPCL SOIL LOG /DRAFT SP19-463-00 - WEST PORTION.GPJ SPCL.GDT 11/12/19

LOG OF BOREHOLE BH 20

PROJECT: Geotechnical & Hydrogeological Investigation for Fire Station #4 Project

CLIENT: Town of New Tecumseth

PROJECT LOCATION: 6375 14th Line, Alliston, New Tecumseth

DATUM: Geodetic

BH LOCATION: See Drawing 1

DRILLING DATA

Method: Solid Stem Auger

Diameter: 150 mm

Date: Jun/07/2019

REF. NO.: SP19-463-00

ENCL NO.: 13

SOIL PROFILE (m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
220.4											
0.0	**TOPSOIL:** 600 mm		1	SS	4		220	○	○		
219.8											
0.6	**SILTY CLAY:** some sand, brown, moist, soft		2	SS	4		219	○	○		
1 218.9											
1.5	**SANDY SILT:** trace clay, brown to grey, wet, loose		3	SS	7		218	○	○		
2 218.1											
2.3	**SAND:** trace silt, brown, wet, very loose		4	SS	3		217	○	○		
3	becoming brown to grey, wet, loose		5	SS	8			○	○		
4 215.8							216				
4.6	**SILTY CLAY TILL:** trace gravel, trace sand, grey, moist, very stiff		6	SS	4			○	○		
5 215.3											
5.1	**END OF BOREHOLE:**										

1. Water was encountered at 0.9 mbgs upon completion of drilling.
2. Borehole caved at 2.1 mbgs.

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ $^{\varepsilon_f}$=3% Strain at Failure

SPCL SOIL LOG /DRAFT SP19-463-00 - WEST PORTION.GPJ SPCL.GDT 11/12/19

APPENDIX C

SIRATI & PARTNERS
Geotechnical Hydrogeological & Environmental Solutions

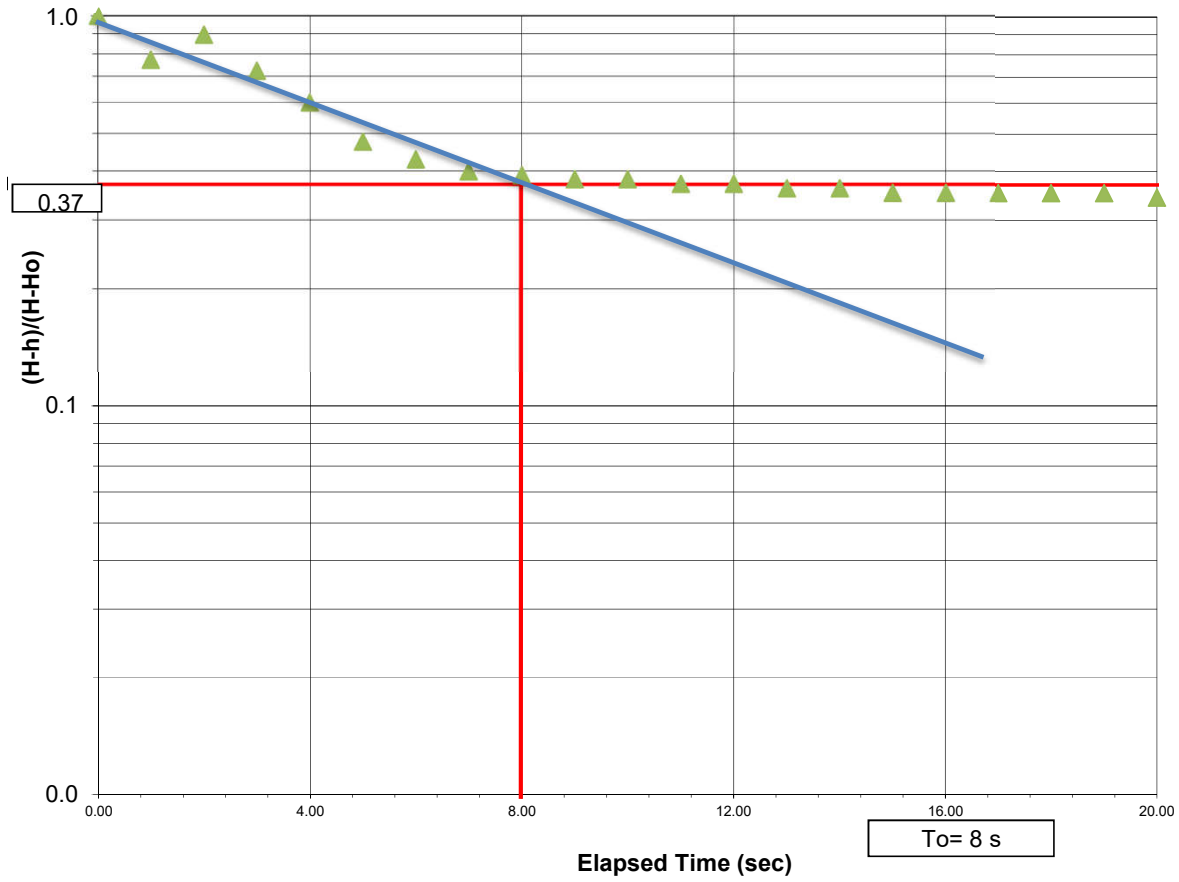
Slug Test: BH/MW105 **Project No.: SP19-463-00**

Project Location: 6375 14th Line, Alliston, Ontario

Data Source: Datalogger Readings based on Falling Head Method dated October 15, 2019

Conducted by:	Sudhakar Kurli			
Interpretted by:	Bujing Guan	H =	Initial Water Head prior to test	
Processing Date:	28-Oct-19	Ho =	Water Head at time = 0	
Well Elevation (mASL):	-	h =	Water Head/Level at time t	
Screen Depth (mBGS):	1.5 ~ 3.0			
Well Diameter:	2.0" ID	L =	55	cm
Static Water Level (mBGS):	2.45	R =	10.2	cm
Initial Reading (H)	10.86	r =	2.54	cm
Test Start Reading (H_0)	11.175	To =	8	sec
Test End Reading	10.86	$K = r^2 \ln(L/R)/(2LTo)$ =	**1.2E-02**	cm/s

Slug Test Result (Hvorslev Method) - BH/MW105
Based on Datalogger Readings

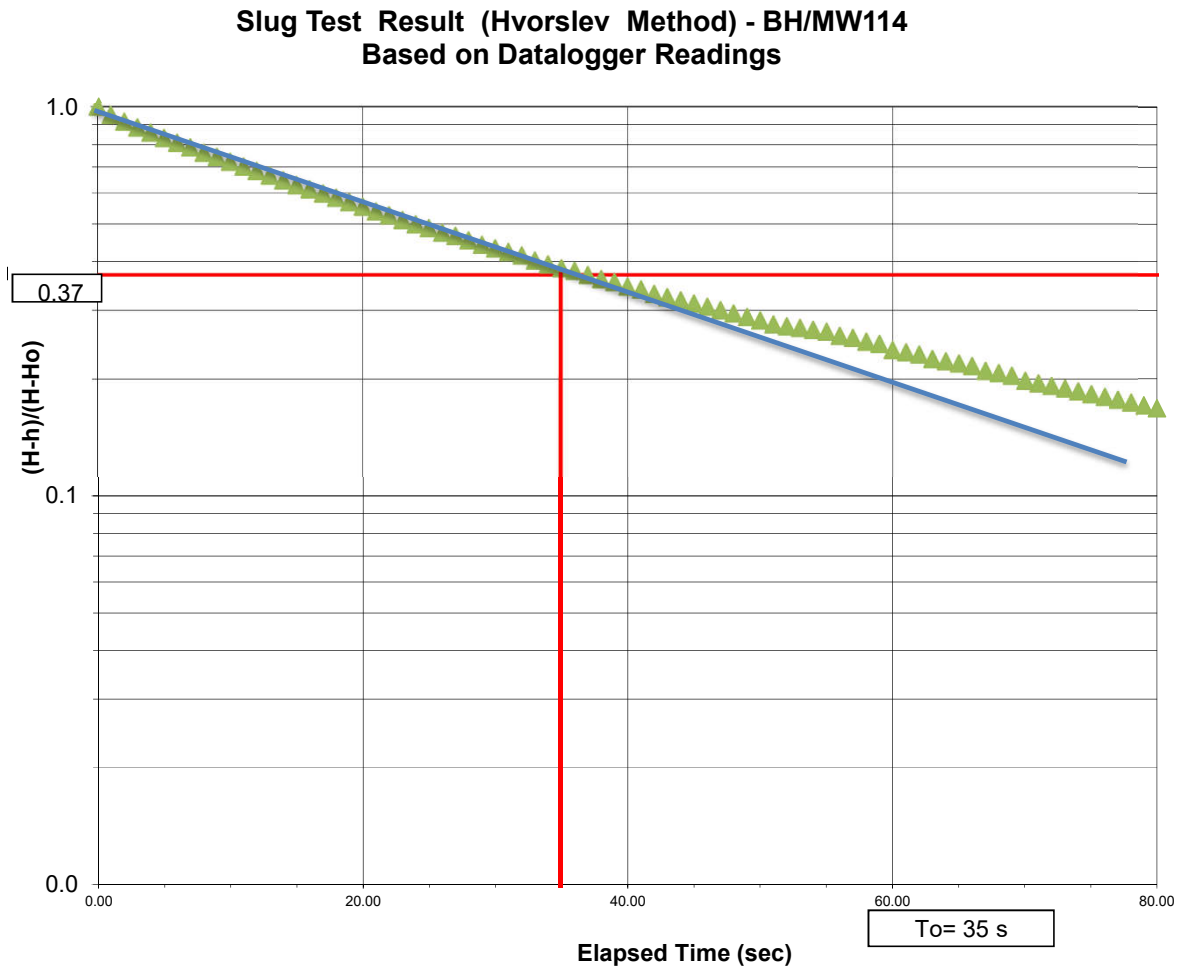


Slug Test: BH/MW114 **Project No.: SP19-463-00**

Project Location: 6375 14th Line, Alliston, Ontario

Data Source: Datalogger Readings based on Falling Head Method dated October 15, 2019

Conducted by:	Sudhakar Kurli			
Interpretted by:	Bujing Guan	H =	Initial Water Head prior to test	
Processing Date:	28-Oct-19	Ho =	Water Head at time = 0	
Well Elevation (mASL):	-	h =	Water Head/Level at time t	
Screen Depth (mBGS):	3.0 ~ 4.6			
Well Diameter:	2.0" ID	L =	206	cm
Static Water Level (mBGS):	2.54	R =	10.2	cm
Initial Reading (H)	11.5	r =	2.54	cm
Test Start Reading (H_0)	12.495	To =	35	sec
Test End Reading	11.5	$K = r^2 \ln(L/R)/(2LTo) =$	**1.3E-03**	cm/s



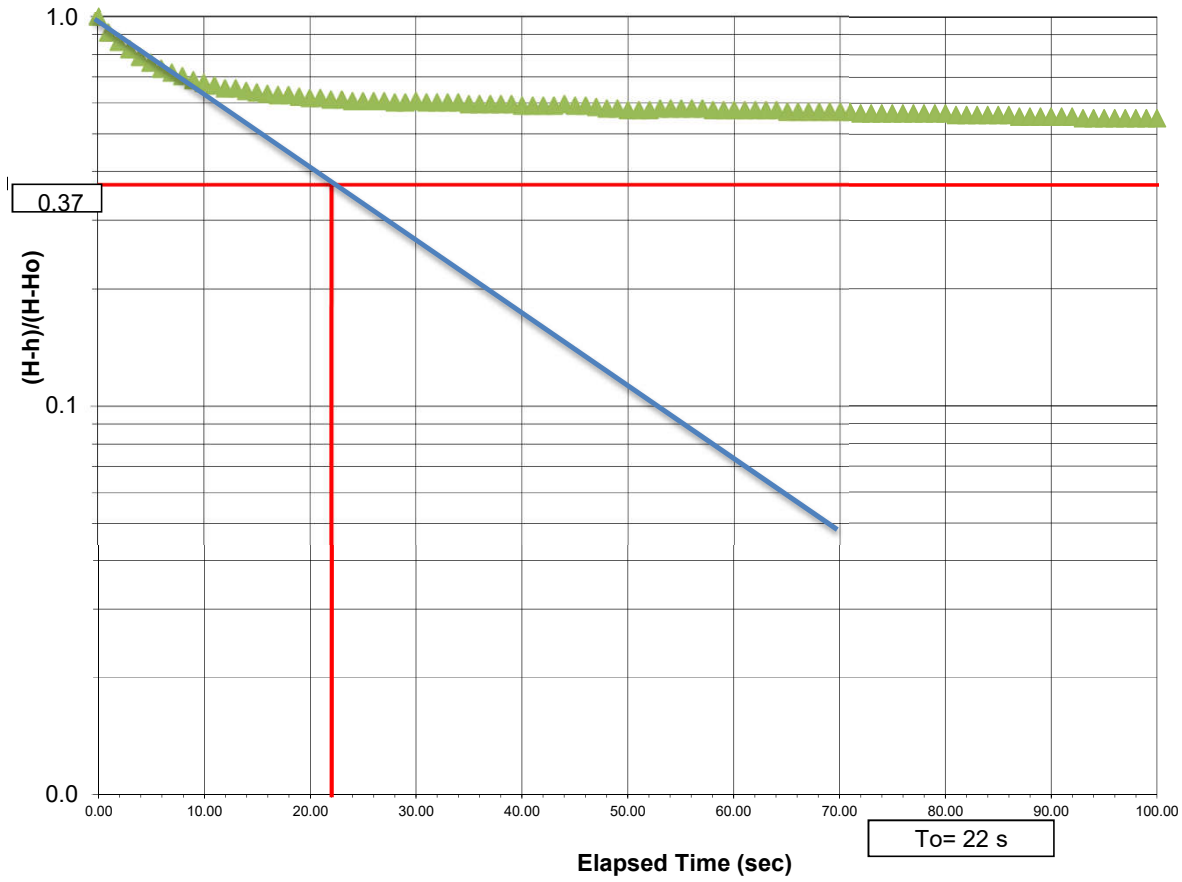
Slug Test: BH/MW121 **Project No.: SP19-463-00**

Project Location: 6375 14th Line, Alliston, Ontario

Data Source: Datalogger Readings based on Falling Head Method dated October 15, 2019

Conducted by:	Sudhakar Kurli			
Interpretted by:	Bujing Guan	H =	Initial Water Head prior to test	
Processing Date:	28-Oct-19	Ho =	Water Head at time = 0	
Well Elevation (mASL):	-	h =	Water Head/Level at time t	
Screen Depth (mBGS):	2.3 ~ 3.8			
Well Diameter:	2.0" ID	L =	130	cm
Static Water Level (mBGS):	2.5	R =	10.2	cm
Initial Reading (H)	11	r =	2.54	cm
Test Start Reading (H_0)	11.565	To =	22	sec
Test End Reading	11	$K = r^2 \ln(L/R)/(2LTo)$ =	**2.9E-03**	cm/s

Slug Test Result (Hvorslev Method) - BH/MW121
Based on Datalogger Readings

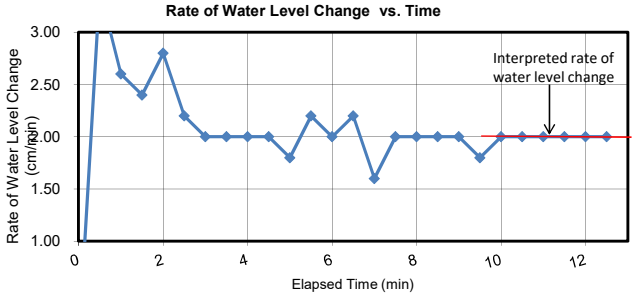


Guelph Permeameter Test Report

Site Location: 6375 14th Line, Alliston, Ontario

Test Location: BH107

SIRATI & PARTNERS
Geotechnical Hydrogeological & Environmental Solutions



Elapsed Time (min)	Water Level in Reservoir (cm)	Water Level Change (cm)	Infiltration (cm/min)
0.00	6.6	-	-
0.50	8.3	1.7	3.40
1.00	9.6	1.3	2.60
1.50	10.8	1.2	2.40
2.00	12.2	1.4	2.80
2.50	13.3	1.1	2.20
3.00	14.3	1.0	2.00
3.50	15.3	1.0	2.00
4.00	16.3	1.0	2.00
4.50	17.3	1.0	2.00
5.00	18.2	0.9	1.80
5.50	19.3	1.1	2.20
6.00	20.3	1.0	2.00
6.50	21.4	1.1	2.20
7.00	22.2	0.8	1.60
7.50	23.2	1.0	2.00
8.00	24.2	1.0	2.00
8.50	25.2	1.0	2.00
9.00	26.2	1.0	2.00
9.50	27.1	0.9	1.80
10.00	28.1	1.0	2.00
10.50	29.1	1.0	2.00
11.00	30.0	1.0	2.00
11.50	31.0	1.0	2.00
12.00	32.0	1.0	2.00
12.50	33.0	1.0	2.00
		R1	**2.00**

Combined Reservoir Surface Area =	**35.220**	cm^2
Test Hole Depth =	90	cm
Interpreted Rate of Water Level Change (R1) =	**3.3E-02**	**cm/s**
Steady Intake Water Rate (Q_1) =	**1.2E+00**	**cm^3/s**
hole radius (a) =	3	cm
Water column height in hole (H_1) =	5	cm

H1	**5**	**cm**	**water column height in test hole, first test**
a	3	cm	Test Hole Radius
α	0.04		slope fitting parameter (estimated based on soil structure)
R1	**3.33E-02**	**cm/s**	
X	**35.220**	**cm^2**	surface area for combined reservior used
Q1=X1*R1	**1.174**	**cm^3/s**	Flow rate based on combined reservoir area and average rate of infiltration
	2		**Shape Factor, where:**

1: compacted, structure-less clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc
2: Soils which are both fine-textured (clayey or silty) and unstructured; may also include some fine sands
3: Structured soils from clays to loams; also incudes unstructured medium and fine sands
4: Coarse and/or gravelly sands; may also include some highly structured soils with

C1	**0.84205855**		**Shape factor coefficient**
K_{fs} =	**1.02E-03**	**cm/min**	
=	**1.71E-05**	**cm/s**	

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{a^*}\right)}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	$\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)a^* + 2\pi H_1}$
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi(2H_1H_2(H_2-H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1H_2(H_2-H_1) + a^2(H_1C_2 - H_2C_1))}$ $K_{fs} = G_2Q_2 - G_1Q_1$ $G_3 = \frac{(2H_2^2 + a^2C_2)C_1}{2\pi(2H_1H_2(H_2-H_1) + a^2(H_1C_2 - H_2C_1))}$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	$G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi(2H_1H_2(H_2-H_1) + a^2(H_1C_2 - H_2C_1))}$ $\Phi_m = G_3Q_1 - G_4Q_2$

Soil Texture-Structure Category	$\alpha^*(cm^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_2/a}{2.081 + 0.121(H_2/a)}\right)^{0.672}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091(H_1/a)}\right)^{0.603}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091(H_2/a)}\right)^{0.603}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$
Coarse and gravelly sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

Project: SP19-463-00
Test Date: October 15, 2019 conducted by: SK
Process Date 28-Oct-19 processed by: BG

Guelph Permeameter Test Report

Site Location: 6375 14th Line, Alliston, Ontario

Test Location: BH111

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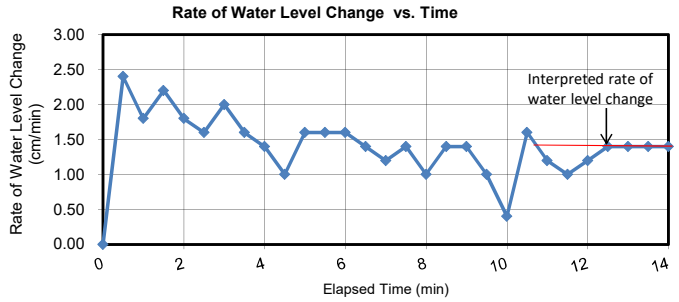

Elapsed Time (min)	Water Level in Reservoir (cm)	Water Level Change (cm)	Infiltration (cm/min)	
0.00	3.6	-	-	
0.50	4.8	1.2	2.40	
1.00	5.7	0.9	1.80	
1.50	6.8	1.1	2.20	
2.00	7.7	0.9	1.80	
2.50	8.5	0.8	1.60	
3.00	9.5	1.0	2.00	
3.50	10.3	0.8	1.60	
4.00	11.0	0.7	1.40	
4.50	11.5	0.5	1.00	
5.00	12.3	0.8	1.60	
5.50	13.1	0.8	1.60	
6.00	13.9	0.8	1.60	
6.50	14.6	0.7	1.40	
7.00	15.2	0.6	1.20	
7.50	15.9	0.7	1.40	
8.00	16.4	0.5	1.00	
8.50	17.1	0.7	1.40	
9.00	17.8	0.7	1.40	
9.50	18.3	0.5	1.00	
10.00	18.5	0.2	0.40	
10.50	19.3	0.8	1.60	
11.00	19.9	0.6	1.20	
11.50	20.4	0.5	1.00	
12.00	21.0	0.6	1.20	
12.50	21.7	0.7	1.40	
13.00	22.4	0.7	1.40	R1
13.50	23.1	0.7	1.40	1.40
14.00	23.8	0.7	1.40	

Project: SP19-463-00
Test Date: October 15, 2019 conducted by: SK
Process Date 28-Oct-19 processed by: BG

Combined Reservoir Surface Area =	**35.220**	cm^2
Borehole Depth =	85	cm
Interpreted Rate of Water Level Change (R1) =	**2.3E-02**	**cm/s**
Steady Intake Water Rate (Q_1) =	**8.2E-01**	**cm^3/s**
hole radius (a) =	3	cm
Water column height in hole (H_1) =	5	cm

H1	**5**	**cm**	**water column height in test hole, first test**
a	3	cm	Test Hole Radius
α	0.04		slope fitting parameter (estimated based on soil structure)
R1	**2.33E-02**	**cm/s**	
X	**35.220**	**cm^2**	surface area for combined reservior used
Q1=X1*R1	**0.822**	**cm^3/s**	Flow rate based on combined reservoir area and average rate of infiltration
	2		**Shape Factor, where:**

1: compacted, structure-less clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc
2: Soils which are both fine-textured (clayey or silty) and unstructured; may also include some fine sands
3: Structured soils from clays to loams; also incudes unstructured medium and fine sands
4: Coarse and/or gravelly sands; may also include some highly structured soils with large/numerous

C1	**0.84205855**	**Shape factor coefficient**
K_{fs} =	**7.16E-04**	**cm/min**
=	**1.19E-05**	**cm/s**

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{a^2}\right)}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	$\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)a^2 + 2\pi H_1}$
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi(2H_1H_2(H_2-H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1H_2(H_2-H_1) + a^2(H_1C_2 - H_2C_1))}$ $K_{fs} = G_2Q_2 - G_1Q_1$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	$G_3 = \frac{(2H_1^2 + a^2C_2)C_1}{2\pi(2H_1H_2(H_2-H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi(2H_1H_2(H_2-H_1) + a^2(H_1C_2 - H_2C_1))}$ $\Phi_m = G_3Q_1 - G_4Q_2$

Soil Texture-Structure Category	$\alpha^*(cm^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_2/a}{2.081 + 0.121(H_2/a)}\right)^{0.672}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091(H_1/a)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091(H_2/a)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

Guelph Permeameter Test Report

Site Location: 6375 14th Line, Alliston, Ontario

Test Location: BH114

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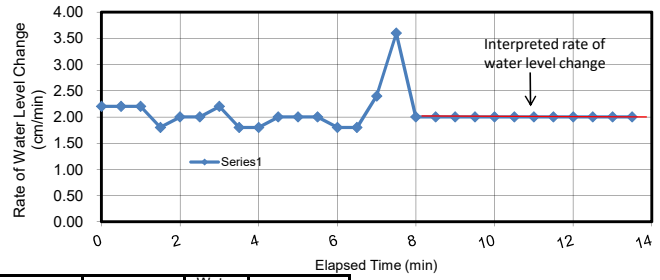
Rate of Water Level Change vs. Time



Elapsed Time (min)	Water Level in Reservoir (cm)	Water Level Change (cm)	Infiltration (cm/min)	
0.0	4.1	-	-	
0.5	5.2	1.1	2.20	
1.0	6.3	1.1	2.20	
1.5	7.4	1.1	2.20	
2.0	8.3	0.9	1.80	
2.5	9.3	1.0	2.00	
3.0	10.3	1.0	2.00	
3.5	11.4	1.1	2.20	
4.0	12.3	0.9	1.80	
4.5	13.2	0.9	1.80	
5.0	14.2	1.0	2.00	
5.5	15.2	1.0	2.00	
6.0	16.2	1.0	2.00	
6.5	17.1	0.9	1.80	
7.0	18.0	0.9	1.80	
7.5	19.2	1.2	2.40	
8.0	21.0	1.8	3.60	
8.5	22.0	1.0	2.00	
9.0	23.0	1.0	2.00	
9.5	24.0	1.0	2.00	
10.0	25.0	1.0	2.00	
10.5	26.0	1.0	2.00	
11.0	27.0	1.0	2.00	
11.5	28.0	1.0	2.00	
12.0	29.0	1.0	2.00	
12.5	30.0	1.0	2.00	
13.0	31.0	1.0	2.00	
13.5	32.0	1.0	2.00	R1
14.0	33.0	1.0	2.00	2.00

Project: SP19-463-00
Test Date: October 15, 2019 conducted by: SK
Process Date 28-Oct-19 processed by: BG

Combined Reservoir Surface Area =	**35.220**	cm^2
Test Hole Depth =	80	cm
Interpreted Rate of Water Level Change (R1) =	**3.3E-02**	**cm/s**
Steady Intake Water Rate (Q_1) =	**1.2E+00**	**cm^3/s**
hole radius (a) =	3	cm
Water column height in hole (H_1) =	5	cm

H1	**5**	**cm**	**water column height in test hole, first test**
a	3	cm	Test Hole Radius
α	0.04		slope fitting parameter (estimated based on soil structure)
R1	**3.33E-02**	**cm/s**	
X	**35.220**	**cm^2**	surface area for combined reservior used
Q1=X1*R1	**1.174**	**cm^3/s**	Flow rate based on combined reservoir area and average rate of infiltration
	2		**Shape Factor, where:**

1: compacted, structure-less clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc
2: Soils which are both fine-textured (clayey or silty) and unstructured; may also include some fine sands
3: Structured soils from clays to loams; also incudes unstructured medium and fine sands
4: Coarse and/or gravelly sands; may also include some highly structured soils with

C1	**0.84205855**		**Shape factor coefficient**
K_{fs} =	**1.02E-03**	**cm/min**	
=	**1.71E-05**	**cm/s**	

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{\alpha^*}\right)}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	$\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)\alpha^* + 2\pi H_1}$
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi(2H_1H_2(H_2-H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1H_2(H_2-H_1) + a^2(H_1C_2 - H_2C_1))}$ $K_{fs} = G_2Q_2 - G_1Q_1$ $G_3 = \frac{(2H_2^2 + a^2C_2)C_1}{2\pi(2H_1H_2(H_2-H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi(2H_1H_2(H_2-H_1) + a^2(H_1C_2 - H_2C_1))}$ $\Phi_m = G_3Q_1 - G_4Q_2$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

Soil Texture-Structure Category	$\alpha^*(cm^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_2/a}{2.081 + 0.121(H_2/a)}\right)^{0.672}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091(H_1/a)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091(H_2/a)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

Guelph Permeameter Test Report

Site Location: 6375 14th Line, Alliston, Ontario

Test Location: BH117

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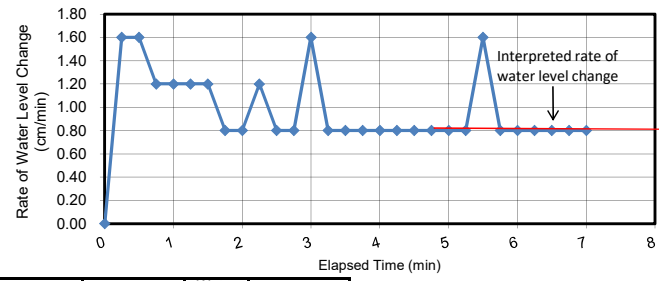
Rate of Water Level Change vs. Time



Elapsed Time (min)	Water Level in Reservoir (cm)	Water Level Change (cm)	Infiltration (cm/min)	
0.00	5.5	-	-	
0.25	5.9	0.4	1.60	
0.50	6.3	0.4	1.60	
0.75	6.6	0.3	1.20	
1.00	6.9	0.3	1.20	
1.25	7.2	0.3	1.20	
1.50	7.5	0.3	1.20	
1.75	7.7	0.2	0.80	
2.00	7.9	0.2	0.80	
2.25	8.2	0.3	1.20	
2.50	8.4	0.2	0.80	
2.75	8.6	0.2	0.80	
3.00	9.0	0.4	1.60	
3.25	9.2	0.2	0.80	
3.50	9.4	0.2	0.80	
3.75	9.6	0.2	0.80	
4.00	9.8	0.2	0.80	
4.25	10.0	0.2	0.80	
4.50	10.2	0.2	0.80	
4.75	10.4	0.2	0.80	
5.00	10.6	0.2	0.80	
5.25	10.8	0.2	0.80	
5.50	11.2	0.4	1.60	
5.75	11.4	0.2	0.80	
6.00	11.6	0.2	0.80	
6.25	11.8	0.2	0.80	
6.50	12.0	0.2	0.80	
6.75	12.2	0.2	0.80	R1
7.00	12.4	0.2	0.80	0.80

Project: SP19-463-00
Test Date: October 15, 2019 conducted by: SK
Process Date 28-Oct-19 processed by: BG

Combined Reservoir Surface Area =	**35.220**	cm^2
Test Hole Depth =	80	cm
Interpreted Rate of Water Level Change (R1) =	**1.3E-02**	**cm/s**
Steady Intake Water Rate (Q_1) =	**4.7E-01**	**cm^3/s**
hole radius (a) =	3	cm
Water column height in hole (H_1) =	5	cm

H1	**5**	**cm**	**water column height in test hole, first test**
a	3	cm	Test Hole Radius
α	0.04		slope fitting parameter (estimated based on soil structure)
R1	**1.33E-02**	**cm/s**	
X	**35.220**	**cm^2**	surface area for combined reservior used
Q1=X1*R1	**0.470**	**cm^3/s**	Flow rate based on combined reservoir area and average rate of infiltration
	2		**Shape Factor, where:**

1: compacted, structure-less clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc
2: Soils which are both fine-textured (clayey or silty) and unstructured; may also include some fine sands
3: Structured soils from clays to loams; also incudes unstructured medium and fine sands
4: Coarse and/or gravelly sands; may also include some highly structured soils with

C1	**0.84205855**	**Shape factor coefficient**
K_{fs} =	**4.09E-04**	**cm/min**
=	**6.82E-06**	**cm/s**

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{\alpha^*}\right)}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	$\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)\alpha^* + 2\pi H_1}$
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi(2H_1H_2(H_2-H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1H_2(H_2-H_1) + a^2(H_1C_2 - H_2C_1))}$ $K_{fs} = G_2Q_2 - G_1Q_1$ $G_3 = \frac{(2H_2^2 + a^2C_2)C_1}{2\pi(2H_1H_2(H_2-H_1) + a^2(H_1C_2 - H_2C_1))}$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	$G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi(2H_1H_2(H_2-H_1) + a^2(H_1C_2 - H_2C_1))}$ $\Phi_m = G_3Q_1 - G_4Q_2$

Soil Texture-Structure Category	$\alpha^*(cm^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_2/a}{2.081 + 0.121\left(H_2/a\right)}\right)^{0.672}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091\left(H_1/a\right)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091\left(H_2/a\right)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093\left(H_1/a\right)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093\left(H_2/a\right)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093\left(H_1/a\right)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093\left(H_2/a\right)}\right)^{0.754}$

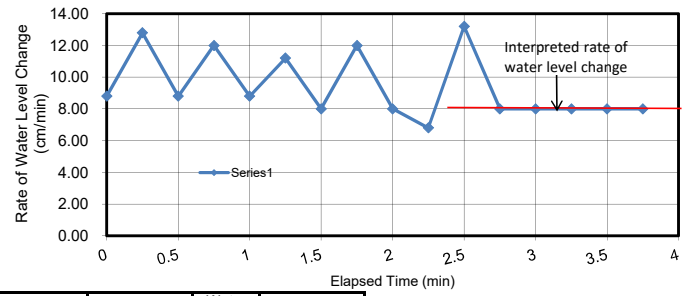
Guelph Permeameter Test Report

Site Location: 6375 14th Line, Alliston, Ontario

Test Location: BH120

SIRATI & PARTNERS
Geotechnical Hydrogeological & Environmental Solutions

Rate of Water Level Change vs. Time



Elapsed Time (min)	Water Level in Reservoir (cm)	Water Level Change (cm)	Infiltration (cm/min)
0.00	6.0	-	-
0.25	8.2	2.2	8.80
0.50	11.4	3.2	12.80
0.75	13.6	2.2	8.80
1.00	16.6	3.0	12.00
1.25	18.8	2.2	8.80
1.50	21.6	2.8	11.20
1.75	23.6	2.0	8.00
2.00	26.6	3.0	12.00
2.25	28.6	2.0	8.00
2.50	30.3	1.7	6.80
2.75	33.6	3.3	13.20
3.00	35.6	2.0	8.00
3.25	37.6	2.0	8.00
3.50	39.6	2.0	8.00
3.75	41.6	2.0	8.00
		R1	8.00

Combined Reservoir Surface Area =	**35.220**	cm^2
Test Hole Depth =	80	cm
Interpreted Rate of Water Level Change (R1) =	**1.3E-01**	**cm/s**
Steady Intake Water Rate (Q_1) =	**4.7E+00**	**cm^3/s**
hole radius (a) =	3	cm
Water column height in hole (H_1) =	5	cm

H1	**5**	**cm**	**water column height in borehole, first test**
a	3	cm	well radius
α	0.04		slope fitting parameter (estimated based on soil structure)
R1	**1.33E-01**	**cm/s**	
X	**35.220**	**cm^2**	surface area for combined reservior used
Q1=X1*R1	**4.696**	**cm^3/s**	Flow rate based on combined reservoir area and average rate of infiltration
	2		**Shape Factor, where:**

1: compacted, structure-less clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc
2: Soils which are both fine-textured (clayey or silty) and unstructured; may also include some fine sands
3: Structured soils from clays to loams; also incudes unstructured medium and fine sands
4: Coarse and/or gravelly sands; may also include some highly structured soils with large/numerous cracks. macropores. etc

C1	**0.84205855**		**Shape factor coefficient**
K_{fs} =	**4.09E-03**	**cm/min**	
=	**6.82E-05**	**cm/s**	

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{a^*}\right)}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	$\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)a^* + 2\pi H_1}$
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi(2H_1H_2(H_2-H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1H_2(H_2-H_1) + a^2(H_1C_2 - H_2C_1))}$ $K_{fs} = G_2Q_2 - G_1Q_1$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	$G_3 = \frac{(2H_2^2 + a^2C_2)C_1}{2\pi(2H_1H_2(H_2-H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi(2H_1H_2(H_2-H_1) + a^2(H_1C_2 - H_2C_1))}$ $\Phi_m = G_3Q_1 - G_4Q_2$

Soil Texture-Structure Category	$\alpha^*(cm^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_2/a}{2.081 + 0.121(H_2/a)}\right)^{0.672}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091(H_1/a)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091(H_2/a)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

Project: SP19-463-00
Test Date: October 15, 2019 conducted by: SK
Process Date 28-Oct-19 processed by: BG

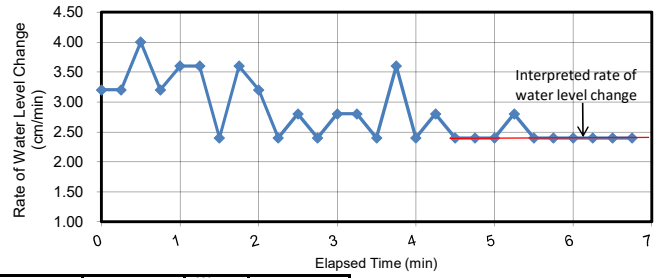
Guelph Permeameter Test Report

Site Location: 6375 14th Line, Alliston, Ontario

Test Location: BH121

SIRATI & PARTNERS
Geotechnical Hydrogeological & Environmental Solutions

Rate of Water Level Change vs. Time



Elapsed Time (min)	Water Level in Reservoir (cm)	Water Level Change (cm)	Infiltration (cm/min)	
0.00	4.8	-	-	
0.25	5.6	0.8	3.20	
0.50	6.4	0.8	3.20	
0.75	7.4	1.0	4.00	
1.00	8.2	0.8	3.20	
1.25	9.1	0.9	3.60	
1.50	10.0	0.9	3.60	
1.75	10.6	0.6	2.40	
2.00	11.5	0.9	3.60	
2.25	12.3	0.8	3.20	
2.50	12.9	0.6	2.40	
2.75	13.6	0.7	2.80	
3.00	14.2	0.6	2.40	
3.25	14.9	0.7	2.80	
3.50	15.6	0.7	2.80	
3.75	16.2	0.6	2.40	
4.00	17.1	0.9	3.60	
4.25	17.7	0.6	2.40	
4.50	18.4	0.7	2.80	
4.75	19.0	0.6	2.40	
5.00	19.6	0.6	2.40	
5.25	20.2	0.6	2.40	
5.50	20.9	0.7	2.80	
5.75	21.5	0.6	2.40	
6.00	22.1	0.6	2.40	
6.25	22.7	0.6	2.40	
6.50	23.3	0.6	2.40	
6.75	23.9	0.6	2.40	R1
7.00	24.5	0.6	2.40	2.40

Project: SP19-463-00
Test Date: October 15, 2019 conducted by: SK
Process Date 28-Oct-19 processed by: BG

Combined Reservoir Surface Area =	**35.220**	cm^2
Test Hole Depth =	80	cm
Interpreted Rate of		
Water Level Change (R1) =	**4.0E-02**	**cm/s**
Steady Intake Water Rate (Q_1) =	**1.4E+00**	**cm^3/s**
hole radius (a) =	3	cm
Water column height in hole (H_1) =	5	cm

H1	**5**	**cm**	**water column height in test hole**
a	3	cm	test hole radius
α	0.04		slope fitting parameter (estimated based on soil structure)
R1	**4.00E-02**	**cm/s**	
X	**35.220**	**cm^2**	surface area for combined reservior used
Q1=X1*R1	**1.409**	**cm^3/s**	Flow rate based on combined reservoir area and average rate of infiltration
	2		**Shape Factor, where:**

1: compacted, structure-less clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc
2: Soils which are both fine-textured (clayey or silty) and unstructured; may also include some fine sands
3: Structured soils from clays to loams; also incudes unstructured medium and fine sands
4: Coarse and/or gravelly sands; may also include some highly structured soils with

C1	**0.84205855**	**Shape factor coefficient**
K_{fs} =	**1.23E-03**	**cm/min**
=	**2.05E-05**	**cm/s**

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{\alpha^*}\right)}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	$\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)\alpha^* + 2\pi H_1}$
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi(2H_1H_2(H_2-H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1H_2(H_2-H_1) + a^2(H_1C_2 - H_2C_1))}$ $K_{fs} = G_2Q_2 - G_1Q_1$ $G_3 = \frac{(2H_2^2 + a^2C_2)C_1}{2\pi(2H_1H_2(H_2-H_1) + a^2(H_1C_2 - H_2C_1))}$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	$G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi(2H_1H_2(H_2-H_1) + a^2(H_1C_2 - H_2C_1))}$ $\Phi_m = G_3Q_1 - G_4Q_2$

Soil Texture-Structure Category	$\alpha^*(cm^{-1})$	Shape Factor
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Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

Appendix D: Limitations of Report

This report is intended solely for the Client named. The material in it reflects our best judgment in light of the information available to Sirati & Partners Consultants Limited (SIRATI) at the time of preparation. Unless otherwise agreed in writing by SIRATI, it shall not be used to express or imply warranty as to the fitness of the property for a particular purpose. No portion of this report may be used as a separate entity, it is written to be read in its entirety.

The conclusions and recommendations given in this report are based on information determined at the borehole locations. The information contained herein in no way reflects on the environment aspects of the project, unless otherwise stated. Subsurface and groundwater conditions between and beyond the boreholes may differ from those encountered at the borehole locations, and conditions may become apparent during construction, which could not be detected or anticipated at the time of the site investigation. The benchmark and elevations used in this report are primarily to establish relative elevation differences between the borehole locations and should not be used for other purposes, such as grading, excavating, planning, development, etc. Professional judgement was exercised in gathering and analyzing data and formulation of recommendations using current industry guidelines and standards. Similar to all professional persons rendering advice, SIRATI cannot act as absolute insurer of the conclusion we have reached. No additional warranty or representation, expressed or implied, is included or intended in this report other than stated herein the report.

The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with the details stated in this report.

The comments made in this report on potential construction problems and possible methods are intended only for the guidance of the designer. The number of boreholes may not be sufficient to determine all the factors that may affect construction methods and costs. For example, the thickness of surficial topsoil or fill layers may vary markedly and unpredictably. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusions as to how the subsurface conditions may affect their work. This work has been undertaken in accordance with normally accepted geotechnical engineering practices. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. SIRATI accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

We accept no responsibility for any decisions made or actions taken as a result of this report unless we are specifically advised of and participate in such action, in which case our responsibility will be as agreed to at that time. Any user of this report specifically denies any right to claims against the Consultant, Sub-Consultants, their officers, agents and employees in excess of the fee paid for professional services.

SIRATI engagement hereunder is subject to and condition upon, that SIRATI not being required by the Client, or any other third party to provide evidence or testimony in any legal proceedings pertaining to this finding of this report or providing litigations support services which may arise to be required in respect of the work produced herein by SIRATI. It is prohibited to publish, release or disclose to any third party the report produced by SIRATI pursuant to this engagement and such report is produced solely for the Client own internal purposes and which shall remain the confidential proprietary property of SIRATI for use by the Client, within the context of the work agreement. The Client will and does hereby remise and forever absolutely release SIRATI, its directors, officers, agents and shareholders of and from any and all claims, obligations, liabilities, expenses, costs, charges or other demands or requirements of any nature pertaining to the report produced by SIRATI hereunder. The Client will not commence any claims against any Person who may make a claim against SIRATI in respect of work produced under this engagement.

NEW TECUMSETH FIRE STATION #4
6365 14 LINE, NEW TECUMSETH, NORTH PART LOT 8
CONCESSION 13, PART 1 & 3 OF 51R26286
ROLL #432404000514860

STORM WATER MANAGEMENT DESIGN BRIEF

NEW DEVELOPMENT DRAINAGE SYSTEM

REV 4 – September 13, 2023

PREPARED FOR:

New Tecumseth
Alliston · Beeton · Tottenham

10 Wellington St. E. Alliston
ON L9R 1A1

PREPARED BY:

HALLEX ENGINEERING LTD.

HALLEX PROJECT #191204
Development File No. D11-TE-046

HALLEX NIAGARA
4999 VICTORIA AVENUE
NIAGARA FALLS, ON L2E 4C9

HALLEX HAMILTON
745 SOUTH SERVICE ROAD, UNIT 205
STONEY CREEK, ON L8E 5Z2

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3. DESIGN CONSIDERATIONS 1
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PRE-DEVELOPMENT CATCHMENT AREA PLAN

POST-DEVELOPMENT CATCHMENT AREA PLAN

EXHIBITS – Storm Water Management Design

1. PRE-DEVELOPMENT CONDITIONS

1.1 LOCATION

The proposed New Tecumseth Fire Station #4 development is located at 6365 14 Line, which is located east of the Industrial Parkway and 14 Line intersection in New Tecumseth, ON.

1.2 DRAINAGE PATTERN

The current drainage path for the site consists of overland sheet flow drainage to the existing roadside ditch along 14 Line and overland sheet drainage to the south of the subject area of the site where the development is proposed.

2. PROPOSED WORK

2.1 GRADING

The objective of the design is to utilize the existing natural slope and achieve the minimum and maximum slopes in the grading of the granular/asphalt surfaces. This will ensure the surface not only drains as per the design, but is not too steep. The grading of the site also ensures that the storm water flow will mostly drain through the onsite drainage system for storm water quantity and quality controls. The proposed drainage system onsite has been designed according to the five and one-hundred-year storm events as per the Town of New Tecumseth intensity-duration-frequency curve.

2.2 DRAINAGE

The proposed design requires 46.0 meters of storm sewer piping, 101.2 meters of flat bottom swale and a stormwater management pond.

3. DESIGN CONSIDERATIONS

3.1 SITE DRAINAGE

3.1.1 Pre-development

A. Peak Runoff

The total drainage area for the subject area of the site p for the proposed development is 1.265 hectares with an existing runoff coefficient of 0.38 for the five-year storm based on the existing asphalt and grass surfaces.

The time of concentration is determined to be 10 minutes to the start of the sewer as required by the Town of New Tecumseth.

Using the Rational Method, the peak flow rates are $Q = \frac{CiA}{360}$

Subcatchment	Description	Draining to	Area, ha	Tc, min
Area.1	Sheet flow	14 Line	0.421	10
Area.2	Sheet flow	South Side of the Property	0.844	10
5-year Storm	A,ha	C	*i*,mm/h	Q, L/s
Area.1	0.421	0.46	120	64.1
Area.2	0.844	0.34	120	95.0
Total	1.265	0.38	120	159.1
100-year Storm	A,ha	C	*i*,mm/h	Q, L/s
Area.1	0.421	0.57	199	133.0
Area.2	0.844	0.42	199	197.3
Total	1.265	0.47	199	330.4

Therefore, the total pre-development flow for the subject site is 159.1L/s for the five-year storm and 330.4L/s for the one-hundred-year storm.

B. Quantity

There is no known storm quantity control measure in place for the pre-development condition.

C. Quality

There is no known storm quality control measure in place for the pre-development condition.

3.1.2 Post Development

A. Peak Runoff

The proposed New Tecumseth Fire Station #4 development consists of the construction of a new building, concrete sidewalk and asphalt areas. The resulting runoff coefficient in the post-development condition of the site is 0.57 for the five-year storm.

The proposed development will drain through the proposed onsite storm drainage system and shall discharge to the existing roadside ditch at 14 Line. Part of the site will continue to drain directly to the roadside ditch and to the south similar to the pre-development condition of the site.

The time of concentration is determined to be 10 minutes to the start of the sewer as required by the Town of New Tecumseth.

Using the Rational Method, the peak flow rates are as follows:

Subcatchment	Description	Draining to	Area, ha	Tc, min
Area.1	Sheet flow	14 Line	0.346	10
Area.2	Sheet flow	South Side of the Property	0.195	10
Pond	Channel flow	14 Line	0.724	10
5-year Storm	A,ha	C	*i*,mm/h	Q, L/s
Area.1	0.346	0.58	120	66.9
Area.2	0.195	0.45	120	29.0
Pond	0.724	0.63	120	141.8
Total	1.265	0.57	120	237.7
100-year Storm	A,ha	C	*i*,mm/h	Q, L/s
Area.1	0.346	0.73	199	138.9
Area.2	0.195	0.56	199	60.2
Pond	0.724	0.79	199	294.5
Total	1.265	0.72	199	493.7

Therefore, the total post-development flow for the subject site is 237.7L/s for the five-year storm and 493.7L/s for the one-hundred-year storm. The flows and other design information are contained in Exhibit #1 for the 5-year storm and Exhibit #2 for the 100-year storm at the end of the design brief.

B. Quantity

The post-development storm water runoff from the subject area of the site is higher than the pre-development runoff. As such, storm water detention is required to ensure post-development flows do not exceed the pre-development flows from the site.

The stormwater management pond located south of the building has been proposed for storm water quantity control. The storm is controlled by a 250mm orifice pipe and the resulting storm volume shall be stored within the dry pond. The orifice pipe is designed to outlet to the roadside ditch in the municipal right-of-way via a flat bottom swale. The pond has a total storage capacity of 228.4m^3 with a 300mm freeboard for the 100-year storm event.

The following table summarizes the pre-development flow rates, the post development uncontrolled flow rates and the post-development-controlled flow rates for the subject site:

	Pre- Development Flow Rate (L/s)	Post- Development Uncontrolled Flow Rate (L/s)	Post- Development Controlled Flow Rate (L/s)
5-year Storm			
Area.1	64.1	66.9	66.9
Area.2	95.0	29.0	29.0
Pond	N/A	141.8	27.5
Total	159.1	237.7	123.4
100-year Storm			
Area.1	133.0	138.9	138.9
Area.2	197.3	60.2	60.2
Pond	N/A	294.5	72.8
Total	330.4	493.7	271.9

The orifice pipe and subsequent storage volume for the detained flow are indicated in Exhibit #3 for the 5-year storm and Exhibit #4 for the 100-year storm.

C. Quality

The storm water collected in the proposed development passes through the flat bottom trapezoidal channel which is to be utilized for water quality control as indicated in the MOE Stormwater Management Planning and Design Manual, dated March 2003 (refer to Chapter 4: Stormwater Management Plan and SWMP Design, Section 4.5.9 – Grassed Swale).

To ensure pollutant removal as stated in the aforementioned section the following design constraints are utilized: trapezoidal channel, grassed lined (n = 0.035), 2.5:1 sideslopes. Furthermore, the design velocity for the 4-hour 25mm Chicago storm is not to exceed 0.5m/s to ensure water quality enhancement.

Since the proposed flat bottom swale is designed according to the above constraints (see Exhibit #5) the water quality from the site is thereby improved.

D. Maintenance Recommendations

The storm sewer system includes swales and a stormwater management pond. It is important to regularly inspect the elements to ensure that storm water is flowing as originally designed. Debris and sediment commonly clog the system and reduce the overall effectiveness.

The following maintenance and inspection tasks should be done:

1. Inspect the culverts for structural integrity. (Annually) Check culvert pipes for structural integrity to ensure they aren't crumbling or broken.

2. Conduct routine inspections for trash or other debris that may be blocking the culvert pipes, swales and dry pond. (Monthly and after rain events) Remove all trash and debris.

3. Conduct routine maintenance of swales and pond including grass cutting.

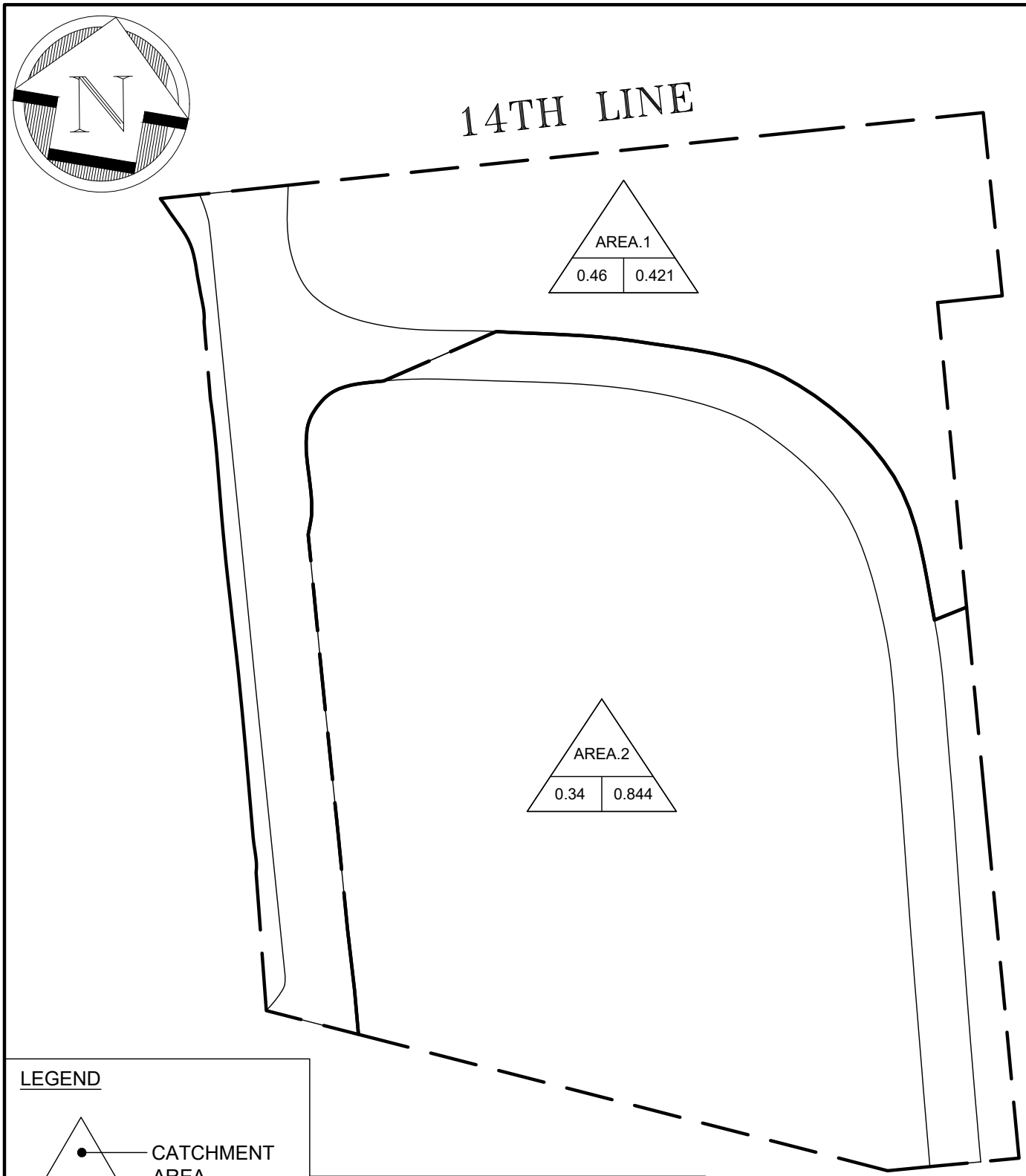
4. Inspect for sediment accumulation at pipes (Semi-annually and after rain events). It is important to clean out sediment that might be restricting water flow.

5. Do not dump any materials in the storm system.

Yours truly,
HALLEX ENGINEERING LTD

Jim Halucha P.Eng
Civil/Structural Engineer

Jonathan Skinner, C.E.T., B.Tech
Civil Technologist



LEGEND

CATCHMENT AREA
AREA (HECTARES)
AVERAGE RUNOFF COEFFICIENT

LEGAL DESCRIPTION:
NORTH PART LOT 8 CONCESSION 13,
PART 1 & 3 OF 51R26286

ROLL #:
432404000514860

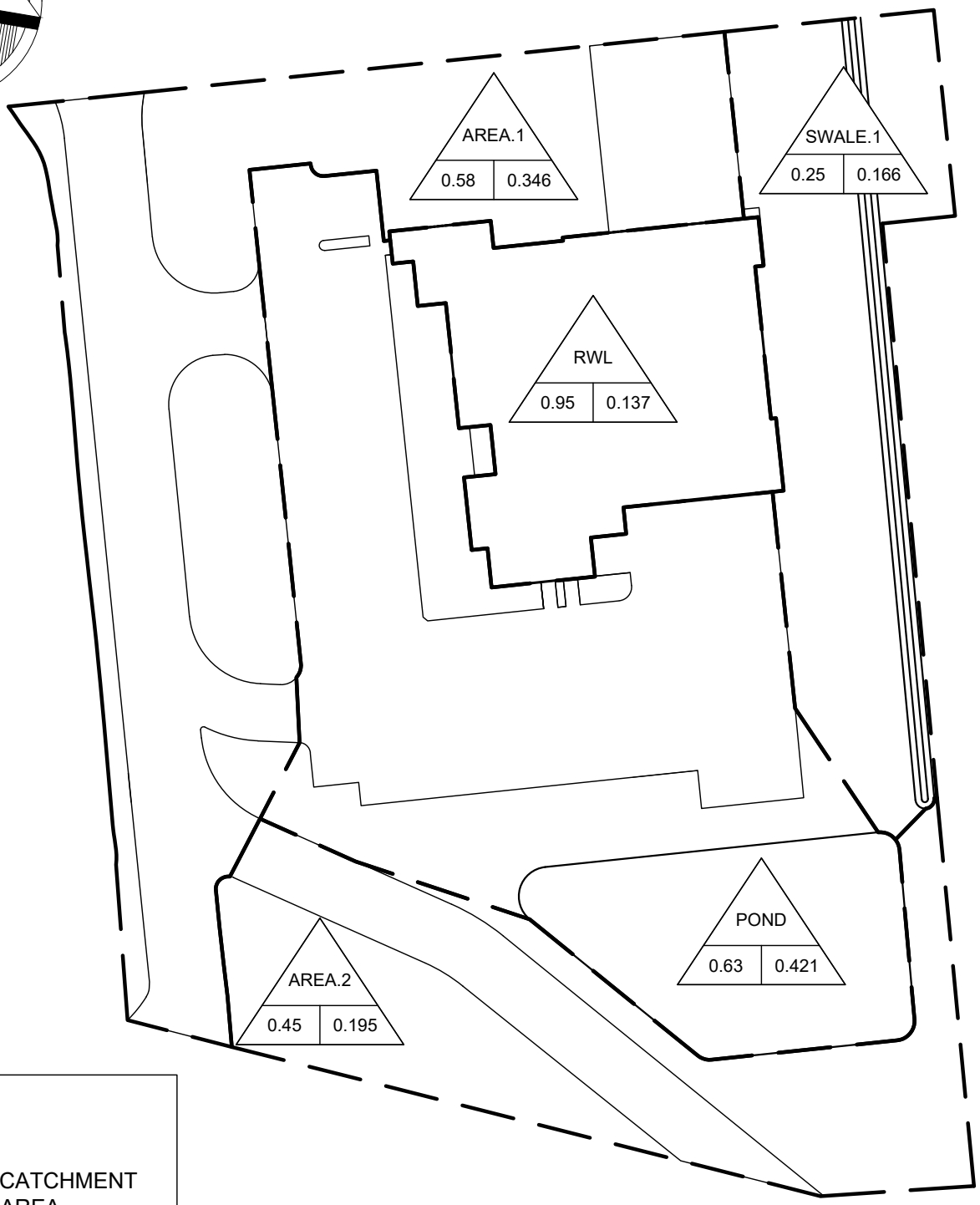
HALLEX ENGINEERING LTD.
4999 Victoria Avenue,
Niagara Falls, ON L2E 4C9
Tel: 905-357-4015 Fax: 905-353-1105
745 South Service Rd. Unit 205,
Stoney Creek, ON L8E 5Z2
Tel: 905-561-4016 Fax: 905-561-1105

PROJECT:
NEW TECUMSETH FIRE HALL #4
6365 14th LINE, NEW TECUMSETH, ONTARIO

SHEET TITLE:
PRE-DEVELOPMENT CATCHMENT AREA

DATE: 2023/09/13
SCALE: 1:750
DR. BY: AI
CH. BY: JH/JS

JOB No.: 191204
DWG. CSK1
REV. 3



LEGEND

CATCHMENT AREA
AREA (HECTARES)
AVERAGE RUNOFF COEFFICIENT

LEGAL DESCRIPTION:
NORTH PART LOT 8 CONCESSION 13,
PART 1 & 3 OF 51R26286

ROLL #:
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Stoney Creek, ON L8E 5Z2
Tel: 905-561-4016 Fax: 905-561-1105

PROJECT:
NEW TECUMSETH FIRE HALL #4
6365 14th LINE, NEW TECUMSETH, ONTARIO

SHEET TITLE:
POST-DEVELOPMENT CATCHMENT AREA

DATE: 2023/09/13
SCALE: 1:750
DR. BY: AI
CH. BY: JH/JS

JOB No.: 191204
DWG. CSK2
REV. 3

HALLEX ENGINEERING LTD.

MUNICIPALITY: **New Tecumseth**

New Tecumseth Fire Station #4
Exhibit #1 - 5 Year Post - Development Calculations

2023-09-13
Job: 191204

Rainfall Intensity Values = A= 679.900, B= 1.170, C= 0.720

manning's n = 0.013 PVC Pipe; 0.013 Conc Pipe; 0.024 Corr. Stl Pipe; 0.035 Grass Swale

Location			Length of Pipe	Area		Flow Time		Rainfall Intensity	Unit rate of Runoff	Design Flows		Flow Control	Sewer/Channel Design				Invert Elevations	
Pipe	From Node	To Node		Incre-ment	Cum Total	To Upper	In Section			Cum Flow	Cum Flow		Slope	Capacity Full	Velocity Full	*Dia/ Depth	Up-stream	Down-stream
			(m)	(ha)	(ha)	(min)	(min)	mm/hr	m^3/ha*day	(m^3/d)	(m^3/s)	(m^3/s)	(m/m)	(m^3/s)	(m/s)	(m)	(m)	(m)
1	**Area 1**	**Street 1**	**N/A**	**0.346**	**0.346**	**10.00**	**N/A**	**120**	**34454**	**5779.7**	**0.0669**	**0.0669**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
Paved	-	-	-	0.164	-	-	-	-	27276.1	4473.3	-	-	-	-	-	-	-	-
Grass	-	-	-	0.182	-	-	-	-	7177.9	1306.4	-	-	-	-	-	-	-	-
2	**Area 2**	**Prpty 1**	**N/A**	**0.195**	**0.195**	**10.00**	**N/A**	**120**	**34454**	**2505.1**	**0.0290**	**0.0290**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
Paved	-	-	-	0.055	-	-	-	-	27276.1	1500.2	-	-	-	-	-	-	-	-
Grass	-	-	-	0.140	-	-	-	-	7177.9	1004.9	-	-	-	-	-	-	-	-
3	**RWL. 1**	**Pond 1**	**38.7**	**0.137**	**0.137**	**10.00**	**0.57**	**120**	**27276**	**3736.8**	**0.0433**	**0.0433**	**0.0120**	**0.0359**	**1.1437**	**0.200**	**220.57**	**220.10**
Roof	-	-	-	0.137	-	-	-	-	27276.1	3736.8	-	-	-	-	-	-	-	-
4	**Pond 1**	**Swale 1**	**7.3**	**0.421**	**0.558**	**10.57**	**0.15**	**115**	**33241**	**11112.2**	**0.1286**	**0.0275**	**0.0050**	**0.0420**	**0.8566**	**0.250**	**220.10**	**220.06**
Paved	-	-	-	0.230	-	-	-	-	26315.9	6052.7	-	-	-	-	-	-	-	-
Grass	-	-	-	0.191	-	-	-	-	6925.2	1322.7	-	-	-	-	-	-	-	-
5	**Swale 1**	**Street 1**	**101.2**	**0.166**	**0.724**	**10.72**	**3.52**	**114**	**6862**	**12251.3**	**0.1418**	**0.0275**	**0.0040**	**0.1200**	**0.4798**	**0.200**	**220.06**	**219.65**
Grass	-	-	-	0.166	-	-	-	-	6862.2	1139.1	-	-	-	-	-	-	-	-

* Swale/Ditch geometry based on the following assumptions: trapezoidal channel, grassed lined (n = 0.035), 2.5:1 sideslopes, 0.75 m bottom width.

Run-off Coefficients Used:

Roof Structure C = 0.95
Paved Surface C = 0.95
Grass Surface C = 0.25

Velocity Range:

Minimum Velocity = Use Minimu m/s
Maximum Velocity = 4.50 m/s

Time of Concentration:

Time of Concentration = 10 min

New Tecumseth Fire Station #4
Exhibit #2 - 100 Year Post - Development Calculations

MUNICIPALITY: **New Tecumseth**

Rainfall Intensity Values = A= 1141.000, B= 1.250, C= 0.722

manning's n = 0.013 PVC Pipe; 0.013 Conc Pipe; 0.024 Corr. Stl Pipe; 0.035 Grass Swale

Location			Length of Pipe	Area		Flow Time		Rainfall Intensity	Unit rate of Runoff	Design Flows		Flow Control	Sewer/Channel Design				Invert Elevations	
Pipe	From Node	To Node		Incre-ment	Cum Total	To Upper	In Section			Cum Flow			Slope	Capacity Full	Velocity Full	*Dia/ Depth	Up-stream	Down-stream
			(m)	(ha)	(ha)	(min)	(min)	mm/hr	m^3/ha*day	(m^3/d)	(m^3/s)	(m^3/s)	(m/m)	(m^3/s)	(m/s)	(m)	(m)	(m)
1	**Area 1**	**Street 1**	**N/A**	**0.346**	**0.346**	**10.00**	**N/A**	**199**	**71558**	**12003.8**	**0.1389**	**0.1389**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
Paved	-	-	-	0.164	-	-	-	-	56649.8	9290.6	-	-	-	-	-	-	-	-
Grass	-	-	-	0.182	-	-	-	-	14907.8	2713.2	-	-	-	-	-	-	-	-
2	**Area 2**	**Prpty 1**	**N/A**	**0.195**	**0.195**	**10.00**	**N/A**	**199**	**71558**	**5202.8**	**0.0602**	**0.0602**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
Paved	-	-	-	0.055	-	-	-	-	56649.8	3115.7	-	-	-	-	-	-	-	-
Grass	-	-	-	0.140	-	-	-	-	14907.8	2087.1	-	-	-	-	-	-	-	-
3	**RWL. 1**	**Pond 1**	**38.7**	**0.137**	**0.137**	**10.00**	**0.57**	**199**	**56650**	**7761.0**	**0.0898**	**0.0898**	**0.0120**	**0.0359**	**1.1437**	**0.200**	**220.57**	**220.10**
Roof	-	-	-	0.137	-	-	-	-	56649.8	7761.0	-	-	-	-	-	-	-	-
4	**Pond 1**	**Swale 1**	**7.3**	**0.421**	**0.558**	**10.57**	**0.15**	**192**	**69049**	**23081.3**	**0.2671**	**0.0728**	**0.0050**	**0.0420**	**0.8566**	**0.250**	**220.10**	**220.06**
Paved	-	-	-	0.230	-	-	-	-	54663.9	12572.7	-	-	-	-	-	-	-	-
Grass	-	-	-	0.191	-	-	-	-	14385.2	2747.6	-	-	-	-	-	-	-	-
5	**Swale 1**	**Street 1**	**101.2**	**0.166**	**0.724**	**10.72**	**3.52**	**190**	**14255**	**25447.6**	**0.2945**	**0.0728**	**0.0040**	**0.1200**	**0.4798**	**0.200**	**220.06**	**219.65**
Grass	-	-	-	0.166	-	-	-	-	14254.9	2366.3	-	-	-	-	-	-	-	-

* Swale/Ditch geometry based on the following assumptions: trapezoidal channel, grassed lined (n = 0.035), 2.5:1 sideslopes, 0.75 m bottom width.

Run-off Coefficients Used:

Roof Structure C = 1.19
Paved Surface C = 1.19
Grass Surface C = 0.31

Velocity Range:

Minimum Velocity = Use Minii m/s
Maximum Velocity = 4.50 m/s

Time of Concentration:

Time of Concentration = 10 min

New Tecumseth Fire Station #4
Exhibit #3 - 5 Year Orifice Plate and Storage Volume Calcs

2023-09-13
Job: 191204

Site Data

Site Discharge	Flow	Adj. Flow (w/o Surface Runoff)	Total Storm Volume
	(m^3/s)	(m^3/s)	(m^3)
Pre - Develop.	0.1591	0.0500	
Post - Develop.	0.2377	0.1286	105.0

Control Node Data

Outlet Pipe	Storm Control Node	Outlet Pipe Size	Outlet Invert Elev.	Elev. @ Orifice
		(m)	(m)	(m)
4	Pond 1	0.250	220.10	220.23

* Volume calculated using SWMM 5.1 modelling software in accordance with the flow rate for actual size of the orifice.

Head Height 0.03 m **Storm Retention Elev. Check** **220.25 m**

Bio-Retention Pond / Pond Storage

Pond Sections	Pond Dimensions		Storage Volume
	Depth	Avg Area	
	(m)	(m)	(m^3)
Pond	0.150	734.86	110.23
Total			**110.23**

Total Storage = 110.2 m^3 **Required Storage Achieved**

Orifice Diameter Calculation (A=Q/(Cd*sqrt(2*g*h)))

Coefficient of Discharge	Cd =	0.8	(tube)	0.62	Sharp Orifice coefficient of discharge
Allowable Flow Rate	Q =	0.0500	m^3/s	0.80	Tube coefficient of discharge
Force of Gravity	g =	9.81	m/s/s		
Head Height	h =	0.03	m		
Dia of Max. Orifice	dia =	337.13	mm	Use -	250 mm

Flow Rate for Actual Size of Hole (Q=Cd*A*sqrt(2*g*h))

Area of Orifice	A =	0.0491	m^2
Flow Rate through Orifice	Q =	0.0275	m^3/s

New Tecumseth Fire Station #4
Exhibit #4 - 100 Year Orifice Plate and Storage Volume Calcs

Site Data

Site Discharge	Flow	Adj. Flow (w/o Surface Runoff)	Total Storm Volume
	(m^3/s)	(m^3/s)	(m^3)
Pre - Develop.	0.3304	0.1038	
Post - Develop.	0.4937	0.2671	224.0

Control Node Data

Outlet Pipe	Storm Control Node	Outlet Pipe Size	Outlet Invert Elev.	Elev. @ Orifice
		(m)	(m)	(m)
4	Pond 1	0.250	220.10	220.23

* Volume calculated using SWMM 5.1 modelling software in accordance with the flow rate for actual size of the orifice.

Head Height 0.18 m **Storm Retention Elev. Check** **220.40 m**

Bio-Retention Pond / Pond Storage

Pond Sections	Pond Dimensions		Storage Volume
	Depth	Avg Area	
	(m)	(m)	(m^3)
Pond	0.300	761.41	228.42
Total			**228.42**

Total Storage = 228.4 m^3 **Required Storage Achieved**

Orifice Diameter Calculation (A=Q/(Cd*sqrt(2*g*h)))

Coefficient of Discharge	Cd =	0.8	(tube)	0.62	Sharp Orifice coefficient of discharge
Allowable Flow Rate	Q =	0.1038	m^3/s	0.80	Tube coefficient of discharge
Force of Gravity	g =	9.81	m/s/s		
Head Height	h =	0.18	m		
Dia of Max. Orifice	dia =	298.69	mm	Use -	250 mm

Flow Rate for Actual Size of Hole (Q=Cd*A*sqrt(2*g*h))

Area of Orifice	A =	0.0491	m^2
Flow Rate through Orifice	Q =	0.0728	m^3/s

HALLEX ENGINEERING LTD.

New Tecumseth Fire Station #4
Exhibit #5 - Chicago 25mm Storm Calculations

2023-09-13
Job: 191204

Chicago 25mm Storm

Rainfall Intensity Values =
A= 500.000
B= 8.100
C= 0.810

manning's n =
0.013 PVC Pipe
0.013 Conc Pipe
0.024 Corr. Stl Pipe
0.035 Grass Swale

Location			Length of Pipe	Area		Flow Time		Rainfall Intensity	Unit rate of Runoff	Design Flows		Sewer/Channel Design				Invert Elevations	
Pipe	From Node	To Node		Incre-ment	Cum Total	To Upper	In Section			Cum Flow	Cum Flow	Slope	Capacity Full	Velocity Full	*Dia/ Depth	Up-stream	Down-stream
			(m)	(ha)	(ha)	(min)	(min)	mm/hr	m^3/ha*day	(m^3/d)	(m^3/s)	(m/m)	(m^3/s)	(m/s)	(m)	(m)	(m)
1	**Area 1**	**Street 1**	**N/A**	**0.346**	**0.346**	**10.00**	**N/A**	**48**	**17815**	**3045.8**	**0.0353**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
Paved	-	-	-	0.164	-	-	-	-	10919.1	1790.7	-	-	-	-	-	-	-
Grass	-	-	-	0.182	-	-	-	-	6896.2	1255.1	-	-	-	-	-	-	-
2	**Area 2**	**Prpty 1**	**N/A**	**0.195**	**0.195**	**10.00**	**N/A**	**48**	**17815**	**1566.0**	**0.0181**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
Paved	-	-	-	0.055	-	-	-	-	10919.1	600.5	-	-	-	-	-	-	-
Grass	-	-	-	0.140	-	-	-	-	6896.2	965.5	-	-	-	-	-	-	-
3	**RWL. 1**	**Pond 1**	**38.7**	**0.137**	**0.137**	**10.00**	**0.57**	**48**	**10919**	**1495.9**	**0.0173**	**0.0120**	**0.0359**	**1.1437**	**0.200**	**220.57**	**220.10**
Roof	-	-	-	0.137	-	-	-	-	10919.1	1495.9	-	-	-	-	-	-	-
4	**Pond 1**	**Swale 1**	**7.3**	**0.421**	**0.558**	**10.57**	**0.15**	**47**	**17373**	**5229.5**	**0.0605**	**0.0050**	**0.0420**	**0.8566**	**0.250**	**220.10**	**220.06**
Paved	-	-	-	0.230	-	-	-	-	10648.2	2449.1	-	-	-	-	-	-	-
Grass	-	-	-	0.191	-	-	-	-	6725.2	1284.5	-	-	-	-	-	-	-
5	**Swale 1**	**Street 1**	**101.2**	**0.166**	**0.724**	**10.72**	**4.04**	**46**	**6682**	**6338.7**	**0.0734**	**0.0040**	**0.0737**	**0.4180**	**0.155**	**220.06**	**219.65**
Grass	-	-	-	0.166	-	-	-	-	6681.8	1109.2	-	-	-	-	-	-	-

* Swale/Ditch geometry based on the following assumptions: trapezoidal channel, grassed lined (n = 0.035), 2.5:1 sideslopes, 0.75 m bottom width.
* Grassed swale Flow Velocity for Water Quality Enhancement to be maximum 0.5 m/s for the 4 hour 25mm Chicago Storm.

Run-off Coefficients Used:

Roof Structure C = 0.95
Paved Surface C = 0.95
Grass Surface C = 0.25

Velocity Range:

Minimum Velocity = Use Minimum m/s
Maximum Velocity = 4.50 m/s

Time of Concentration:

Time of Concentration = 10 min

PART 1: GENERAL

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 RELATED WORK UNDER OTHER SECTIONS

.1 Contractor shall be responsible for coordinating this section with all related sections.

1.3 REFERENCE STANDARDS

.1 All Codes, Standard Specifications and By-Laws referred to in this Specification shall be current editions including all latest revisions and addenda.

.2 Conform with the Building Code from the province of construction.

.3 Concrete Formwork is to conform with CSA Standard CAN3-A23.1.

.4 Falsework, where required, is to conform with CSA Standard S269.

.5 Assume full responsibility for the design and for the adequacy and for the safety of all formwork and falsework.

.6 Conform with all applicable standards listed in National Building Code of Canada Table 1.3.1.2.

1.4 SHOP DRAWINGS

.1 Formwork and supporting falsework shall be designed by a qualified professional Engineer registered in the province of construction and familiar with the methods and procedures to be employed, who shall be hired by the contractor.

.2 Prepare drawings showing complete details of materials, design, fabrication and erection of formwork and falsework for the framed slabs. Formwork shall be constructed maintained and removed in conformity to these drawings, which must be stamped signed and dated by the professional engineer responsible for the formwork design. The contractor’s engineer shall:

A) Design the formwork.

B) Produce formwork drawings.

C) Work out the procedures and timing for the removal of the forms.

D) Set the procedure for controlling the strength of concrete in the structure for the purpose of form and re-shore removal.

E) Carry out field supervision of construction, maintenance, and removal of forms shores and re-shores, including the procedures for controlling the strength of concrete. An adequate number of inspections shall be performed by the contractor's engineer to enable him to certify that all requirements set in his drawings and instructions have been followed by the construction crew.

F) Issue construction reports to the Architect twice monthly.

G) Form removal and re-shoring shall not commence until in place strength of concrete is at least 75% of its specified 28 day strength or otherwise specified by the consulting engineer in writing.

.3 Show on the drawings:

.1 All materials, sizes, lengths and connection details.

.2 Field adjustment provisions.

.3 Anchors, shores and braces including spacing of diagonal bracing.

.4 Camber or adjustment elevations to compensate for settlement or deflection of forms, as well as any camber specified or noted on the drawings.

.5 Details on shoring, re-shoring or leaving original shores in place as forms are stripped.

.6 Locations and details of construction joints. Construction joints not shown on drawings shall be subject to structural consultant's approval.

.4 Submit for review copies of drawings as directed by the Architect. Drawings to bear the stamp of the registered professional engineer responsible for the design.

.5 Be responsible for the structural design of formwork, its construction, maintenance, and removal, including shoring and bracing, to ensure its stability and to support safely and resist loads imposed by weight of forms and wet concrete, wind, fluid pressure of concrete, equipment and workers.

.6 Conform with the requirements of Regulatory Agencies including submission of required shop drawings. Proceed with construction of formwork only with the approval of the jurisdictional authorities.

1.5 CRANES OR OTHER CONSTRUCTION EQUIPMENT

.1 Submit for review as directed by the Architect, details of any crane or the construction equipment which is to be used to erect formwork and place concrete, which will affect the structure as shown on the structural drawings. Include details for dismantling and removal of crane upon Completion of Work.

PART 2 : PRODUCTS

2.1 MATERIALS

.1 Formwork Lumber:

Plywood and wood formwork materials are to conform with CSA Standard CAN3-A23M.

.2 Plywood:

Form plywood shall be exterior grade. Plywood shall be resin coated on side (in contact with concrete). Use sound undamaged plywood with clean true edges. Make-up or patching strips between panels shall be kept to a minimum.

.3 Steel:

Minimum 16-gauge sheet, well matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.

.4 Exposed Surfaces:

Form materials for concrete surfaces which will be exposed to view, or which required smooth and uniform surfaces for applied finishes or other purposes, shall consist of square edged smooth panels of plywood, metal or plastic. The panels shall be square and made in a true plane, clean, free of holes, surface markings and defects.

.5 Falsework Materials:

To conform with CSA Standard S269. Materials shall bear grade marks or be accompanied with certificates, test reports or other proof of conformity.

.6 Formwork Release Agent:

Shall be a proprietary material which will not stain the concrete or impair the natural bonding or colour characteristics of coating intended for use on the concrete.

.7 Chamfers wood, 45 degree cut from 1” x 1” or plastic type.

PART 3: EXECUTION

3.1 EARTH FORMS

.1 Obtain Engineer's approval for use of earth forms.

.2 Hand trim sides and bottoms and remove loose earth from excavations before placing concrete.

.3 Footings and caps to have plywood side forms unless otherwise approved by the Engineer.

3.2 SURFACE CONDITIONS

.1 Examine the excavation and foundations for adequate working room and support for the Work of this Section. Report discrepancies which affect the Work in the Section.

3.3 PREPARATION

.1 Coat the inside surface of forms with a form release agent, used in strict accordance with the manufacturer's instructions. Apply the agent prior to placing reinforcing steel, anchoring devices and embedded parts.

.2 Do not apply form release agent where concrete surface will receive special finishes and applied coverings which would be affected by the agent. Soak the inside surface of untreated forms, subject to shrinkage or absorption of water, with clean water and keep surface wet prior to placing concrete.

3.4 ASSEMBLY AND ERECTION

.1 Construct the formwork and shoring and bracing to meet the design requirements, accurately, so that the resultant finished concrete shall conform to the shapes, lines and dimensions of the members shown on the drawings (within the tolerances stipulated below).

.2 Formwork shall be so arranged and assembled as to permit easy dismantling and stripping so that concrete will not be damaged during its removal.

3.5 CAMBER

.1 Camber forms for slabs and beams ¼" per 10' – 0" of span, unless otherwise shown.

.2 Uplift ends of forms for cantilever beams or slabs ¼" per 6' – 0" of cantilever length.

.3 Maintain beam and slab thickness from cambered surface.

3.6 TOLERANCES

.1 Variations from plumb: In 10' – 0" … ¼".

.2 In any storey of 20' – 0", maximum … 3/8".

.3 Variation from level in tops of floor slabs: In 10' – 0" … ¼".

.4 For exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines: In any bay … ¼".

.5 Variation of the linear building lines from established position in plan and related position of columns, wall and partitions: In any bay of 20' – 0", maximum … ¼".

In greater than 40' – 0" … ½".

.6 Variation in size of walls and floor openings: …+ ½".

.7 Variation in cross-sectional dimensions:

.1 Variation in plan dimensions: - ¼" + ½".

.2 Slabs and walls: - 1/8" + ¼".

.8 Footings and Caps:

.1 Variation in plan dimensions: - ½" + 2".

.2 Variation in thickness: - 0".

.9 Variation in steps: Rise ± 1/8". Tread ± ¼".

3.7 JOINTS IN FORMS

.1 Make form joints tight in order to prevent leakage of mortar. Keep form joints to a minimum.

.2 Form chases, slots, openings, drips, recesses, expansion joints and control joints as detailed.

3.8 SHORING AND BRACING

.1 Provide bracing to ensure the stability of the formwork as a whole. Prop or strengthen all previously constructed parts liable to be overstressed by construction loads.

.2 Provide a positive means for adjustment of shores and struts and to take up settlement of formwork during placing of concrete.

3.9 TEMPORARY PORTS AND OPENINGS

.1 Provide temporary ports or openings where required to facilitate cleaning and inspection. Such openings are to be closed with tight fitting panels so that joints will not be apparent in exposed concrete surfaces.

3.10 FORMWORK SCHEDULE

.1 Concrete Finish C-1:

.1 Plywood panel forms for surfaces not exposed to view.

.2 Concrete Finish C-2:

.1 Plywood panel forms, snap form ties, with tie holes patched immediately after forms are stripped, for surfaces exposed to view and surfaces to receive waterproofing and sandblasted finish.

3.11 FIELD QUALITY CONTROL

.1 Inspect and check the complete formwork, shoring and bracing to ensure that the work is in accordance with the formwork design. The engineer responsible for the design of the formwork shall assist in this inspection.

.2 Obtain the approvals of the engineer responsible for the design of the formwork and the general approval of the engineer before placing concrete.

.3 If requested, submit test data on patented and proprietary devices and assemblies that are proposed for use on the Work.

3.12 CLEANING

.1 Clean the forms as erection proceeds to remove foreign matter. Remove cuttings, shavings and debris from within the forms.

3.13 REMOVAL OF FORMWORK

.1 Do not remove forms, shores and bracing until the concrete has gained sufficient strength to carry its own weight and construction and design loads which are liable to be imposed on it. The strength of concrete shall be verified by compressive test results to the approval of the Engineer.

.2 Where early stripping of forms is contemplated, comply with Section 03 30 00 Cast-In-Place Concrete.

.3 Remove falsework progressively so that no shock loads or unbalanced loads are imposed on the structure. In general, and unless otherwise approved by the Engineer, load supporting forms may be removed when the concrete has attained 75% of the required design 28 day compressive strength, provided the construction is re-shored.

.4 Forms not directly supporting the weight of concrete may be removed as soon as stripping operation will not damage concrete.

.5 The following is a table of minimum time that forms should remain in place under ordinary conditions, unless otherwise specified, but compliance with these requirements shall not relieve the Contractor of
his obligation to delay the removal of forms if the concrete has not set sufficiently so as not to cause any damage whatsoever..

.1	Beam Soffits	28 days or 7 days if re-shored, and 75% of specified 28 day strength is achieved in the concrete elements.
.2	Columns	24 hours.
.3	Walls	24 hours.
.4	Sides of Beams & Slabs	24 hours.
.5	Soffits of Slabs	28 days or 7 days if re-shored and 75% of the specified 28 days strength of the concrete has been achieved.
.6	Removal of Re-shores	28 days, if no formwork is erected or to be erected above same.

.6 Minimum Curing Period Prior to Form Removal:

.1	Air Temperature: Above 15C:	3 days
.2	Air Temperature: 10C to 15C:	5 days
.3	Air Temperature: 5C to 10C:	7 days
.4	Air Temperature: Less than 5C: When temperature below 5C prevails, leave forms until concrete reaches 75% of 28 – day design strength.	

.7 Observance of minimum curing periods listed above does not relieve Contractor of responsibility for safety of structure during construction.

.8 Any stripping sequence at an accelerated rate than that given above, requires approval of the Engineer. Approval and instruction to be in writing and at no cost to the Owner.

3.14 RE-SHORING

.1 Re-shore in two directions so that no large areas of new construction are permitted to support their own weight. Install re-shores at mid-span of members and in no case at more than 10’ – 0” on centre. Tighten re-shores to carry the weight of new

construction and any loads imposed thereon. Do not over-stress new construction by over-tightening.

.2 Leave re-shores in place beneath framed slabs which support the weight of newly placed concrete above. Locate such shoring so that it is concentric with shoring above and leave in position until the newly placed concrete reaches at least 75% of its specified 28-day compressive strength.

.3 The Contractor shall be responsible for the design, installation and maintenance of the re-shoring system.

END OF SECTION

PART 1: GENERAL

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this section.

1.2 RELATED WORK UNDER OTHER SECTION

.1 Contractor shall be responsible for coordinating this section with all related sections.

1.3 REFERENCE STANDARDS

.1 All Codes and Standards referred to in this Specification shall be current editions including all latest revisions and addenda.

.2 Conform with CSA-A23.1, .2, and .3.

.3 Conform with the Building Code from the province of construction.

.4 Conform with ACI Standard 315 and the RSIO Manual of Standard Practice.

.5 Conform with CSA Standard G30.12.

.6 Conform with CSA Standard G30.5.

.7 Conform with ASTM A775.

1.4 SOURCE QUALITY CONTROL

.1 Provide certified copies of mill test reports of steel supplied, with each major shipment to the site.

.2 If requested by Engineer, submit test data from an approved testing company that each size and grade of reinforcing steel meets the Specification requirements. Pay for cost of such testing.

.3 Any reinforcing which fails to conform with the Specification requirements shall be removed from the site and replaced at no additional expense to the contract.

.4 Comply with Section 03 30 00 Cast-In-Place Concrete.

1.5 SHOP DRAWINGS

.1 Provide shop drawings (placing drawings and bar bending schedules) showing dimensions and information necessary for fabrication and placing the reinforcing steel, without recourse to the structural drawings.

.2 Submit copies in accordance with Section 01 30 00 Administrative Requirements.

.3 Generally, placing diagrams shall be in accordance with the Manual of Standard Practice for Detailing Reinforced Concrete Structures ACI-315 and the RSIO.

.4 Structural drawings take precedence over placement drawings and bar schedules unless otherwise instructed, in writing, by the Engineer.

.5 Conform with the typical details shown on the structural drawings.

1.6 SUBSTITUTIONS

.1 Substitution of different size bars permitted only with written approval of the Engineer.

PART 2: PRODUCTS

2.1 MATERIALS

.1 Reinforcing Bars:

Shall be new deformed “hi-Bond” bars of Canadian manufacture conforming with CSA Standard G30.18 with a minimum yield stress of 400 MPa. All bars shall have typical identification patterns of Canadian producers and standard identification requirements as shown in the RSIO Manual of Standard Practice.

.2 Welded Wire Mesh:

Shall conform with CSA Standard G30.5. Shall be supplied and stored in flat sheets.

.3 Epoxy Reinforcing Bars:

To meet specified requirements of ASTM Specification A775.

.4 Provide chairs, bolsters, bar supports, side wall spacers and spacers adequate for strength and support of reinforcing to satisfy the construction conditions. Chairing of slab steel shall be in accordance with the Standard Practice - Bar Supports Section of the Reinforcing Steel Manual of Standard Practice produced by The Reinforcing Steel Institute of Canada. Reinforcing steel shall be tied and supported such that it cannot be displaced by normal or expected construction activity. Any and all reinforcement not adequately secured in place shall be rectified prior to concreting. Always provide support bars below the lowest layer of top steel. Main reinforcement, hung from the support bars, will be rejected.

.5 For exposed architectural concrete surfaces, use solid plastic chairs and/or side wall spacers, etc.

.6 Tie wires shall be annealed wire No. 16 (U.S. Standard Gauge), or heavier or an approved proprietary system, conforming with CSA G30.3. Provide epoxy or plastic-coated wires to tie epoxy coated reinforcing steel.

.7 Wire mesh laps shall be minimum 150 mm.

2.2 FABRICATION

.1 Fabricate and place all reinforcement in conformity to current manual of standard practice for detailing reinforced concrete structures A.C.I. 315, CSA-A23.1, CSA-A23.3, and reinforcing steel manual of Standard practice by RSIO.

.2 Where tension laps are specified, lap reinforcing steel in accordance with the requirements of CSA-A23.3. All other laps and embedment of dowels shall be 24 bar diameters, but not less than 450 mm if not specified otherwise.

.3 Location of splices not shown on the drawings shall be approved by the Engineer and shall, for beams and slabs, be away from points of maximum stress.

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

PART 3: EXECUTION

3.1 EXAMINATION

.1 Examine Work upon which this Section depends and report any discrepancies to the Architect and Engineer, before proceeding with the Work.

3.2 PLACING OF REINFORCEMENT

.1 Conform with CSA-A23.1.

.2 Place reinforcing within the following tolerances:

.1 For clear protection of reinforcement ± 6mm.

.2 Lateral spacing of bars shall be within ± 25mm of the specified spacing.

.3 For longitudinal location of bends and ends of bars ± 50mm except discontinuous ends ± 20mm.

.3 Side form spacers shall be used for all column, beam and wall construction to secure reinforcement against displacement and maintain required cover distance between the reinforcement and the vertical formwork.

.4 Spacing of bars shall be approximately uniform within the corresponding strips of two-way slabs. Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval of all modifications from the structural engineer before placing concrete..

.5 All materials shall be clean and free of all deleterious material. All deleterious material shall be removed in a manner acceptable to the Engineer.

.6 Provide dowels from all footings into reinforced concrete walls, piers and columns. Column dowels shall be secured in position before concrete is placed.

.7 Where new concrete abuts existing concrete, dowels shall be drilled in and epoxy grouted to existing concrete. Size, and number of dowels to match reinforcement in new concrete which runs perpendicular to the face of the existing concrete. If not specified on drawings, assume min. 200mm embedment into existing concrete. Lap length as per above specification. (This does not apply at expansion joints).

.8 Reinforcement around openings to be provided in accordance with typical details unless if not specified elsewhere on drawings.

3.3 EPOXY COATED REINFORCING STEEL

.1 All reinforcing steel used in cast-in-place concrete work which is within 60mm of concrete surfaces which are exposed to weather (including slab soffits), in contact with earth (unless scheduled to receive a waterproof membrane), or where so indicated on the drawings shall be fusion bonded epoxy coated (F.B.E.C.). Such coating shall conform to ASTM Specification A775.

.2 All handling and hoisting of F.B.E.C. reinforcing steel shall be performed using methods and equipment designed to minimize damage to the epoxy coating. Use nylon or padded lifting slings at multiple pick-up points to keep curvature of bundles of bars to a minimum. Bundled bars shall not be dropped or dragged.

.3 Bars bundled for shipping shall have padded ties. Bundles shall be stored on padded or wooden cribbing. Foot traffic on coated bars shall be discouraged at all stages of the construction process.

.4 Inspect reinforcing steel for coating damage after unloading and during and after the placing operation.

.5 Repair all areas of damage where the total damaged area does not exceed two percent of the total bar surface. Where damage exceeds two percent of the total bar surface, the bar shall be replaced.

.6 Where rusted areas or areas of cracking and debonding occur, the bar shall be cleaned using power tools and the coating repaired or the bar replaced according to the previously described “two percent” criteria.

.7 Repair all damage using patching material conforming to ASTM Specification A775-86 applied as recommended by the manufacturer. Temperature and moisture conditions shall be suitable during repairs.

.8 All F.B.E.C. reinforcing steel shall be set in position on the forms using plastic low and

high chairs and shall be tied firmly in place using plastic or plastic coated tie wire to avoid damage to the epoxy coating.

.9 During concrete placing operations, suitable care shall be employed in the use of equipment and tools to avoid damage to the coating of the bars.

.10 All supplementary chair, spreader or separator bars used to support F.B.E.C. reinforcing steel in position shall be epoxy coated, or solid plastic. In no case shall epoxy coated steel reinforcement be in contact with black steel. Epoxy coated steel installed against black steel will be removed and replaced at the contractor's expense.

.11 All F.B.E.C. reinforcing steel shall be bent cold. All field-cut ends of F.B.E.C. reinforcing steel shall be coated with approved patching material.

3.4 FIELD REVIEW

.1 Refer to Section 03 30 00 Cast-In-Place Concrete.

END OF SECTION

PART 1: GENERAL

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 RELATED WORK UNDER OTHER SECTIONS

.1 Contractor shall be responsible for coordinating this section with all related sections.

1.3 REFERENCE STANDARDS

.1 All Codes, Standard Specifications and By-Laws referred to in this Specification shall be current editions including all revisions and addenda.

.2 Conform with the Building Code from the province of construction.

.3 Conform with CSA Standards CAN3-A23.1, .2, and .3. (References made to CAN/CSA A23M shall mean whichever Part .1, .2 or .3 that is relevant to the topic.)

.4 Conform with all applicable standards listed in National Building Code of Canada Table 1.3.1.2.

PART 2: PRODUCTS

2.1 GENERAL

.1 Provide new materials equal in all respects to those specified.

.2 No substitutions will be allowed unless the following arrangements are made:

A) Written permission is obtained from the architect/engineer
B) The contractor ensures that substitutions can be both physically and dimensionally incorporated in the work with no loss of intention, function or construction time and at no additional cost to the owners.

The contractor shall reimburse all consultants for additional expenses due to these substitutions.

2.2 MATERIALS

.1 **Cement:**

Provide Portland Cement of Canadian Manufacture conforming with CSA Standard CAN/CSA-A5. **Type GU**, unless noted otherwise on plans, (from the same source for entire project for concrete exposed to view.)

.2 **Aggregates:**

.1 Provide clean, uncoated sand and coarse aggregates from approved sources which conform with CSA Standard CAN3-A23.1. Nominal size of coarse aggregate shall be 20mm unless otherwise stated on the structural drawings or specification.

.2 Coarse aggregate for concrete in 300mm to 375mm thick columns shall be of calcareous nature and shall contain a combined total of not more than 10% of quartz, chert and flint.

.3 **Water:**

To CSA-A23.1. Verify that no salts are present which will cause efflorescence.

.4 **Ready Mix Concrete:**

Shall be quality controlled concrete conforming with CSA-A23.1.

.1 Unless noted on drawings, the following concrete mixes and 28-day compressive strengths for concrete shall be used:

Interior Foundations…….25 MPa		Class N
Exterior Foundations……...25 MPa		Class F2
Basement walls……25 MPa		Class F2
Foundation walls……..25 MPa		Class F2
Grade beams…….25 MPa		Class F2
Interior slab-on-grade……..25 MPa		Minimum cement content 280kg/m^3 Maximum water/cement ratio 0.55
Interior piers, walls, columns and all other interior concrete……	25 MPa	Minimum cement content 280kg/m^3 Maximum water/cement ratio 0.55
Retaining walls……	35 MPa	Class C1
Parking structure slabs, walls and columns……..	35 MPa	Class C1
All exterior reinforced concrete……	35 MPa	Class C1
All exterior unreinforced concrete……	32 MPa	Class C2

.2 Concrete shall also conform to the following:

a) Conform with the requirements of CSA-A23.1.

b) The coefficient of variation of 28-day compressive test results shall be in the "Good or Better" range (15% variation is acceptable) as laid down in ACI 214.

c) Chlorides of any kind shall not be used.

d) Limit water / cement ratio of mixes to no more than the requirements of CSA-A23.1 or as specified on the structural drawings/specifications, whichever is less.

.5 **Slumps:**

In accordance with CSA-A23.1 unless otherwise noted on structural drawings.

.6 **Admixtures:**

Where permitted, shall conform with CSA -A266M.

.1 Water Reducing Admixtures: CSA-A266.2 and A266.4.

.2 Air Entrainment: CSA-A266.1.

.3 Chemical Admixtures: CAN3-A266.2 and A266.4, Type A – water reducing.

a) Admixtures containing thyocyanates, calcium chlorine or more than 0.1% chloride ions are not permitted. Corrosive content: no more than present in municipal drinking water.

b) Maximum water-soluble chloride ion content in hardened concrete at 28 days: Not to exceed 0.15% by weight of cement.

.7 **Fly-Ash and Slag:**

Do not incorporate Fly-Ash or Slag into concrete mix designs without prior approval in writing.

Fly-Ash will not be accepted in any concrete which is exposed to view.

Obtain consultant's written approval prior to the use of any other admixtures.

.8 **Grout:**

.1 **Dry pack grout:** Use a mix consisting of one (1) part Portland Cement and 1-1/2 parts sand and 2 parts of 8mm pea gravel with only sufficient water to dampen the mixture, and to attain a compressive strength of 50 MPa @ 28 days.

.2 **Non-Shrink Grout:** Pre-mixed, non-shrinking, high strength grout, COE CRD-621; compressive strength of 50 MPa in28 days.

1. Masterflow 713 by Master Builders Co.
2. Euco-N-S Grout by Euclid Chemical Company.
3. Sonogrout by Sonneborn Building Products.
4. M-BED standard by Stern Construction Products.

.3 **Epoxy Bonding Agent: ASTM C881**

1. Concresive 1001 LPL by M.B.T. Co.
2. Similar product by other manufacturers; submit name, compressive strength and tensile strength for acceptance.
3. Sikadur 32 by Sika Canada Inc.

.9 **Concrete Curing Materials**

.1 **Chemical Cure for Slabs:** Kure-N-Seal by Sonneborn Building Products, or Flortec 22 by Sika Canada Inc.; acrylic formula designed and certified to compatible with resilient flooring adhesives.

.1 Substitutions: None accepted.

Chemical curing shall not be used for parking deck slabs.

.2 **Moisture Cure:**

1. Water: Potable
2. Moisture–retaining Coverings: burlap, cotton mats, or other moisture-retaining fabrics; AASHTO M182, ASTM C171 or AASHTO M73. Provide burlap free of seizing; rinse thoroughly in caustic soda to remove soluble substances and make burlap more absorbent.

.10 **Concrete Mix**

.1 Mix and deliver concrete in accordance with CSA-A23.1 and ASTM C94.

PART 3: EXECUTION

3.1 APPROVALS

.1 Submit for review proposed concrete mix designs for each class and strength of concrete to be utilized in the project, including pump mix designs as intended to be provided by the supplier.

.2 Submit copies of mix designs to the Architect, the Engineer and the appointed inspection and testing company.

.3 Submit for approval brand name, etc. of admixtures to be incorporated in mix designs.

.4 Submit for approval brand name of proposed curing compound to be used.

.5 Submit for the Architect's review, drawings (scale 1:48 or 1:50) showing type, extent and location of items to be cast in, and openings to be formed in concrete work. Concrete must not be placed until Architect has reviewed these drawings. Particular emphasis is to be placed on accurately locating all openings in walls.

.6 Use concrete pumps to place concrete only with approval of methods, equipment and mix design.

.7 Submit drawings or marked-up prints showing proposed locations of construction and control joints in all slabs for review by the Engineer.

3.2 EXAMINATION

.1 Ensure that no water is present. No flooding water is permitted on foundation beds. Provide skim coats where footings and other concrete work are to be placed on soils which do not provide an acceptable working surface. Place concrete only on frost-free ground. Remove previously frozen bearing surfaces.

.2 Ensure that all spread foundations bear on undisturbed soil or approved engineered fill. If bearing surfaces are disapproved because conditions do not meet those anticipated during design, make adjustments only as directed. No extra payment will be made for adjustments made necessary because of damage to bearing surfaces caused by weather, traffic, or removal of frozen material, or by presence of adjacent construction or services incorporated in the Work.

.3 Ensure that compacted fill has been placed to meet specified requirements and that under-slab services have been installed, inspected, tested and approved.

.4 Keep excavations dry while placing concrete. Pump as required.

.5 Verify anchors, seats, plates reinforcement and other items to be cast into concrete are accurately placed, held securely and will not cause hardship in placing concrete.

3.3 PREPARATION

.1 Reinforcement shall be stored in such a manner that it is off the ground and kept free of mud and foreign matter.

.2 Before concrete is placed, all reinforcing steel, accessories and hangers, inserts, conduits, sleeves, outlets, etc., must be securely tied in place and reviewed.

.3 Before casting concrete, obtain engineer's approval of reinforcement in place. Leave open one side of forms for the following structural elements until all reinforcement is secured in place and reviewed and accepted by the consultant's representatives:

A) All columns;

B) walls or deep beams containing heavy or complicated reinforcement.

.4 At least 75% of all reinforcing steel in any structural concrete member must be properly secured in position before the reviewing inspector can accept the steel for casting concrete.

.5 All dirt, clips, sawdust, water, snow, ice and other foreign matter must be removed from forms and reinforcing steel.

.6 All forms, surfaces, reinforcing steel and ground with which the concrete is, or is calculated to come in contact with, shall be heated to a temperature of not less than 5° C.

.7 The bottom of excavations for footings and foundations must be undisturbed soil or approved engineered fill, clean, free from loose material, organic material, water and frost, properly leveled and approved by the soils consultant prior to the placing of concrete.

.8 All sides of footings shall be formed unless hand excavated on stiff cohesive soil.

.9 Prepare previously placed concrete by cleaning with steel brush and applying bonding agent. Apply bonding agent in accordance with manufacturer's instructions. Do not apply bonding agent at slab-on-grade construction joints.

3.4 WORKMANSHIP

.1 Conform with the requirements of CSA Standard CAN/CSA-A23M. Maintain a copy of the Standard on the site throughout the construction period.

2. Provide a competent and experienced supervisor or foreman who shall be present on the site continuously throughout each working day.

3.5 PLACING CONCRETE

.1 Place concrete in accordance with CAN/CSA-A23-1; including hot and cold weather placement procedures.

.2 Notify the rebar inspection company at least 24 hours before any concreting operation is to proceed, for a review of the preparations. The planned casting must be made continuously without stopping.

.3 Maximum time between adding mix water and complete discharge of concrete into forms shall be ninety (90) minutes.

.4 Conveying and placing equipment shall be such that once concreting has started, the depositing of concrete shall be at such a rate and of such sequence that the concrete is at all times sufficiently plastic to ensure proper bonding of successive layers or panels.

.5 Conveying and placing equipment shall be kept free from hardened concrete and foreign material and shall be cleaned at frequent intervals.

.6 Contact local meteorological office at least 24 hours before start of concrete casting. Re-schedule casting if adverse weather conditions are imminent (rain, snow, etc.). Do not place concrete when it is raining or likely to rain.

.7 Notify testing laboratory minimum 24 hours prior to commencement of concreting operations.

.8 Inspect reinforcement, insets and embedded parts before beginning concrete placement to ensure accurate size and location.

.9 Ensure reinforcement, insets, embedded parts and formed joints are not disturbed during concrete placement.

.10 Do not deposit concrete which has partially set or hardened. Do not deposit initial lubricating mortar when pumping concrete. Remove hardened or partially hardened concrete which has accumulated on forms or reinforcement. Do not place concrete on previously deposited concrete which has hardened sufficiently to cause formation of seams or planes of weakness within respective members or sections, except as specified.

.11 Do not deposit concrete into excavation where water is standing. If place of deposit cannot be successfully pumped dry, place through tremie with outlet end near bottom of place of deposit.

.12 Consolidate and screed concrete slabs-on-grade by use of vibratory screed of size to allow construction joint pattern as indicated on Structural drawings and specified.

.13 Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Structural Engineer upon discovery.

.14 Trench Drain: Form trench drain, providing minimum 3mm slope to drain as indicated. Provide solid bearing surface for continuous grating, Section 05500. Interior surfaces of trench: trowel smooth.

3.6 JOINTS

.1 Construction Joints:

In general, incorporate both horizontal and vertical construction joints in accordance with CSA Standard CAN/CSA-A23-M and typical details shown on the drawings.

.2 Refer also to in slabs-on-grade specifications in this section.

.3 Refer to Submittals in this section

.4 ACI recommends that reinforced concrete slabs shall be cast in sections not exceeding 560 square metres in area. Contractor shall take necessary measures to prevent excessive cracking if pour size is increased and shall be responsible for repairing cracked concrete resulting from exceeding recommended maximum pour size. Each pour shall be bounded by a vertical bulkhead or abutting construction. Provide additional reinforcement as per typical details.

.5 Maximum spacing between vertical construction joints in walls shall be 9000mm. Engineer's approval shall be obtained for location and details of construction joints if required otherwise by site conditions.

.6 Provide 40mm deep x 90mm wide continuous key in all footings under reinforced concrete walls and wall joints below grade.

3.7 COLD WEATHER PROTECTION REQUIREMENTS

.1 Conform with the requirements of CSA Standard CAN/CSA-A23M, and as hereinafter specified.

.2 Protection Against Early Frost Damage:

Effective means shall be provided for maintaining the temperature of the concrete in place above the minimum limits shown in Table 14 in CAN/CSA-A23.1-M for a minimum period of 3 days or until sufficient hydration has occurred to protect the concrete from frost damage.

.3 Protection for Structural Safety:

If, subsequent to the above period of protection, the ambient conditions are not likely to be favourable for continuous strength development, the protection period shall be extended until the concrete has achieved sufficient strength for structural safety.

.4 Protection for Strength and Durability:

When subsequent ambient conditions are not conducive to continued curing and strength development, the protection period shall be extended until a total period of seven (7) days at temperatures above 10° C has been attained.

.5 The Architect may instruct that additional protection and/or heating facilities be provided, if in his opinion, that which has already been provided is inadequate, at no extra cost to the contract.

.6 Equipment and materials capable of maintaining adequate temperature, humidity and protection shall be available on site and be ready for operation when any concrete is placed.

3.8 HOT WEATHER PROTECTION REQUIREMENTS

.1 Conform with the requirements of CSA Standard CAN/CSA-A23M, the

recommendations of ACI Standard 305 and as hereinafter specified.

.2 Job Preparation:

Facilities shall be provided for protection of the concrete in place from the effects of hot and/or drying weather conditions. In extremely hot weather, the formwork, reinforcement and concreting equipment shall be protected from the direct rays of the sun, or cooled by fogging and evaporation.

.3 Concrete Temperature:

When the air temperature is at or above 25° C or when there is a probability of it rising to this during the placing (as forecast by the local official meteorological office) special effort shall be made to maintain the temperature of the concrete as low as practicable and in no case more than that stipulated in Table 14 in CAN/CSA-A23.1-M.

3.9 FINISHING OF CONCRETE

.1 Exposed Surfaces:

Cut off projecting fins, cut out and fill all honeycombed areas and fill all holes left by form separators using a 1:2 cement-sand mix and a bonding agent. Rough, unsightly or other imperfect areas shall be rubbed flush with the general surface by use of a carborundum brick and water, unless otherwise specified.

.2 Non-Exposed Surfaces:

Honeycombing shall be cut out and filled and any fins which interfere with strapping, etc., shall be cut back. Holes left by form separators shall be filled. (See also Defective Concrete.)

.3 Concrete to be Waterproofed:

Where membrane waterproofing is required, treat as exposed finish in accordance with CSA Standard CAN/CSA-A23M, to obtain a surface which will ensure a good waterproofing job. Obtain the approval of the finished surfaces by the waterproofing sub-contractor.

.4 Exposed concrete shall be “Architectural Quality” and shall have removable cone-ties to Architect’s approval. Finish is to be consistent and be approved by the Architect.

.5 Where shown on architectural drawings and/or specifications, floor slabs to be “sealed”. Use approved sealing compound in strict accordance with manufacturer’s recommendations.

3.10 CONCRETE BASES AND CURBS FOR EQUIPMENT

.1 Whether indicated on drawings or not, form curbs around duct shafts, electrical shafts, pipe shafts and other floor openings for mechanical and electrical services except

where protected by masonry walls. Make curbs 100 mm high, 100 mm wide. Cove base and chamfer corners. Anchor to slab with minimum 10M@300mm steel dowels cast into slab, unless otherwise specified on drawings.

.2 Use 25 MPa concrete unless indicated otherwise.

3.11 TROWELLING AND SCREEDING

.1 Conform with the requirements of CSA Standard CAN/CSA-A23M and as modified hereinafter.

.2 Bring tops of floors to even level or sloping surfaces as shown on the drawings.

.3 Machine trowel all floor slabs, except as required by the Drawings and/or Specifications. (Class A Finish.) For Class “F-1 & C-1” exposure, limit power float to a single pass.

.4 Surfaces of exterior exposed steps and platforms shall be finished, with a wood float and given a “fine broom” finish to the Architect’s satisfaction. (Class A Finish.)

.5 Floors to receive separate finishes shall be screeded to proper elevation and wood float finished. (Class B Finish.)

.6 Finished levels shall be determined by a 3000mm straight edge placed anywhere on the slab in any direction.

.7 Tolerances as follows: (Refer to CAN/CSA-A23.1-M).

.8 Cement finishing of floors shall be by a contractor thoroughly experienced in this type of work. The floor finishes shall be guaranteed for a period of two (2) years against dusting, disintegration or any other defect coming within the control of the finishes.

3.12 CURING

.1 Conform with the requirements of CSA Standard CAN/CSA-A23M.

.2 Refer also to COLD WEATHER PROTECTION REQUIREMENTS and HOT WEATHER PROTECTION REQUIREMENTS.

.3 All equipment needed for curing and protection of the concrete shall be on hand and ready for use before actual placing is started.

.4 All exposed non-formed surfaces shall be kept wet cured for a period of at least 7 consecutive days after casting. The water for curing shall be clean and free from any materials that will stain or discolour the concrete. A liquid, membrane forming, curing compound may be used under circumstances where application of such compounds will not jeopardize the appearance of the concrete nor the bonding of floor finishes.

.5 Wheeling, handling, piling or storing of any material over or on slabs is prohibited during the first seven (7) days after placing concrete, except

such handling or wheeling on planked runways as may be approved by the Engineer.

.6 Protect all freshly placed concrete from extreme heat, running water and mechanical shock for the duration of the curing period.

3.13 DEFECTIVE CONCRETE

.1 Concrete not meeting the requirements of the specifications and drawings shall be considered defective concrete.

.2 Concrete not conforming to lines, details, quality and grade specified or as shown on the drawings shall be modified or replaced at no increase to the contract price, and to the satisfaction of the Architect and Engineer.

.3 Finished lines, dimensions and surfaces shall be correct and true within tolerances specified.

.4 Cores drilled and tested from areas in question, as directed by the Engineer and in accordance with CSA Standard CAN/CSA-A23M and/or load testing of the structural elements in accordance with the requirements of the Engineer shall be done at no increase to the contract price.

.5 Defective concrete shall be repaired or replaced to the Architect's and Engineer's satisfaction at no increase to the contract price.

3.14 CONDUITS, PIPES, OPENINGS AND INSERTS

.1 Comply with Clause Submittals in this section.

.2 No sleeves, ducts, pipes or other openings shall pass through joists, beams or columns, except where expressly detailed or approved by the structural engineer in writing.

.3 Electrical conduit and other pipe embedded in the concrete shall not be of aluminum or any other material harmful to the concrete and shall:

.1 Not pass through or be embedded in a column.

.2 Not be a larger outside diameter than one-third the thickness of the slab, wall or beam in which they are embedded.

.3 Not be spaced closer than 3 diameters on centre unless otherwise shown on the structural drawings.

.4 Have a concrete covering of not less than 25mm or one third the thickness of the slab, whichever is greater.

.5 Be so installed that it will not require cutting, bending or displacement of the reinforcement or impair the structural strength of the system.

.4 Provide and cast-in all sleeves, frameouts, inserts and fastening devices shown on the drawings except as otherwise specified.

.5 Provide sleeves in slabs or walls for mechanical piping and avoid openings where possible. Engineer's approval must be obtained for any concentration of sleeves in column band and around columns. Conform to typical details. Sleeving drawings must be submitted for approval minimum two weeks prior to pouring of concrete.

.6 Provide openings in slabs or walls as shown on structural drawings or otherwise required by various trades. Engineer's approval must be obtained for locations and sizes of openings not shown on structural drawings. All openings must be formed before the slab or wall is poured. See typical details. Do not cut any openings, after concrete has been poured, unless specifically authorized by the engineer.

.7 Openings and driven fasteners required in the concrete work after the concrete is placed shall be approved by the Engineer prior to installation.

.8 Install where required in the concrete frame, all brackets and inserts etc., as required by the window and/or curtain wall supplier for the support of the windows, and/or curtain walls.

.9 Check the drawings and specifications for the requirements of other trades as they may affect the placing of concrete and make provisions for holes through structural members and be responsible for all inserts, sleeves, conduits, etc., as set by all trades.

.10 Give instruction and information in writing or by schedules to all trades, of the requirements necessary for services, materials or inserts prepared and/or supplied by other trades which will affect the work of this section.

.11 Assist and coordinate with all trades in the preparation of drawings showing the type, extent and location of items to be cast in and openings to be formed in Concrete Work. These drawings must be submitted to the Engineer and reviewed prior to placing of concrete. (Refer to Clause 3.1.5).

3.15 GROUT

.1 Provide and place dry pack concrete grout or non-shrink grout as required and cooperate with other trades in the placing thereof.

3.16 REINFORCED MASONRY LINTELS

.1 Where required or where covered by the requirements of the General Notes and

Typical Details, provide reinforcing and place concrete for reinforced masonry block lintel beams. Reinforcing and concrete is to
be in accordance with the requirement of the Drawings and General Notes.

3.17 SLABS-ON-GRADE

.1 Provide screeds set to an engineer's level for leveling the surface of floor slabs-on-grade.

.2 Provide keys or dowels at construction joints as detailed on the drawings.

.3 Provide separate concrete pour around columns. Unless otherwise shown, leave out diamond shaped, or circular shaped areas around columns equal to the dimension of the cap below or 300mm larger than the column. Concrete shall be placed in these areas not less than fourteen (14) days after the adjoining floor slabs have been placed. See typical details on structural drawings.

.4 ACI recommends that slab-on-grade shall not be cast in sections exceeding 950 square metres. Contractor shall take necessary measures to prevent excessive cracking if pour size is increased and shall be responsible for repairing cracked concrete resulting from exceeding recommended maximum pour size. Each pour shall be bounded by a vertical bulkhead or abutting construction joint.

.5 Provide 3mm wide x 25mm deep saw cuts as soon as possible after slab is poured at maximum 36 times the slab thickness each way. Also provide saw cuts in slab along column lines each way, and at building expansion joints.

.6 Where panels abut construction joints, construction joints shall be considered to act as saw cuts, and additional saw cutting is not required.

.7 Slab-on-grade panels are to be approximately square with the longer side of the panel not greater than 1.5 times the shorter side.

.8 Caulk at saw cut lines with approved flexible caulking material.

.9 Provide a drawing, or marked-up print, for review by the Architect, for proposed joint locations in the slab-on-grade. Also, co-ordinate saw cuts with architectural floor pattern.

.10 Provide double stripping in terrazzo and/or line tile joints over saw cuts.

.11 Where floor depressions occur, maintain the slab thickness specified on the foundation plans. Refer to architectural drawings for depression locations, depths, etc.

.12 For granular material under slab-on-grade, see soil report and foundation plan. Recommendations in soil report shall govern when specifications differ.

.13 Permission to pour concrete slab-on-grade shall be granted subject to the following conditions:

A) That the grade is compacted to min. 97% modified Proctor maximum dry density or as recommended by the soil engineer.
B) That any trenches, holes, etc., which are dug after the compaction as stated in A) above, are finished, and filled with new granular 'B' material and compacted to a minimum of compaction mentioned above.
C) That a properly spaced system of saw cuts is used to take care of shrinkage of the slab-on-grade.
D) That the operations mentioned under items A to C inclusive are carried out under approved supervision.

.14 Obtain all requirements, and provide for mechanical bases, pits, sumps and trenches not shown on the structural drawings.

.15 Do not use frozen material containing ice or snow. Do not place concrete on frozen sub-grade or on sub-grade containing frozen material. Ascertain that forms, reinforcing steel and adjacent concrete surfaces are entirely free of frost, snow and ice, and that the temperature of these materials are above 5 degrees Celsius before placing concrete.

PART 4: QUALITY CONTROL

4.1 GENERAL

.1 Refer also to Section 03 20 00 Concrete Reinforcing.

.2 Refer also to Clauses 3.1.

.3 Refer also to Clauses 3.16.1.

.4 Routine testing of materials and of proposed mix designs shall be carried out by an independent inspection and testing company, appointed by the Owner, and will be paid for by the Owner.

.5 Any testing required by the Contractor to vary mix design, grade of steel, or to prove strength of concrete in place, or load testing where specified design strengths are not attained, or where errors have been made in construction, shall be done at the Contractor's expense.

4.2 ROUTINE INSPECTION AND TESTING

.1 Inspect the ready-mix plant and truck mixers and ascertain that good quality control practices are followed in accordance with CSA Standard CAN/CSA-A23M and ASTM C-94.

.2 Review proposed concrete mix design and check-test if considered necessary.

.3 Concrete Strength Tests:

.1 Obtain representative samples of fresh concrete from each 130 cubic yards or fraction thereof and of each mix design of concrete placed in any one day.

.2 Perform a standard slump test to conform with CSA Standard CAN/CSA-A23M for each set of specimens.

.3 Perform standard air entrainment test for concrete so specified to conform with CSA Standard CAN/CSA-A23M for each set of specimens.

.4 Three specimens moulded in 150mm diameter cylindrical steel moulds, stored, and laboratory cured to conform with CSA Standard CAN/ CSA-A23M, shall comprise a strength test. One specimen shall be compression tested at seven (7) days and the remaining two at twenty-eight (28) days after sampling.

.5 During the placing of concrete under the conditions of "Cold Weather Concreting", one additional specimen shall be made and shall be stored on the job site under conditions similar to the concrete it represents. This specimen is intended as a field control test and shall be field cured to conform with CSA Standard CAN/CSA-A23M. This specimen shall be compression tested at seven (7) days after sampling.

.6 Early Stripping of Forms:

Any stripping sequence at an accelerated rate to that specified, requires approval in writing by the Architect. "Pull-Out" moulds cast with the casting may be required. The use of "Pull-Out" moulds shall be at the discretion of the Engineer. (Refer also to Clause 4.5).

.4 Identify and correlate reinforcing steel from Canadian Mills with mill test reports for compliance with the requirements of CSA Standard G30.12-M1977.

Specimens of unidentified reinforcing steel or reinforcing steel from non-Canadian mills shall be tested for each ten (10) tonnes of steel. The cost of this inspection and testing shall be paid for by the Contractor.

.5 Reports:

.1 Inspection company reports of test of materials and compression tests of concrete control cylinders shall be distributed as directed by the Architect.

.2 Concrete cylinder test reports shall contain the following information: whether specimens are laboratory or field cured, date cast, date received in lab, date tested, unit weight of concrete, specified twenty-eight (28) day strength, correlate the exact location of each casting with the test cylinders in question, concrete supplier, person who cast the cylinder, time mixer charged, time cylinder cast, measured slump, temperature of concrete and air, whether or not water was added at the job and by what authority, nominal aggregate size, type of admixture, air-entrainment agent, project identification and with sequential numerical identification.

.3 Should a crushed cylinder show a test result below that which is anticipated, the inspection company shall immediately advise the Architect and Engineer by telephone of such occurrence in order to expedite curing or remedial measures which may be required.

.4 In the event that test cylinders indicate a strength of concrete below that which is specified, the test report shall state the reason for the lack of strength, i.e. poor quality concrete in place, cylinders improperly taken, stored, capped, frozen, improperly handled or faulty testing procedure. A correct analysis of the cause of poor tests will save unnecessary inconvenience when the report is submitted to all parties involved.

.5 The inspection company shall supply written reports of tests of materials and reinforcing steel, giving all pertinent information required by the above-mentioned Specifications and Standards.

4.3 RESPONSIBILITY OF THE INSPECTION COMPANY

.1 The representative of the inspection company shall not be required to supervise the Work or to instruct the Contractor. The inspector's function shall be that of sampling and testing materials, observing procedures and reporting of same to the Engineer. If any material is at variance with the Specification the inspector shall immediately advise the superintendent and then inform the Engineer by telephone.

.2 The inspection company will advise and cooperate with the Contractor regarding adequate protection of cylinders. The inspection company will supply the Contractor, with a copy to the Engineer, with a drawing and specification for an insulated storage box for cold weather curing of cylinders.

4.4 RESPONSIBILITY OF THIS SECTION

.1 Cooperate with the representatives of the inspection company.

.2 Advise the inspection company and the Engineer at least twenty-four (24) hours in advance of the placing of concrete.

.3 Provide an insulated storage box according to the specification and drawing supplied by the inspection company.

.4 Protect test cylinders.

.5 Keep a record set of drawings upon which shall be marked by the Contractor's Superintendent, the time and date of casting of each section of concrete, the date of removal of forms and a daily record of the temperature.

4.5 RETESTING

.1 Payment for re-testing and re-inspection of Work replacing that found defective

following initial inspection made under Contract Work, or as otherwise made evident, is the responsibility of the Contractor and will not be considered as additional Work to this Section..

PART 5: CLEAN-UP (GENERAL)

.1 Upon satisfactory Completion of the Work, clear away from the building and site, excess or waste materials and debris and leave the premises in a condition acceptable to the Architect within the contract time.

.2 Do not unload excess concrete from concrete trucks during clean-up operations and do not deposit in undesignated or unauthorized locations within the Scope of Work boundaries whether concealed or not.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

.1 Section includes:

.1 Architectural precast concrete cladding.

1.2 Administrative Requirements

.1 Conduct a pre-installation meeting in accordance with Section 01 31 19.

.1 Independent inspection and testing company shall attend the pre-installation meeting.

1.3 Submittals

.1 Submit required submittals in accordance with Section 01 33 00.

.2 *Product* data sheets:

.1 Submit manufacturer's *Product* data sheets for *Products* proposed for use in the work of this section.

.3 Shop drawings:

.1 Submit engineered shop drawings indicating the following in addition to the requirements of Section 01 33 00:

.1 Seismic design, connections and restraint of wall assemblies.

.2 Show design loads and calculations, including mechanical connections, typical reaction, and support movement allowances, both vertical and horizontal.

.3 Location and dimensions of each unit in the completed structure.

.4 Location and layout for structural steel inserts and/or units, plates and dowels cast into cast-in-place concrete.

.5 Reinforcing details and grade of reinforcing.

.6 Concrete strength and admixtures used.

.7 Jointing clearances and clearances between the units and the structural building framework.

.8 Jointing profiles and edge profiles.

.9 Full size details of typical methods of sealant installation.

.10 Complete connection and insert details including materials, size and length of welds.

.11 Class of finish and location of each precast item.

.12 Manufacturing sequence to control consistency of colour and appearance qualities of panels within contiguous facade areas.

.13 Identifying marks for each precast unit.

.14 Location and details of lifting hooks and handling points.

.15 Sequence of erection and any special handling instructions or bracing required.

.16 Special precautions to be taken by other sections affecting the work of this section.

.17 Details of any special reinforcement which may be locally required around embedded units when such reinforcement is not shown in the *Contract Documents.*

.18 Submit comprehensive face mix design for review by *Consultant.*

.4 Samples:

.1 Submit a minimum of three 305 mm x 305 mm (12" x 12") precast concrete samples of the specified finish showing the expected range of variations in colour or appearance (pigment amount). and showing depth of sandblast for each sandblast texture specified. Upon acceptance of samples for finish, colour, appearance, depth of sandblast. and variation, fabricate and erect a full size panel for each type of finish specified at the plant for acceptance. Sample sizes may be smaller upon approval by the *Consultant.*

.2 The *Consultant* shall review the full-size panels prior to further production. No visible blotching, patchiness or shade difference will be accepted.

1.4 Quality Assurance

.1 Qualifications:

.1 *Provide* the work of this section, executed by competent installers with a minimum of 5 years' experience in the application of the *Products,* systems, and assemblies specified, and with approval and training of the *Product* manufacturers.

.2 Manufacturer shall be qualified in accordance with CSA A23.4-16.

.3 Precast concrete manufacturers shall be certified with the Canadian Precast Prestressed Concrete Institute (CPCI). And have Plant Certification of Architectural Precast Concrete Products.

.4 Only precast elements fabricated under the CPCI plant certification program to be acceptable, and plant certification is to be maintained for the duration of fabrication, erection, and until warranty expires.

.5 Precast fabrication to meet the requirements of CSA A23.4-16, including Annexes A and B, together with PCI MNL-116 and 117 and CPCI certification requirements.

.6 Design and construct precast concrete under direct supervision of a professional structural engineer experienced in design of the work of this section and licensed at the *Place of the Work.*

.7 Aspects of the work of this section are required to be prepared by a professional engineer. Refer to Section 01 33 00 for specific details and requirements in this regard.

.8 Mock-ups:

.1 *Provide* full scale mock-up of each type of finished panel at precast yard, for review by *Consultant* prior to fabrication of precast units..

.2 Erect framing and mock-up at precast fabricating plant where it can be viewed in natural daylight.

1.5 Delivery, Storage, and Handling

.1 Design and cast lifting devices into the units to ensure that they will be safely and efficiently handled. Lifting devices shall be so arranged that they do not have to be removed or, if they must be removed, they shall be arranged so that they are readily filled by this section. Exposed to view cast-in lifting devices are unacceptable.

.2 Stack units on properly cushioned supports to protect the edges.

.3 Do not permit units to contact earth or other staining influences or to rest on corners.

.4 Protect stockpiles against inclement weather during storage, transportation, and after installation. Remove visible marks on panels caused by moisture movement or deposits of impurities resulting from lack of appropriate protection.

.5 Protect holes and reglets against water and ice in freezing weather.

.6 Protect the work of other sections during erection and final cleaning.

.7 Protect work in progress. Protect work at openings and exposed corners where there is likelihood of damage with substantial non-staining coverings and remove upon completion of work of this section.

.8 Transport, handle and store units to prevent staining, chipping, cracking, spalling, distortion, warping or other physical damage.

.9 *Make Good* damaged panels or elements of precast.

PART 2- PRODUCTS

2.1 Performance/Design Requirements

.1 Manufacturer shall be responsible for the design, connections and installation of the precast concrete units and shall direct the placing of items to be cast in concrete work.

.2 Design precast concrete panel system, associated components , connections and anchorages in accordance with CSA-A23.1-09, CSA A23.4-16, CSA-S16-09, CAN/CSA G40.20-13/G40.21-13, ASTM A123/A123M -09, CSA W59-13, and the building code to resist live, dead, wind, seismic, thermal, structure movement. and other relevant loads.

.3 Design and construct system to prevent air infiltration/exfiltration and water infiltration into building under design loads.

.4 Design for superimposed loads of indicated work, as applicable.

.5 Reinforce bearing areas against diagonal tension, splitting, rupture, and flexure. Extra ties, stirrups and reinforcing bars shall be placed at support points. Allow no bearing pressure in edges of unreinforced sections.

.6 Design and construct connections for the effect of shrinkage forces, temperature changes, deflections of the supporting or adjacent structures.

.7 Maximum deflection shall be not more than 11360th of the span for any unit under weight of dead and live loads.

.8 Mechanical connections:

.1 Unless otherwise accepted by *Consultant,* connections for panels shall be hot dipped galvanized and shall be clearly shown and detailed on shop drawings.

.2 Design mechanical connections, such as bolts, inserts and special manufactured items to provide means of compensating for deviations in dimensions or thickness of unit in field. Select and joint materials in a manner such that embrittlement of any part of assembled connections will not occur. Bearing materials used in joints shall have a record of satisfactory performance otherwise test results to prove their adequacy shall be made available to *Consultant.* Allow for steel plates and angles to be cast into base concrete structure. Include steel braces.

.3 Connections shall have ultimate strength such that when precast units are installed under the most unfavourable permissible conditions of construction tolerance, they will support total loads for which units are designed with a safety/resistance factor appropriate for the materials and load conditions.

.4 Allowance for movement shall be as specified in CSA A23.4-16.

.5 Connections indicated are suggestions only. Be responsible for complete structural design and checking of anchorage and connections.

.9 Insulate panels to provide an insulation board value of R-30 or as noted on drawings.

2.2 System Description

.1 Architectural precast concrete cladding panels.

.2 *Provide* the following as required by the *Contract Documents* for a complete and proper installation.

.1 Precast concrete insulated (sandwich) panels.

.1 *Provide* real and false joints as indicated and as required by shop drawings.

.2 Precast concrete copings.

.3 Structural steel inserts, and/or units, plates and dowels, cast into precast concrete members required for connection of precast concrete members. *Provide* loose structural steel items required to connect precast concrete members to the structure of the building or as required between precast concrete members.

.4 Install inserts required and supplied by other sections.

.5 Supply the following materials to be installed as part of the work of other sections:

.1 Structural steel inserts, and/or units and plates cast into the cast-in-place concrete.

.2 Special reinforcement which may be locally required around embedded units when such reinforcement is not shown.

.3 Complete layout details for the installation of the above with supervision and checking, as required to ensure that the installation is correct.

.6 *Provide* dual barrier modified rainscreen joint system between precast units in accordance with Section 07 92 00. Interior bead of sealant shall serve as the air barrier.

.7 Finish on exposed surfaces of precast concrete work shall be as follows. locations as indicated or scheduled:

.1 Colour and texture: to later selection by Consultant Minimum class F1 concrete to CSA A23.4 - smooth finish.

.1 Standard aggregate mix.

.2 White pigment: final pigment amount per approved sample.

.3 Light sandblast: final depth of sandblast per approved sample.

.2 Minimum class F1 concrete to CSA A23.4 - smooth finish.

.1 Standard aggregate mix.

.2 White pigment: final pigment amount per approved sample.

.3 Medium sandblast: final depth of sandblast per approved sample.

2.3 Materials

.1 Precast concrete units:

.1 Cement, water reducer, air entrainment, pigment, sand, aggregates, water admixture: to CSA A23.4-16 and CSA-A23.1-09.

.1 Use white cement pigment in face mix at exposed locations.

.2 Aggregate: in conformance with CSA-A23.1-09 and shall be tested for soundness prior to manufacture in accordance with CSA A23.4-16.

.3 Use same brand and source of materials used for facing throughout the *Work* to ensure uniformity of colouration and other mix characteristics.

.4 Admixture: in accordance with CSA-A23.1-09. Introduce admixtures to concrete at time of batching in accordance with the manufacturer's recommendations. Under no circumstances shall the use of calcium chloride or an admixture containing calcium chloride be permitted. Admixtures shall be subject to the acceptance of the *Consultant.*

.5 Concrete reinforcement:

.1 Reinforcing steel: billet steel bars conforming to CAN/CSA G30.18-09. Reinforcing larger than 6.4 mm (1/4") diameter shall be deformed bars conforming to the same standard. Welded wire mesh shall conform to ASTM A1064 / A1064M-18a. Galvanize reinforcing with less than 25.4 mm (1") cover.

.6 Water: in accordance with CSA-A23.1-09.

.7 Structural steel: new material conforming to CSA G40.20-13, or ASTM A36/A36M-14.

.8 Concrete mix:

.1 Use concrete mix designed to produce minimum of 35 MPa compressive strength at 28 days, with a maximum water/cement ratio to CSA A23.4-16.

.2 Air entrainment of concrete mix: to CSA-A23.1-09.

.3 Use of calcium chloride not permitted.

.9 Forms: to CSA A23.4-16, constructed of approved concrete, steel or fibreglass reinforced plastic or high density overlaid plywood conforming to CSA 0121-08 to obtain the quality of the finish specified.

.1O Form release agent: Commercially produced liquid release agent that will not bond with, stain or adversely affect precast concrete surfaces. Form release agent must be compatible with sealants.

.11 Zinc-rich paint: to CAN/CGSB 1.181-M99, standard brushing grade.

.12 Insulation: to achieve R-Value specified for the thicknesses indicated.

.13 Bolt, nuts, and washers: ASTM A307, ASTM A325.

.14 Bearing pads and shims: High density plastic, smooth both sides.

.15 Metal precast anchor and hardware finish:

.1 Hot dip galvanizing to ASTM A123/A123M-09. Paint welds and damaged areas of galvanized finish with zinc-rich touch-up paint before and after erection.

.2 Joint sealants; dual barrier modified rainscreen joint system: in accordance with Section 07 92 00.

2.4 Fabrication

.1 Fabricate precast concrete wall panels in accordance with CSA A23.4-16.

.2 Exposed surfaces of precast concrete shall be made to requirements of CSA A23.4-16, Finish Grade 'A'.

.3 Precast concrete exposed surface finish shall match approved samples. Colour and texture shall be uniform and consistent throughout, free from air pockets, imperfections, blemishes and discolourations.

.4 Fabricate units to profiles and sizes detailed, in accordance with reviewed shop drawings and to requirements of local authority having jurisdiction.

.5 Execute work accurately, true to dimensions, square, in true planes, free from waves, twists, cracks, checks and broken edges. Warped, cracked, chipped or broken units shall not be used in the *Work*. Edges shall be straight and with clean accurate arris.

.6 Quality of concrete, placing materials in forms, vibrating, curing, stripping and handling shall be in accordance with CSA A23.4-16 and this Standard shall apply to precast concrete units required under this Section.

.7 Fabricate precast work to maintain the most stringent requirements for dimensional tolerances as specified in CSA A23.4-16 and installation tolerances as specified in this section.

.8 Cast-in lifting devices required for erection of precast concrete work. Manufacturer shall ensure that lifting devices used externally or installed are capable of supporting precast concrete work in altitudes occurring during course of manufacturing and installation. Ultimate capacity of lifting devices shall be sufficient to resist forces obtained by applying minimum load factor of 2.5 to weight of precast concrete work.

.9 Cast-in anchors and inserts supplied by other sections as required. Conceal and permanently attach to reinforcing anchors, hooks and inserts.

.10 Before commencement of fabrication, independent inspection and testing company may visit plant to inspect proposed methods of control of mix, fabrication and curing.

.11 Manufacture units in accurate moulds designed to withstand vibration and lateral forces. Vibrate continuously during casting until full thickness is reached.

.12 Identify precast units with a unique number on back face as well as mark identifying orientation of unit in final position. The number must be visible. Maintain record of tracking of panels in yard through to installation.

.13 Curing shall be in accordance with the requirements of CSA A23.4-16.

.14 Retain sufficient quantities of face matrix materials to allow for repairs and patching.

PART 3 - EXECUTION

3.1 Examination

.1 Examine surfaces that are to receive the work of this section and do not proceed until unsatisfactory conditions are corrected. Report defects of work prepared by other sections that affect the work of this section. Commencement of work shall imply acceptance of surfaces and tolerances.

3.2 Dimensions

.1 Check dimensions at *Place of the Work* before commencing shop drawings and before fabrication and report discrepancies to *Consultant* and *Contractor.*

3.3 Welding

.1 Perform welding in accordance with CSA W59-13 and CSA W186-M1990(R2012). Organization undertaking welding shall be fully approved by Canadian Welding Bureau under requirements of CSA W47.1-09(R2014).

.2 Touch-up welds to galvanized steel with zinc rich paint after welding. Remove weld spatter, smoke marks, and other contaminants or visible indications of welding at visible and sealant joint surfaces of panels. *Provide* fit-up plates or angles to compensate for deviations alignment or location of inserts.

.3 Exercise care to minimize effect of welding heat. Design welds to prevent tearing at end of weld which would cause progressive failure.

.4 Detailed welding procedure covering specified welds on erection and shop drawings may be requested for review by the independent inspection and testing company.

3.4 Shrinkage of Units

.1 Where shrinkage of units will occur after erection, final restraining connections shall be made after 75% of shrinkage of units has taken place and after initial creep of the structure has taken place.

3.5 Installation

.1 Erect precast concrete units in accordance with CSA A23.4-16.

.2 Where tolerances will interfere with work of other sections that will force other work to be out of plumb or deviate from straight lines indicated, *Provide* remedial work for this defect.

.3 Install precast concrete units so that joints are within tolerances listed as follows:

.1 Face width of joint; insulated panels: Nominal 25.4 mm (1") joints, to vary not more than +/- 3.2 mm (1/8") unless otherwise indicated.

.2 Joint taper: unit edges not out of parallel over 0.6 mm in 300 mm (1/40" per foot) but not more than 3.2 mm (1/8") in total.

.3 Faces of adjacent panels, offset not more than 3.2 mm (1/8").

.4 Edge alignment: alignment of panels edges not to exceed 3.2 mm (1/8").

.5 Bowed panels, within allowable bowing tolerances, arranged so offset between adjacent panels does not exceed 6.4 mm (1/4").

.6 Assume face to be outside face. Allow for building tolerances.

.4 Fill holes around anchors with cement grout.

.5 Install each precast concrete unit in a way to permit removal and replacement of defective and condemned panel without damaging adjacent panels.

.6 Examine the structure and any other elements of the building and if necessary, reinforce for any temporary load caused during erection.

.7 Do not erect precast concrete units without a non-working supervisor being present.

.8 Clean with wire brush and paint damaged galvanized hardware surfaces after erection with 2 coats zinc-rich paint.

.9 Isolate dissimilar metals to prevent corrosion.

.10 Supply adequate information on handling methods and restrictions to other trades due to erection of any part of the work of this Section.

3.6 Field Quality Control

.1 Conduct quality control in accordance with Section 01 45 00, supplemented as follows:

.1 Inspection of the following may be carried out at the plant by the independent inspection and testing company:

.1 Forms.

.2 Size and location of reinforcing.

.3 Size and location of cast-in hardware.

.4 Mill Test Reports.

.5 Concrete batching methods.

.6 Cement analysis.

.7 Aggregate analysis.

.8 Cylinder tests.

.9 Curing methods.

.10 Slump tests.

.11 Air tests.

.12 Size of complete units.

.13 Insulation.

.14 Finishes.

.2 Inspection of the following will be carried out at the *Place of the Work* by the independent inspection and testing company:

.1 Erection.

.2 Connections in accordance with reviewed shop drawings.

.3 Welding of connections.

.4 Joint widths.

.5 Joint sealants.

.3 Submit to the *Consultant* certified copies of quality control tests related to the *Work* as specified in CSA A23.4-16.

.2 Acceptance ofwork:

.1 Concrete units containing concrete which has failed to meet required strength requirements will be rejected. Units fabricated out-of-square, out-of-dimension, without proper reinforcement, proper opening or inserts, shall be rejected.

.2 The following deficiencies shall be cause for rejection of installed panels: visible damage such as bruises, cracks, chips, rust stains, soiling that cannot be removed, excessive 'bugholes' (defined as presence of "bugholes" significantly exceeding accepted pre-production finish sample), discolouration, efflorescence, poorly matched (visually obvious) patching, and permanent moisture "run-down" lines.

.3 Except for hairline cracks which are defined as surface cracks of minute width, visible but not measurable by ordinary means, units which have become cracked or broken will be rejected.

3.7 Joint Sealants

.1 Provide two stage drained joints, with drain/vents in accordance with Section 07 92 00.

3.8 Adjusting and Cleaning

.1 Remove, as the *Work* progresses, excess or foreign materials which would set up, stain, or become difficult to remove from finished surfaces.

.2 At completion, clean exposed surfaces of precast units. Remove dirt and other extraneous matter. Do not use acids without *Consultant's* acceptance.

.3 Take precautions to prevent staining the material of others during cleaning operations.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services necessary for masonry Work in accordance with the Contract Documents.

1.2 **REFERENCES**

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

.2 ASTM C207, Specification for Hydrated Lime for Masonry Purposes.

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

.4 CSA A165 Series, CSA Standards on Concrete Masonry Units.

.5 CSA A179, Mortar and Grout for Unit Masonry.

.6 CSA A370, Connectors for Masonry.

.7 CSA A371, Masonry Construction for Buildings.

.8 CAN/CSA A3000, Cementitious Materials Compendium.

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

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

1.3 **DESIGN REQUIREMENTS**

.1 Design unit masonry in accordance with following Climatic Design Data for the Municipality contained in the Ontario Building Code:
  .1 Design temperature: January 1%, July 2 1/2%.
  .2 Hourly wind pressures: 1 in 50 year occurrence.

1.4 **SUBMITTALS**

.1 Shop drawings:
  .1 Submit shop drawings in accordance with Section 01 33 00 indicating.
  .2 Wall sections and details, reinforcing and anchors, special detailing, patterning and locations of control joints.
  .3 Seismic anchors, supports and accessories for complete installation.

.2 Samples:
  .1 Submit samples in accordance with Section 01 33 00:

.2 Submit samples of each type and colour of masonry unit used prior to placing order.
.3 Submit samples of coloured mortar to match masonry samples.
.4 Submit samples of masonry anchors, and ties.
.5 Submit 250 x 200 mm samples of dampproof course and flashing.

.3 Quality control submittals: Submit manufacturer's certificates stating that materials supplied are in accordance with this Specification.

1.5 **QUALITY ASSURANCE**

.1 Provide plain and reinforced masonry in accordance with CSA A370, CSA A371, CSA S304.1, and as indicated.

.2 Retain a licensed Professional Engineer, registered in Province of Ontario, to perform following services for unit masonry Work:
.1 Design of unit masonry Work.
.2 Design of brick ties and anchors, including requirements necessary to meet seismic requirements.
.3 Review, stamp and sign shop drawings.
.4 Conduct shop and field inspections and prepare and submit inspection reports.

.3 Cold Weather Protection:
.1 To CAN/CSA-A371 and as follows:
.1 Maintain temperature of mortar between 5°C and 50°C until batch is used or becomes stable.
.2 Maintain ambient temperature of masonry work and its constituent materials between 5°C and 50°C and protect site from windchill.
.3 Maintain temperature of masonry above 0°C for minimum of 3 days, after mortar is installed.
.4 Preheat unheated wall sections in enclosure for minimum 72 hours above 10°C, before applying mortar.
.5 Do not use scorched aggregate. Do not use salts or anti-freezes. Only use approved smokeless heaters.

.4 Hot Weather Requirements:
.1 To CAN/CSA-A371 and as follows:
.1 Plan in advance for hot weather construction. Protect freshly laid masonry from drying too rapidly, by means of waterproof, non-staining coverings.
.2 Avoid using dry masonry in hot weather conditions. Use predampened masonry unit nominally saturated, but surface dry at time of laying. Do not dip masonry unit in bucket of water.
.3 Spread only enough mortar to permit soft setting of masonry units; do not over mix mortar materials; do not retemper mortar after 2 hours of use; do not retemper pigment coloured mortar; do not spread more than 900 mm of mortar for placement of masonry unit.

.5 Mock-up:
.1 Construct one mock-up panel of unit masonry construction, 1200 mm wide x 1200 mm high in a location accepted by Consultant.
.2 Demonstrate use of reinforcement, ties, through-wall flashing, weep holes, jointing, coursing, coping and sills, mortar, bonding, control joints, and workmanship.
.3 Mock-up may form part of Work if accepted by Consultant. Mock-ups which do not form part of Work are to be removed from Site during final cleanup, or when directed by Consultant.

1.6 **DELIVERY, STORAGE, AND HANDLING**

.1 Deliver, store and handle Products in accordance with the Conditions of the Contract and as specified herein.

.2 Remove unacceptable materials from Site and replace to acceptance of Consultant. Store materials off ground protected from wetting by rain, snow or ground water, or inter-mixture with earth or other materials. Store metal ties and reinforcement to prevent corrosion.

.3 Do not concentrate storage of materials on any part of structure beyond design load, take particular care not to overload unsupported portions of structure which may have not attained their full design strength.

.4 Comply with CSA A371. Do not use salt or calcium-chloride to remove ice from masonry surfaces.

.5 Deliver mortar materials in original unbroken and undamaged packages with the maker's name and brand distinctly marked thereon. Prevent damage to units.

.6 Keep masonry materials free from ice and frost. Keep units protected from concrete, mortar and other materials which could cause staining.

2 Products

2.1 **MASONRY UNITS**

.1 Architectural Block: normalweight units, 90 mm thick unless otherwise indicated, sizes as indicated, CSA A165 Series; H/15/A/M; S/15/A/M; Sc/15/A/M; as shown on Materials Legend. Profiled concrete block to have profile on face and on exposed ends where special shapes are required. Provide the following block types:
.1 Type 1: Ground face block as manufactured by Richvale York Block Inc.
.2 Type 2: Polished ground face block as manufactured by Day & Campbell.

.2 Insulated concrete block: normalweight concrete block, metric modular size complete with expanded polystyrene as manufactured by Omni Block or approved alternative.

.3 Concrete block units: Normalweight units, CSA A165 Series, as indicated on Contract Drawing, classifications as follows:
- .1 H/15/A/M.
- .2 S/15/A/M.
- .3 Sc/15/A/M.

.4 Special shapes: Unless indicated otherwise, supply and install corner returns, bull-nosed or double bull-nosed units for exposed and external corners, bond beams, sash blocks for control joints, solid block where noted, concrete block lintels over openings in concrete block walls and any additional special shapes as indicated.

.5 Obtain each masonry unit type from same manufacturer. Supply and install units of uniform texture and colour for each kind required.

.6 Supply masonry units with exposed surfaces free of cracks, chips, blemishes, and broken corners.

2.2 ACCESSORIES

.1 Reinforcement: CSA A370, CSA A371, and ASTM A1064/A1064-M, all components to be hot dip galvanized unless otherwise specified:
- .1 This specification is based on products manufactured by Blok-Lok Limited. Products by Dur-O-Wal Ltd. and Fero Corporation are approved alternatives.
- .2 Type 1 (single wythe): Truss type; >Blok-Trus BL30'.
- .3 Type 2 (cavity wall block back-up): Adjustable truss type, fabricated from minimum 4.76 mm wire, complete with adjustable box anchor and insulation fasteners; >Adjustable Econo-Cavity Blok-Trus II BL37 System 2000' with ‘wedge-Lok Insulation Retainers’. Insulation retainer to straddle wire bridging the cavity.
- .4 Provide Fero brick ties where indicated as shown on Structural drawings.
- .5 Connectors: CSA A370 and CSA S304.1.
- .6 Reinforcing steel: CSA G30.18, Grade 400, refer to Contract Drawings for number, size, and location.

.2 Cavity wall insulation: In accordance with Section 07 21 00.

.3 Loose steel lintels and lateral support angles: Supplied as part of Work of Section 05 50 00 and as indicated.

.4 Through wall flashings: Prefinished metal flashings in accordance with Section 07 62 00, continuous strips with a 19 mm folded drip edge.

.5 Dampproof course and flashing: Reinforced SBS rubberized asphalt compound laminated to cross-laminated polyethylene film, 40 mils thick; 'Airshield Thru Wall Flashing' by W.R. Meadows or approved alternative, complete with primer and adhesive recommended by flashing manufacturer.

.6 Compressible filler: 75 x 6 mm thick preformed, polyurethane foam; 25V by Emseal Joint Systems Ltd.

.7 Control joint filler: Prefabricated extruded rubber joint to suit wall thickness; RS Series Rubber Control Joint by Blok-Lok or approved alternative.

.8 Mortar net: 250 mm high x thickness to suit cavity; Mortar Net by Mortar Net USA Ltd.

.9 Weep hole vents:
- .1 Flexible ultra-violet resistant polypropylene-copolymer plastic, 'Cell-Vent' by Blok-Lok, 'Mortar Maze Cell Vents' by Advanced Building Products Inc. or approved alternative.
- .2 Provide manufacturer recommended clear silicone adhesive for suspended applications.
- .3 Colour: To be selected by the Consultant.

2.3 MORTAR MATERIALS

.1 Loadbearing masonry: CSA A179, Type S, proportion method.

.2 Interior non-loadbearing masonry: CSA A179, Type N, proportion method.

.3 Exterior non-loadbearing masonry: CSA A179, Premixed 1-1-6 Type N, portland cement/lime, proportion method.

.4 Cement: CAN/CSA A3000, normal Portland, Type GU. Provide white cement where required for white or light coloured mortars.

.5 Masonry aggregate: CSA A179. Provide white aggregate where required for white or light coloured mortars.

.6 Hydrated lime: ASTM C207, Type S.

.7 Water: Clean potable, free from deleterious elements and free from salts that can cause efflorescence.

.8 Mortar pigment: 'Bay Ferrox' by Bayer Inc. or approved alternative by Elementis Pigments. Colour to later selection by Consultant.

.9 Concrete fill and grout: 20 Mpa concrete in accordance with CAN/CSA A23.1/A23.2.

3 Execution

3.1 EXAMINATION

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

3.2 PROTECTION

.1 Supply and install temporary waterproof, non-staining coverings, secured against displacement, to extend over walls and down sides to protect masonry Work from snow and wind driven rain, and from drying too quickly, until masonry Work is completed and protected by flashings or other permanent construction.

.2 Supply and install non-staining, protective coverings on horizontal and vertical surfaces to protect Work of this Section from damage, staining, marking, and mortar droppings.

3.3 WORKMANSHIP

.1 Perform masonry Work in accordance with CSA A371 and as indicated.

.2 Supply and install masonry Work plumb, level and true to line, with vertical joints in alignment and horizontal courses level, uniform, and straight.

.3 Install masonry Work to a plane flatness and exposed end tolerance of 3 mm in 2400 mm.

.4 Variation in Alignment from Unit to Adjacent Unit: 1.5 mm maximum.

.5 Variation of Mortar Joint Thickness: 3 mm every metre.

3.4 MASONRY - GENERAL INSTALLATION

.1 Construct masonry work as required by jurisdictional authorities.

.2 Before commencing masonry work, verify required limitations for wall heights, wall thicknesses, openings, bond, anchorage, lateral support, and compressive strengths of masonry units and mortars.

.3 Construct masonry fire protection and fire separations of the thickness indicated on Drawings for the fire resistant ratings as noted on Drawings, and conforming to the Fire-Performance Ratings, Appendix ‘D’ to the National Building Code of Canada.

.4 Fire Separations and Fire Separations with Fire Resistance Ratings: Construct walls tightly to construction above and at perimeter, and without openings or voids. Do not reduce the thickness of walls to less than the thickness indicated on the Drawings or for the required fire resistance rating where required.

.5 Do not butter corner units, throw mortar droppings into joints, or excessively furrow bed joints. Do not shift or tap units after mortar has taken initial set. If adjustment is necessary after mortar has started to set, remove and replace with fresh mortar.

.6 Do not use admixtures without Consultant's written acceptance.

.7 Tool mortar joints slightly concave with non-staining tools unless indicated otherwise. Strike joints flush in non-exposed areas or where shown on Contract Drawings. Use sufficient force to press mortar tight against masonry units on both sides of joints. Remove excess, remaining mortar material and burrs.

.8 Install masonry walls 25 mm clear of underside of steel building frames, roof or floor deck. Install masonry with a 19 mm space beneath shelf angles and install compressible filler.

.9 Cut masonry units with a wet saw to obtain straight, clean, even, unchipped edges. Cut units as required to fit adjoining work neatly or for flush mounted electrical outlets, grilles, pipes, conduit, leaving 3 mm maximum clearance. Use full-size units without cutting wherever possible.

.10 Reinforce veneer walls with adjustable wall reinforcing at maximum 400 mm o.c. vertically and 600 mm o.c. horizontally. Install reinforcing in accordance with manufacturer’s instructions. In veneer walls extend reinforcement from support wall, spanning cavity into exterior wythe. Place at maximum 75 mm o.c. each way around perimeter of openings, within 300 mm of openings.

.11 Reinforce block walls with continuous wire reinforcement in every second block course and as indicated. Supply and install prefabricated L and T sections. Cut, bend and lap reinforcing units as per manufacturer's printed directions for continuity at returns, offsets, pipe enclosures, and other special conditions. Bending of masonry reinforcement is not permitted.

.12 Reinforce masonry walls with reinforcing steel as indicated. Vertical reinforcing shall be fully grouted in masonry cores with grout.

.13 At openings in block walls install extra reinforcement, so that first and second courses above and below openings are reinforced. Extend extra reinforcement 600 mm beyond opening in each direction.

.14 Reinforce joint corners and intersections with strap anchors 400 mm o.c.

.15 Do not place reinforcement across masonry wythes at control joints.

.16 Install masonry with 10 mm thick joints unless indicated otherwise. Make vertical and horizontal joints equal and of uniform thickness.

.17 Build control joints in masonry walls at intervals and in locations shown. Form joints for block walls using sash block units in accordance with details shown. Form joints for veneer walls by leaving head joints between stacked units void of mortar. Fill chase and joint with joint filler full height of control joints. Leave a depth of 13 mm for sealing unless otherwise shown.

.18 Install control joints in masonry walls where indicated on drawings and at projections and changes in direction. Where control joints have not been indicated provide joints at 6100 mm o.c. for exterior walls and 9150 mm o.c. for interior walls.

.19 If required, provide movement joints, similar to building control joints, installed between areas with different support conditions.

.20 Supply and install solid block or metal lath under block, and fill block cells solid for lintel bearing and as required to secure built-in anchor bolts and/or anchors shown.

.21 Do not tooth intersections of walls except as otherwise indicated.

.22 Install weep hole vents in accordance with manufacturer's directions, in exterior wythe of masonry above dampproof courses and flashings and at tops of walls using adhesive. Space weep hole vents maximum 600 mm o.c. horizontally. Prevent weep hole vents from becoming plugged with mortar or debris.

.23 Coordinate installation of masonry with installation of air barrier and vapour retarder to ensure continuity of these systems.

3.5 DAMPPROOF COURSES AND FLASHING

.1 Install dampproof courses beneath first masonry bearing course on slabs-on-grade. Trim dampproofing to conceal it.

.2 Install flashings in masonry in accordance with CSA A371.

.3 Install flashings under exterior masonry bearing on foundation walls, slabs, shelf angles, and steel angles over openings and elsewhere as indicated. Where flashings occur over openings in walls extend them past openings a minimum of 200 mm and turn up minimum 150 mm at each end to create a waterproof dam to prevent water draining into cavity.

.4 In veneer walls install flashings continuously from front edge of masonry, under outer wythe, turn up backing minimum 200 mm and provide watertight seal against support wall.

.5 Lap dampproofing and flashing 150 mm and seal in accordance with manufacturer's instructions.

.6 At bottom of cavity install mortar net to manufacturer's instructions. Apply additional mortar net layer as required to fill cavity thickness. Place net in continuous layer.

.7 Before masonry work begins, place specified dampproofing under first course of masonry. Install continuous dampproofing with ends lapped and cut flush with exterior face of wall. Place similar dampproofing over top course.

3.6 MORTAR MIXING

.1 Thoroughly mix mortar ingredients in proper quantities needed for immediate use to requirements of CSA A179.

.2 Measure and batch mortar materials either by volume or weight, to accurately control and maintain proportions. Do not measure materials by shovel.

.3 Mix mortar with maximum amount of water consistent with workability for maximum tensile bond strength within capacity of mortar.

.4 Do not use mortar which has begun to set. Use mortar within 2 hours after initial mixing. Re-temper mortar during 2 hour period only as required to restore workability.

.5 Add mortar colour and admixtures to requirements of manufacturer's instructions.

.6 Provide uniformity of mix and colouration.

3.7 **BLOCK**

.1 Lay blocks in running bond except as indicated otherwise. Align block webs vertically and install thicker ends of face shells up.

.2 Install a full bed of mortar for first courses of masonry, for masonry units 100 mm thick and less, and between solid units. For remaining courses bed face shells, including vertical end joints, fully in mortar.

.3 Install special shaped and sized concrete block units as indicated and as required for a complete and coordinated assembly and to minimize cut units.

.4 Supply and install two courses of solid block beneath lintel bearing.

.5 Stagger end joints in every course. Align joints plumb over each other in every other course.

.6 Bond intersecting block walls in alternate courses. Where block work abuts concrete, anchor each block course to concrete.

3.8 **MASONRY VENEER**

.1 Prior to installation of masonry veneer, coordinate installation of air and vapour retarder with Section 07 26 00.

.2 Prior to installation of cavity insulation, examine air and vapour retarder and make good damage. Install cavity wall insulation in accordance with Section 07 21 00.

.3 Lay masonry veneer in running bond, unless indicated otherwise, and in a full bed of mortar.

.4 Form angle corners with special shaped units; cutting of units is not permitted.

.5 Erect exterior cavity wall construction as shown on Contract Drawings.

.6 Install masonry veneer to prevent mortar droppings and protrusions from impeding drainage and pressure equalization of rainscreen cavities and drained walls.

.7 Apply sufficient mortar on end of stretchers to ensure end joints are compressed full when masonry unit is pressed into place.

3.9 **LINTELS**

.1 Install concrete block lintels over openings in masonry except where steel lintels are indicated.

.2 Set lintels with minimum of 200 mm uniformly distributed bearing at each end and as indicated. Provide bond breaker under bearing ends.

.3 Install reinforcing steel and concrete fill in block lintels as indicated.

.4 Install loose steel lintels, as indicated. Centre over opening width..

3.10 **LATERAL SUPPORT ANGLES**

.1 Where non-load bearing unit masonry partitions meet structural elements at top of partitions, provide lateral supports as required by the Ontario Building Code and in accordance with Structural details. In areas where ceilings are scheduled, use 150 mm lengths of steel angle located each side of partition at 1200 mm and staggered.

3.11 **BUILT-IN ITEMS**

.1 Coordinate and locate build-in items required to be built into masonry or supplied under Work of other Sections including hollow metal doors, windows, lintels, sleeves, inserts, etc. Build-in items to present a neat, rigid, true and plumb installation.

.2 Build wall openings, slots, and recesses required for ducts, grilles, pipes and other items.

.3 Coordinate installation of conduit, outlet boxes and other mechanical and electrical built-ins with Work of Divisions 21, 22, 23 and 26.

.4 Prevent displacement of built-in items during construction. Check plumb, location and alignment frequently, as Work progresses.

.5 Brace door jambs to maintain plumbness. Set anchors between metal frames and masonry and fill voids between hollow metal frames and masonry walls with mortar.

3.12 **INSTALLATION TOLERANCES**

.1 Planes true to within 3 mm under 3 m straightedge.

.2 Plumb within 6 mm in 3 m, or in 6 mm in 6 m at external corners, expansion joints, or other conspicuous lines.

.3 Level within 6 mm in any bay or 6 m maximum distance, and 12 mm in 12 m or more.

.4 Located from position shown, and from related position of columns, walls, and partitions within 12 mm in any bay or 6 m maximum distance, and 19 mm in 12 m or more.

.5 Opening sizes within 6 mm of designated dimension.

.6 Column and wall cross-section dimensions within minus 6 mm and plus 12 mm.

.7 With joints to dimensions indicated, but in no case greater than 12 mm.

3.13 **REPAIR AND POINTING**

.1 Remove and replace masonry units which are loose, chipped, broken, cracked, marked, stained, discoloured, or otherwise damaged. Supply and install new units to match adjoining units and install in fresh mortar, and point to eliminate evidence of replacement.

.2 During tooling of joints, enlarge any cracks, holes, or other defects, point and completely fill with mortar.

.3 Point-up joints including corners, openings, and adjacent Work for a neat, uniform appearance, properly prepared for application of sealant compounds.

3.14 **CLEANING**

.1 Obtain and follow unit masonry manufacturer's written instructions for cleaning of masonry.

.2 Clean exposed, masonry surfaces, removing excess mortar as work progresses. Allow mortar droppings to partially dry then dry brush with a stiff fibre brush.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Design, labour, Products, equipment and services necessary for the structural steel Work in accordance with the Contract Documents.

1.2 **REFERENCES**

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

.2 ASTM A325M, Standard Specification for Structural Bolts, Steel, Heat Treated 830 Mpa Minimum Tensile Strength (Metric).

.3 ASTM A563M, Standard Specification for Carbon and Alloy Steel Nuts [Metric].

.4 ASTM C1107/C1107M, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-Shrinkable).

.5 ASTM F436M, Standard Specification for Hardened Steel Washers [Metric].

.6 CAN/CSA-G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steels.

.7 CAN/CSA G164-M, Hot Dip Galvanizing of Irregularly Shaped Articles.

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

.9 CAN/CSA S136, North American Specification for the Design of Cold Formed Steel Structural Members.

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

.11 CSA W55.3, Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings.

.12 CSA W59, Welded Steel Construction (Metal Arc Welding) (Metric Version).

.13 CAN/CGSB 1.181, Ready Mixed Organic Zinc-Rich Coating.

.14 CISC Handbook of Steel Construction.

.15 SSPC Steel Structures Painting Council.

1.3 DESIGN REQUIREMENTS

.1 Design details and connections in accordance with requirements of CAN/CSA S16 and CSA S136 to resist forces, moments, shears indicated or implied and handling, transportation, erection loads and as indicated on the Contract Drawings.
- .1 Include in design for connections between columns, beams, girders, trusses and braces, and between such members as spandrel angles and beams, hangers, stiffeners and their supporting members.
- .2 Standard connections such as connections for shear only:
  - .1 Select shear connections from the CISC Handbook of Steel Construction.
  - .2 If forces are not indicated, select or design connections to support reaction from maximum uniformly distributed load that can be safely supported by beam in bending, if no point loads act on beam, assuming fully supported compression flange.
- .3 All connections: Designed and stamped by a Professional Engineer licensed in the Province of Ontario.

.2 Structural design to accommodate active loads including live, dead, lateral, wind, seismic, handling, transportation, and erection loads.

.3 Design connections:
- .1 To safely withstand the combined effects of shear, moment, and torque at applicable design stresses.
- .2 Not to interfere with architectural clearance lines or finishes.
- .3 Of base plate and cap plate bearing on column to column section by welding or grinding column to bear.
- .4 Taking into account any eccentricity.
- .5 With direct fastening to flanges of spandrel beams to restrain twisting.
- .6 Single angle and fish-plate type connections are not permitted, except for secondary, lightly loaded elements.
- .7 Make single angle connections of wrapped type.

1.4 SUBMITTALS

.1 Shop drawings:
- .1 Submit shop drawings in accordance with Section 01 33 00.
- .2 Include shop and field splices, cuts, copes, camber, connection details, holes, reinforcements, bearing plates, welds, anchors, identification marks, surface preparation and finishes.
- .3 Indicate welds in accordance with CSA W59 welding symbols standard.
- .4 Submit sketches and design calculations for structural members and connections with the corresponding shop drawings.

.2 Erection drawings:
- .1 Submit erection drawings in accordance with Section 01 33 00.
- .2 Indicate details and information necessary for assembly and erection purposes such as description of methods, member identification, sequence of erection, type of equipment used in erection, and temporary bracings.

.3 Reproduction of the Contract Drawings for use as erection drawings is not permitted without the approval of the Consultant.

.3 Test reports: 4 weeks minimum, prior to structural steel fabrication, submit 2 copies of mill test reports by steel manufacturer indicating chemical and physical properties of steel to be used in the Work and confirming that tests completed conformed to the requirements of CAN/CSA-G40.20/G40.21.

.4 Certifications:
- .1 Submit certifications for welding companies under division 1 or 2.1 of CSA W47.1 for fusion welding of steel structures and CSA W55.3 for resistance welding of structural components.
- .2 Submit confirmation by the design Consultant that fabrication and erection complies with the Contract Documents..

.5 Inspection reports: Submit field reports of shop and field inspections.

1.5 QUALITY ASSURANCE

.1 Retain a Professional Engineer, licensed in the Province of Ontario, with experience in design, fabrication, and erection of structural steel Work of comparable complexity and scope, to perform following services as part of Work of this Section:
- .1 Design of structural members and connections.
- .2 Stamp, and sign shop and erection drawings, design calculations, and amendments.
- .3 Conduct fabrication and erection inspections and prepare and submit written inspection reports verifying that the Work is in accordance with the Contract Documents and reviewed shop and erection drawings.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Exercise care in handling galvanize finished materials. Use nylon slings for handling and a combination of wood or polystyrene blocking between units, in stockpile and in transit. Schedule and sequence the Work so a minimum of handling occurs prior to erection.

2 Products

2.1 MATERIALS

.1 Rolled structural steel shapes, and flat hot-rolled steel Products: CAN/CSA G40.20/G40.21, Grade: 350W.

.2 Hollow structural sections: CAN/CSA G40.20/G40.21, Grade 350W, Class H.

.3 Beam connections, columns, base plates, beams, purlins, and girts: CAN/CSA G40.20/G40.21.

.4 Surface preparation: Remove moisture, oil, grease, dirt, excessive rust, loose mill scale, and clean to SSPC SP6 - Commercial aggregate blast.

.5 Grating: In accordance with Section 05 50 00.

.6 Hot dip galvanizing: CSA G164-M; minimum zinc coating of 600 g/m^2.

.7 Touch-up primer (galvanized steel): CAN/CGSB-1.181.

.8 Welding materials: CSA W59 and certified by the Canadian Welding Bureau.

.9 Anchor bolts and rods: ASTM A307, Grade C, with hexagon heads and nuts, lengths shown with a minimum of 13 mm projecting beyond the nut. Nuts: ASTM A563M.

.10 High strength bolts: ASTM A325M, Type 1, heavy hexagon high strength bolts, of standard size, of lengths required for thickness of members joined and for type of connection.
- .1 Lock washers, lock nuts, burr thread to prevent bolts from working loose.
- .2 ASTM A563; Hexagon semi-finished nuts.
- .3 ASTM F436M; Flat, smooth hardened washers, quenched and tempered.

2.2 FABRICATION

.1 Fabricate structural steel in accordance with CAN/CSA S16 and CISC Handbook of Steel Construction fabrication tolerances except as indicated otherwise.

.2 Splicing of members is not permitted except as shown on the Contract Drawings or as accepted by the Consultant.

.3 Clean, prepare surfaces and galvanize structural steel in accordance with CAN/CSA S16.

.4 Continuously weld structural steel members where indicated. Galvanize vent / weep holes for structural steel members.

.5 Grind shop fabrication welds smooth.

.6 Fabricate structural steel members true and without twists or open joints.

.7 Weld in accordance with CSA W59.

.8 Fabricate properly sized holes to accommodate other parts of the Work including holes required for attachment; locate holes to prevent appreciable reduction of structural member strength. Reinforce openings as necessary to maintain strength of structural members.

.9 Fabricate HSS members with sufficient holes to prevent the accumulation of water.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

.2 Obtain the Consultant's written approval prior to field cutting or altering of structural members.

3.2 **MARKING**

.1 Mark materials in accordance with CAN/CSA G40.20/G40.21; do not use die stamping.

.2 Match marking: Mark bearing assemblies and splices in shop for fit and match.

3.3 **STRUCTURAL STEEL ERECTION**

.1 Supply and coordinate the location and placement of anchor bolts, and base plates.

.2 Erect structural steel in accordance with accepted shop and erection drawings and tolerances of CAN/CSA S16 and CISC Handbook of Steel Construction tolerances except restrict the maximum variation in elevation to 6 mm.

.3 Splicing of members is not permitted except as shown on the Contract Drawings or as accepted by the Consultant.

.4 Set steel accurately to lines and elevations indicated. Set column bases and shim to proper elevations. Install structural grouting in accordance with details and the manufacturer's recommendations.

.5 Assemble structural steel members true, plumb, and level, free of twist and open joints.

.6 Make high strength bolted connections in accordance with CSA S16.

.7 Weld in accordance with CSA W59.

3.4 **FIELD TOUCH-UP**

.1 Upon completion of erection, mechanically brush clean bolts, rivets, welds, and burned or scratched surfaces.

.2 Touch up damaged surfaces with galvanized touch-up primer in accordance with manufacturer's written instructions.

END OF SECTION

PART 1: GENERAL

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

.2 Conform to the National Building Code of Canada, the Construction Safety Act, CSA Standard S16-01 and applicable Provincial Building Code. All codes and standards shall be current editions with all revisions to date.

.3 Co-operate with other trades for satisfactory completion of the Work.

.4 Where structural steel members specified on the drawings are not available to the contractor, the structural steel contractor shall provide members having all section properties equal to or better than the specified members at no additional cost. Contact engineer for acceptance of any and all substitutions.

1.2 RELATED WORK SPECIFIED ELSEWHERE

.1 Contractor shall be responsible for coordinating this section with all related sections.

1.3 QUALITY ASSURANCE

.1 Any organization undertaking to weld under this contract shall be fully approved by the Canadian Welding Bureau under the requirements of CSA W47.1-03, W55.3- (latest edition) and CSA W59- (latest edition).

1.4 SUBMITTALS

.1 Shop Drawings:

.1 Prepare and submit shop and erection drawings which conform to the requirement of the General Conditions and Section 01 33 00, CSA S16-01, and as specified herein.

.2 Show the size, spacing and location of structural steel connections, attachments, reinforcing and anchorage. Include necessary plans, elevations and details. Indicate size and type of fastening. For welded connections, use welding symbols in compliance with AWS and indicate clearly net weld lengths.

.3 Submit typical details of connections and any special connections for review by the Consultant before preparation of shop drawings.

.4 Review of shop drawings by the Architect and Engineer will not absolve the Contractor from his responsibility of providing materials and equipment to complete and finish his work in accordance with the contract documents. Departures or differences from the referenced drawings shall be approved, in writing, by the Architect/ Consultant.

.5 The Subcontractor shall include in his delivery schedule a minimum of two (2) weeks for consultant review of shop drawings.

.6 All connections to be designed by a qualified engineer registered to practice in the province of construction.

.7 All shop drawings are to be signed and sealed by a qualified engineer registered to practice in the province of construction, who shall take responsibility for the design of all connections.

.8 Do not use contract documents as shop drawings or erection drawings. Contract documents used for this purpose will not be reviewed. Delays resulting from this procedure will be the responsibility of the contractor.

1.5 INSPECTION AND TESTING

.1 Qualified inspectors will be employed by the Owner for this Work. Inspection organization undertaking to inspect welding shall be qualified in accordance with the requirements of CSA W178.1- (latest edition) “Qualification Code for Welding Inspection Organizations” and approved by the Canadian Welding Bureau.

.2 Provide free access for inspectors to all places where Work is being done.

.3 Inspectors are to ensure that materials conform with the requirements of this Specification.

.4 Mill test reports, properly correlated to the materials, will be accepted in lieu of physical tests.

.5 Inspection shall include:

.1 Shop inspection of fabrication in the plant.

.2 Identification of material grades.

.3 Check of overall dimensions.

.4 Check of cambers.

.5 Check of workmanship regarding layout, punching and reaming of holes.

.6 Shop and field inspection of bolted connections.

.7 Shop and field inspection of welded joints.

.8 General inspection of field cutting and alternations.

.9 General inspection of shop priming and field touch-up.

.6 The installation and testing of bolts shall conform to the requirements CSA S16-01. Inspector shall check one representative connection in ten by torque testing every bolt and shall check each bolt in every connection with a tap of a hammer for soundness. Inspectors shall enforce the requirements of the connection type.

.7 Inspector shall examine visually all welded joints for inclusions, porosity, lack of fusion, penetration, contour, under-cuts and cracks. Root passes shall be checked for penetration and cracks from the back of the joint. When directed by the Consultant, have one representative weld in ten and every weld in direct tension tested ultrasonically.

.8 Inspector shall make a full prompt written report to the Architect of all inspections and tests. Circulate reports to the Architect (2 copies), Engineers (1 copy), General Contractor (2 copies), Owner (1 copy) and Authorities having jurisdiction.

.9 Steel materials and workmanship not conforming to this Specification will be rejected. Remove and replace defective materials without unnecessary delay and without extra cost.

1.6 DESIGN

.1 Design connections in accordance with the Handbook of Steel Construction by the Canadian Institute of Steel Construction for loads shown or required.

.2 Conform to the National Building Code of Canada (latest edition) and applicable Provincial Building Codes and subsequent updates, CSA S16-01, local by-laws and regulations.

.3 Top of beam elevations given in relation to the underside of steel deck levels shall be:

A) Beams support joists…….. underside of joist shoe.

B) Beams not supporting joists…….. 0.

C) Other……. as noted on plans/sections.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Coordinate deliveries to comply with Construction Progress Schedule and arrange ahead for off-the-ground storage location. Do not load any area beyond the design limits.

.2 Adequately protect steel against rust and damage during manufacturing, delivery and storage.

.3 Store material on planks on a dry area and protect from damage. Make good

immediately any damage done, clean scratches and the like, touch-up with specified primer.

PART 2: PRODUCTS

2.1 MATERIALS

.1 Structural Steel: New stock (not weathered or rusted); to conform to CAN/CSA-G40.20/G40.21- (latest edition), Grade 350W.

.2 Hollow Structural Sections: (HSS); New stock; to conform to CAN/CSA-G40.20/G40.21- (latest edition), Grade 350W, Class H, stress relieved.

.3 Provide high-strength bolts in compliance with ASTM Standard A325 (latest edition) – High Strength Bolts for Structural Steel Joints, including suitable nuts and plain hardened washers.

.4 Provide welding electrodes in compliance with CSA W48-Series – Mild Steel Covered Arc Welding Electrodes. Welding materials shall conform to CSA W59- (latest edition).

.5 Structural Steel Primer: CAN/CGSB-1.40-M (latest edition), Structural Steel, Oil Alkyd Type or CAN/CGSB-140-M (latest edition): Red Lead, Iron Oxide, Oil Alkyd type and zinc rich paint to approved manufacturer's specifications containing 85% zinc in dry film for exterior exposed members. Shop coat and on-site touch-up shall be no less than 0.5 mils thickness.

.6 Touch-up Primer: CAN/CGSB-1.181- (latest edition), zinc rich organic primer, "Gild Zinc 100" by ICI Paints Canada Inc., or other approved manufacturer.

.7 Commercial galvanizing to conform to CSA Standard G164-M (latest edition).

.8 Welded studs shall be by an approved manufacturer such as TRW Nelson and shall conform to CSA Standard W59- (latest edition).

PART 3: EXECUTION

3.1 PREPARATION RELATED TO OTHER TRADES

.1 As the work of other trades progresses, supply anchor bolts, adjustable lintel inserts, bearing plates, lintels and other members required to be built-in with the work of other trades.

.2 Give necessary instructions to other trades for setting bearing plates, anchor bolts and other members to be built-in with the work of other trades.

.3 Verify the locations and elevations of concrete foundations and anchor bolts for column

bases before standing columns, or commencement of erection will be deemed to represent acceptance of the previous work and conditions.

3.2 FABRICATION

.1 Fabrication of structural members shall comply with CSA S16-01 and as specified below.

.2 Use only clean and straight material. If straightening or flattening is necessary, do it only by a process and in a manner that will not injure the material. Material having kinks or bends not called for on the drawings will be rejected.

.3 Shop or field connections shall be bolted with high strength bolts or welded. Connections shall be made with due regard for Architectural Drawings and appearance. **Do Not** interfere with clearance lines or architectural finishes.

.4 Minimum size of welds to be 5mm.

.5 Beam connections shall be adequate to resist the reactions produced by the framing or load conditions.

.6 Provide double angle header connections where practical. Otherwise use seat connections with top clip angles for lateral support.

.7 Header connections shall be used at all expansion joints for structural steel.

.8 Minimum length of double angle header connections shall not be less than half of the depth of the beams.

.9 Do not use one-sided or fish plate type connections.

.10 Provide top and bottom flange angle clips for all spandrel beams.

.11 Provide punched holes 11mm to 27mm in diameter for convenience of other trades in attaching wood or other materials to steel work, when so directed by the Architect. Holes shall be so placed as not to cause any appreciable reduction in the strength of the member.

.12 Provide holes for pipes and ducts and the reinforcing for same as indicated on drawings. Cutting of holes in steel beams in the field will not be permitted, without the written approval of the Consultant.

.13 Provide separators at approximately 1200mm o.c. for double beams and channels as follows:

.1 Beams and channels 200mm or less in depth – one or two rows of pipe separators.

.2 Beams and channels over 200mm in depth – channel separators unless otherwise detailed on the drawings.

.14 Mill column bearing plates under column bearing..

.15 Structural steel members shall not be spliced unless approved by the structural engineer in writing.

.16 Provide 50mm clear space between structural steel at expansion joints.

.17 Provide adjustable galvanized steel anchors 40mm x 6mm on columns that abutt masonry for anchoring every 400mm in height.

.18 Provide adjustable galvanized steel anchors 40mm x 6mm on beams that abut masonry at 400mm on centre vertically and 2000mm on centre horizontally.

.19 Welding shall comply with CSA W59- (latest edition).

.20 Fabricator shall be approved by the Canadian Welding Bureau under the requirements of CSA W47.1-03.

3.3 SHOP PAINTING AND PROTECTION

.1 Clean steel by shot-blasting or power wire brushing to remove rust, mill scale, oil, dirt, and other foreign matter before commencing shop painting. The quality of cleanliness shall be of standard stated in SSPC-SP6 Commercial Blast Cleaning, or SSPC-SP3 Power Tool Cleaning, as may be required to satisfy final paint finish requirements.

.2 Clean welds by wire brushing and wash down with clean water, to remove the chemical residues left by the electrodes, prior to painting.

.3 All steel work shall receive one shop coat of exterior grade primer.

.4 Steel work shall be painted and shall remain under cover until the paint protection has dried.

.5 Give the parts which are inaccessible after assembly two coats of primer coat paint, of different colours, when members are noted to be painted.

.6 Provide sandblasting before finish painting for steel members at edge of openings as shown on drawings.

.7 Steel work shall be left installed in a clean state ready to receive applicable finishes.

.8 Where steel is to be covered with sprayed fireproofing, ensure that paint primer used is compatible with sprayed fireproofing.

.9 The following surfaces shall not be painted:

1. Surfaces and edges to be field welded, except joist surfaces to receive steel decking. If painted, remove paint for field welding for a distance of at least 50mm on all sides of the joint.

2. The contact surfaces of friction-type connections assembled by high strength bolts.

3. Portions of steel members which are to be encased in, or in contact with, concrete slabs cast-in-place.

.10 All exterior exposed structural steel shall be galvanized or painted with approved rust inhibitive paint.

3.4 ERECTION

.1 Make adequate provision for horizontal and vertical erection loads and for sufficient temporary bracing to keep structural steel plumb and in true alignment until the completion of erection and installation of concrete work and roof decks which provide the necessary permanent bracing. Any failure to make proper and adequate provisions for erection stresses shall be entirely at the risk and responsibility of the Contractor.

.2 When temporary steel members are required for erection purposes, such members shall be provided, and removed when no longer required.

.3 Handle and store structural steel on the job site in such a manner that no damage shall be caused to the material, or the structure.

.4 Erect individual members of the structural steel to the following tolerances:

.1 Exterior columns, spandrel beams and angles, 1 to 1000.

.2 All other pieces 1 to 500.

.3 Adjustable Shelf Angles attached to steel frame 3mm plus or minus, with abutting ends of members at the same level. These elements shall be welded in place after final adjustment and galvanizing shall be touched-up with zinc rich paint.

.4 A variation of 1.5mm is permissible in the overall length of members with both ends milled. Members without milled ends which are to be framed to other steel parts of the structure may have a variation from the detail length not greater than 2.5mm for members 9000mm or less in length; and not greater than 3mm for members over 9000mm in length.

.5 Execute all field assembly and welding in accordance with the requirements for shop fabrication excepting such as manifestly apply to shop conditions only.

.6 Provide bearing plates and standard government wall anchors for beams bearing on masonry or concrete.

.7 Provide 150mm bearing for angle lintels and bolt or weld together upstanding legs. Maximum spacing of bolts or welds shall be 600mm.

.8 Paint field bolts, field welds and any abrasions or damage to the shop coat or primer, after erection.

.9 Provide C100 x 8 structural members for framing at perimeter of holes through metal decking where openings between 450mm and 1200mm in roof deck and between 300mm and 1200mm in floor deck measured across the flutes. Connect to main framing members.

3.5 ARCHITECTURALLY EXPOSED STEEL

.1 Where finished surfaces of steel are to be left exposed to view, fabricate as specified in AISC Specification for Architecturally Exposed Steel, including specified straightness.

.2 Continuously weld connection joints where exposed to view and grind them smooth and flush with adjacent surfaces.

.3 Remove mill marks, identification and surface imperfections by grinding smooth and flush with adjacent surfaces.

.4 Clean, prime and protect all steel as specified in this Section. Apply one coat of primer compatible with finish specified in Section 09900.

END OF SECTION

PART 1: GENERAL

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

.2 Unless otherwise specified, conform to CSA Standard S16-01, Steel Structures for Building – Limit States Design and CSA S136-01, Cold Formed Steel Structural Members including all supplements as of the date of tender.

1.2 RELATED WORK SPECIFIED ELSEWHERE

.1 Contractor shall be responsible for coordinating this section with all related sections.

1.3 QUALITY ASSURANCE

.1 Execute the work of this Section only by personnel who have adequate plant, equipment and skill and are known to have been responsible for satisfactory work similar to that specified during a period of at least five years.

.2 Any organization undertaking to weld under this Contract shall be fully approved by the Canadian Welding Bureau under the requirements of CSA W47.1-03, W55.3 and W59, (latest editions).

1.4 SUBMITTALS

.1 Submit in accordance with the General Conditions and Section 01 33 00.

.2 Shop Drawings:

.1 Submit structural design calculations and supporting engineering information concerning joists. Each design data document shall bear the seal of the design engineer responsible for its preparation.

.2 Prepare erection and detail drawings for open web steel joists for review by the Architect and Consultant.

.3 Show pertinent details including capacity, types, and sizes of joists, details of bridging and anchoring, chord extensions, and reinforcing where required.

.4 Do not use contract drawings as shop drawings or erection drawings. Contract drawings used for this purpose will not be reviewed. Delays resulting from this procedure will be the responsibility of the contractor.

1.5 INSPECTION AND TESTING

.1 Make copies of mill test reports (properly correlated to the materials) available to the Consultant upon request. Mill test reports will be accepted in lieu of mill inspection.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Coordinate deliveries to comply with Construction Progress Schedule and arrange ahead for off-the-ground storage location. Do not load any area beyond the design limits.

.2 Adequately protect steel against rust and damage during manufacturing, delivery and storage.

.3 Store material on planks in a dry area and protect from damage. Make good immediately any damage done, clean scratches and the like, touch-up with specified primer.

1.7 DESIGN

.1 Design joists by a qualified Engineer registered to practice in the province of construction to safely support the uniformly distributed loading shown, all concentrated loads carried by the joists, and in addition, snow accumulation loads as shown.

.2 Design joists for conditions such as non-uniform load, fixed or cantilevered ends or absence of adequate lateral support by the decking.

.3 Design joists for all loading conditions specified in the National Building Code and local building codes, in addition to the snow loads specified on plans.

.4 Specified loads are shown on plans.

.5 Areas shaded on the roof plan indicate extent of additional snow piling with peak specified loads noted. Roof joists shall be designed, manufactured and erected to support basic specified loads as well as additional snow loading.

.6 For water filled pipe sizes and locations, refer to mechanical drawings and sprinkler drawings. In the absence of detailed information, the weights of water filled pipes shall be assumed as follows:

100mm diameter pipes and smaller	w =	0.10 kN/m
125mm diameter pipes	w =	0.35 kN/m
150mm diameter pipes	w =	0.47 kN/m
200mm diameter pipes	w =	0.75 kN/m

Add 0.45 kN point loading at the hanging points

Design joists for additional point loads P in kN due to pipe hangers as follows:

$$P = wL + 0.45 \text{ kN}$$

Where L is the hanger spacing in metres and w is the weight of the filled pipe in kN/m.

.7 All mechanical pipes 50mm in diameter and larger shall be hung from top chord of joists at panel points only.

.8 Design joists for net uplift due to wind using gross uplift in accordance with N.B.C. Supplement (latest edition).

.9 All joists are to be cambered for full dead load deflection.

.10 Live load deflection of roof joists when subjected to full total load shall not exceed 1/240 of the span for roof members, except where such members support a plaster ceiling or similar finish like drywall, the deflection due to live load shall not exceed 1/360 of the span. Live load deflection for floor joists shall be as specified on the structural drawings.

.11 T.J. denotes tie joists. Full size of bottom chords shall be framed into columns or beams. Top and bottom chords shall be designed and connected for horizontal loads resulting from a live load moment of negative 14 kN.m specified, or 10% of the specified dead + live vertical end reactions of the joists, (whichever is greater), in addition to the gravity and wind uplift loads specified.

.12 Minimum size of bottom chords for tie joists to be 2L 45x45x5

.13 In order to facilitate the passage of mechanical ducts and pipes through joists, the joist supplier shall locate the diagonals so that they line up from joist to joist..

.14 Steel joist supplier shall design, supply and erect joist bridging of sufficient size and spacing in accordance with the CSA S16-01, and if the assembly is to be fire rated, provide bridging as required by the applicable fire rated design.

.15 Ensure that all bridging is located so that it clears all equipment to be installed between the joists, such as lighting, ductwork, piping etc.

.16 All pipes must be hung from top chord of joists. If a load, (approved by the structural Consultant), is hung from a joist at a location other than the panel point, then a web diagonal shall be welded from the hanger location to the nearest panel point on the opposite chord.

PART 2: PRODUCTS

2.1 MATERIALS

.1 Steel for open web steel joists shall be of quality suitable for the applicable welding processes and shall conform to CSA Standard G40.20/G40.21 (latest edition), General Requirements for Rolled or Welded Structural Quality Steel, and Structural Quality Steels, except that steel used in cold roll-formed components shall conform to the requirements for such steel as prescribed by CSA Standard S136-01, Cold Formed Steel Structural Members.

.2 Welding Electrodes: Conforms to CSA W48.1-M (latest edition) Mild Steel Covered

Arc-Welding Electrodes.

.3 Primer: Refer to Structural Steel, Section 05 10 00.

.4 Commercial galvanizing – CSA Standard G164-M (latest edition).

PART 3: EXECUTION

3.1 WORKMANSHIP

.1 Conform to CSA Standard W55.3-(latest edition), Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings.

.2 Conform to CSA Standard W59-(latest edition), Welded Steel Construction (Metal-Arch Welding).

.3 Connect component members of joists by arc or resistance welding, bolting or other methods approved by the Consultant.

.4 Provide bearings at ends of joists proportioned so that the allowable bearing pressure on the supporting material is not exceeded. On masonry or concrete, extend the end of the bearing a minimum of 100mm beyond the face of the support. On steel, extend the end of the bearing a minimum of 65mm beyond the face of the support.

3.2 PRIME COAT PAINTING AND GALVANIZING

.1 Clean joists by wire brushing or other effective means to remove loose mill scale, rust, oil, dirt and other foreign matter.

.2 Apply one coat of paint in the shop by dipping or spraying.

.3 Touch-up field welds and abrasions in the field.

.4 Where steel joists are covered with sprayed fireproofing, ensure that paint primer used is compatible with sprayed fireproofing.

3.3 ERECTION

.1 Erect, set accurately and in correct alignment, all joists level and true, and so secure them as to remain in place during the installation of the deck.

.2 Anchor joists supporting up to 9 square metres of area to steel supports at each end bearing by a minimum of two 5mm fillet welds, each 25 long, or other comparable means approved by the Consultant.

.3 Anchor joists supporting more than 9 square metres of area to steel supports of each end bearing by not less than two 5mm fillet welds, each 50 long, or other comparable mechanical means approved by the Consultant.

.4 Supply steel packing to elevate joists to the required bearing level or provide a special shoe at the joists.

.5 After erection is complete, remove accumulations of soil or other foreign matter, leaving the surfaces of joists suitable for receiving field painting.

.6 Erect joists in accordance with design.

3.4 INSTALLATION OF BRIDGING

.1 Before the application of any construction load, install bridging in accordance with Section 16.7 of CSA S16-01, and as required by ULC test design where applicable. Anchor each line of bridging to walls and other supporting structural members.

.2 Provide 1 row of horizontal bridging at the first bottom chord panel point at each end of all joists.

.3 Provide additional cross bridging as indicated on plans.

.4 Provide additional X-bridging between the outside perimeter beams/joists and the first row of joists, in all areas where perimeter members run parallel with the joists.

.5 Additional X-bridging is shown thus = = = = on plans.

.6 Minimum size of X-bridging to be L35x35x3 spaced at maximum 6’-8” on centre, unless noted otherwise on plan.

.7 Adjust bridging locations to allow for mechanical / electrical /architectural equipment to be installed between the joists. Contact engineer for advice before relocating bridging shown on contract documents and shop drawings.

3.5 FURRING EXTENSION RODS

.1 Provide furring extension rods for bottom chords of joists where required, suitable to support the weight of ceiling construction.

3.6 SPACING OF JOISTS

.1 All joists are to be equally spaced between tie joists unless specifically dimensioned on the structural drawings.

.2 Where tie joists do not exist, all joists are to be equally spaced in the area in which they are shown, unless specifically dimensioned on the structural drawings.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Design, labour, Products, equipment and services necessary for the steel joists Work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.

.2 ASTM A325M, Standard Specification for Structural Bolts, Steel, Heat Treated 830 Mpa Minimum Tensile Strength (Metric).

.3 ASTM A563M, Standard Specification for Carbon and Alloy Steel Nuts [Metric].

.4 ASTM F436M, Standard Specification for Hardened Steel Washers [Metric].

.5 CAN/CSA-G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steels.

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

.7 CAN/CSA S136, North American Specification for the Design of Cold Formed Steel Structural Members.

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

.9 CSA W55.3, Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings.

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

.11 CAN/CGSB 85.10, Protective Coatings for Metals.

.12 CISC Handbook of Steel Construction.

.13 CISC/CPMA 1.73a Quick Drying Primer.

.14 SSPC Steel Structures Painting Council.

1.3 **DESIGN REQUIREMENTS**

.1 Design steel joists and bridging to carry loads shown on Contract Drawings in accordance with CAN/CSA-S16 and for a minimum load. Design bearing plates where the support is masonry or concrete.

.2 Line up web members to allow unobstructed passage of mechanical services.

.3 Centre bearing of joists except where shown otherwise:
- .1 25 mm past web of supporting steel beam where joists are framing in from one side only.
- .2 25 mm maximum short of web of supporting steel where joists are framing in from two sides.
- .3 Over centre line of supporting masonry, 100 mm maximum from inside face of masonry wall or concrete.

.4 Limit roof joist deflection due to specified live load to 300 of span and deflection due to specified total load to 240 of span.

1.4 SUBMITTALS

.1 Shop drawings:
- .1 Submit shop drawings in accordance with Section 01 33 00.
- .2 Include load design criteria, joist geometry, centre line of bearing, member size, properties, framed openings, splicing details, camber, bearing plates, anchorage, identification marks, orientation and finishes.
- .3 Indicate welds in accordance with CSA W59 welding symbols standard.

.2 Erection drawings:
- .1 Submit erection drawings in accordance with Section 01 33 00.
- .2 Indicate details and information necessary for assembly and erection purposes such as description of methods, sequence of erection, type of equipment used in erection, joist marks, tie joints, depths, spacing, bridging lines, bearing and anchorage details, and temporary bracings.
- .3 Reproduction of the Contract Drawings for use as erection drawings is not permitted. Do not use Contract CADD files.

.3 Test reports: 4 weeks minimum, prior to structural steel fabrication, submit 2 copies of mill test reports by a qualified metallurgist indicating chemical and physical properties of steel to be used in the Work and confirming that tests completed are in accordance with the requirements of CAN/CSA G40.20-04/G40.21.

.4 Certifications: Submit certifications for welding companies under division 1 or 2.1 of CSA W47.1 for fusion welding of steel structures and CSA W55.3 for resistance welding of structural components.

1.5 QUALITY ASSURANCE

.1 Retain a Professional Engineer, licensed in the Province of Ontario, with experience in steel joist Work of comparable complexity and scope, to perform the following services as part of the Work of this Section:
- .1 Design structural members and connections.
- .2 Review, stamp, and sign fabrication and erection shop drawings, design calculations, and amendments thereto.

.3 Conduct shop and on-site inspections, and prepare and submit written inspection reports verifying this part of the Work is in accordance with the Contract Documents and reviewed shop drawings.

1.6 **DELIVERY, STORAGE, AND HANDLING**

.1 Exercise care in handling primer finished materials. Do not handle steel until primer paint has cured sufficiently to handle without damage to same. Use nylon slings for handling and a combination of wood or polystyrene blocking between units, in stockpile and in transit. Schedule and sequence the Work so a minimum of handling occurs prior to erection.

2 Products

2.1 **MATERIALS**

.1 Structural steel for OWSJ: CAN/CSA G40.20-04/G40.21, Grade 300W.

.2 Surface preparation: Remove moisture, oil, grease, dirt, excessive rust, loose mill scale, and clean to SSPC SP6 - Commercial aggregate blast

.3 Shop paint primer and touch-up: CISC/CPMA 1.73a.

.4 Welding materials: CSA W59 and certified by the Canadian Welding Bureau.

.5 Anchor bolts: CAN/CSA G40.20-04/G40.21-M, Grade 300W.

.6 Bolts, nuts and washers: ASTM A325M and ASTM A307.
.1 Lock washers, lock nuts, burr thread to prevent bolts from working loose.
.2 ASTM A563M; Hexagon high strength bolts and semi-finished nuts.
.3 ASTM F436M; Flat, smooth hardened washers, quenched and tempered.

2.2 **FABRICATION**

.1 Fabricate steel joists and accessories, as indicated and in accordance with CAN/CSA S16 and within the CISC Code of Standard Practice Handbook fabrication tolerances except as indicated otherwise.

.2 Clean, prepare surfaces and shop prime steel joists and accessories in accordance with CAN/CSA S16.

.3 Apply primer and finish compatible with arc welding where joints are supporting steel deck and where shear studs are welded to top chord.

.4 Fabricate steel joists and accessories true and without twists or open joints. Grind shop fabrication welds smooth.

.5 Splicing of members is not permitted except as shown on the Contract Drawings or as accepted by the Consultant.

.6 Weld in accordance with CSA W59.

.7 Supply and install chord extensions where indicated. Supply and install diagonal, horizontal and anchorage bridging as indicated.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

.2 Obtain the Consultant's written approval prior to field cutting or altering of structural members.

3.2 **JOIST ERECTION**

.1 Supply and install base plates where required.

.2 Erect steel joists and bridging as indicated in accordance with CAN/CSA-S16 and in accordance with the CISC Code of Standard Practice Handbook tolerances.

.3 Splicing of members is not permitted except as shown on the Contract Drawings or as accepted by the Consultant.

.4 Assemble joists true, plumb, and free of twist. Install diagonal, horizontal and anchorage bridging as indicated.

.5 Obtain written approval from Consultant prior to field cutting or altering joists or bridging that are not shown on shop drawings.

.6 Clean and touch up shop primer to bolts, welds, burned or scratched surfaces at completion of erection.

.7 Weld in accordance with CSA W59.

3.3 **FIELD TOUCH-UP PAINTING**

.1 Upon completion of erection, mechanically brush clean bolts, welds, and burned or scratched surfaces. Touch up damaged surfaces and surfaces in accordance with CGSB 85-GP-14M.

END OF SECTION

PART 1: GENERAL

1.1 GENERAL REQUIREMENTS

.1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

1.2 RELATED WORK UNDER OTHER SECTIONS

.1 Contractor shall be responsible for coordinating this section with all related sections.

1.3 QUALITY ASSURANCE

.1 Execute the work of this Section only by personnel who have adequate plant, equipment and skill and are known to have been responsible for satisfactory work similar to that specified during a period of at least five (5) years.

.2 Welding shall meet specified requirements of CSA Standard W59- (latest edition) and shall be performed only by a fabricator fully certified to the conditions of CSA Standard W55.3- (latest edition), and W47.1-03.

1.4 SHOP DRAWINGS

.1 Submit in accordance with the General Conditions and Section 01 33 00.

.2 Submit in accordance with the General Conditions.

.3 Shop Drawings:

.1 Prepare erection and detail drawings for review by the Architect and Consultant.

.2 Indicate the types of deck, their locations, design load, location of openings and their reinforcement, gauge of steel, surface protective coating, flashing and closure plates, locations of welds, anchorage plates and the like. Provide sufficient detail and sections indicating the deck's orientation to support members.

.3 Do not use contract drawings as shop drawings or erection drawings. Contract drawings used for this purpose will not be reviewed. Delays resulting from this procedure will be the responsibility of the contractor.

1.5 INSPECTION AND TESTING

.1 Make copies of mill test reports (properly correlated to the materials) available to the Consultant upon request. Mill test reports will be accepted in lieu of mill inspection.

1.6 DESIGN

.1 Determine structural properties and capacity of decking in accordance with CSA S136-01, Cold Formed Steel Structural Members.

.2 Areas shaded on roof plans indicate extent of additional snow piling. Roof deck shall be designed, manufactured and erected to support basic specified as well as additional snow loading.

.3 Under live load, the deck shall not have a deflection between consecutive supports, exceeding 1/360th of the span for roof deck supporting plaster or other finished ceilings, such as drywall, 1/240th of span of roof deck in other areas.

.4 Where deck has been designed to act as a diaphragm to resist lateral loads, as indicated on the structural drawings, provide transverse puddle welds, longitudinal puddle welds, and button punched side laps as indicated on the structural drawings.

.5 In areas where deck has not been specified to act as a diaphragm, provide the following minimum deck connections:

Attach to supporting steel with 20mm diameter fusion welds. (effective diameter to be minimum 13mm).

Transverse puddle welds shall be spaced at 300mm on centre maximum.

Side laps to be button punched at 600mm on centre maximum.

.6 Anchor deck to supporting framework to resist uplift forces stated in the National Building Code of Canada, and local building codes. Dead loads may be deducted from gross uplift forces in accordance with the National Building Code of Canada and local building codes.

.7 In cases where deck forms part of a fire rated assembly, ensure that the installation of the deck meets with the minimum requirements of such an assembly as specified in Underwriters Laboratories test design specification. Verify, before erection of deck, that work specified in other sections, as a part of the entire assembly, will be installed to meet validating specification for ceiling-roof assembly.

.8 Span metal deck units continuous over at least three or more supports wherever possible. Increase thickness of metal to compensate for continuity wherever fewer than three supports may occur.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Ship, store and install metal deck to prevent damage to the finish, denting, deformation and rusting, by both careful handling and physical protection. Replace deck that has suffered damage.

.2 Store deck in stacks raised clear of ground, with panels separated by wood blocking, covered with waterproof material leaving space for air circulation, and tilted to drain water.

.3 Secure units to framing with temporary fastenings, until they are permanently welded in place, to ensure against displacement from all causes.

.4 Secure loose bundles of deck in place.

.5 Deliver bearing plates and anchors supplied by this Section for installation by other Sections as directed by installer and to meet construction schedule.

PART 2: PRODUCTS

2.1 MATERIALS

.1 Roof Deck: Metal deck shall have deck flutes at 150mm centres, and shall be formed from sheet steel conforming to the requirements of CSSBI 10M (latest edition) zinc coated structural quality sheet steel for roof deck, Grade 'A', with a minimum zinc coating designation of ZF075 Wiped Coat Finish, and a nominal base steel thickness as specified on the structural drawings.

.2 Zinc-Rich Paint: Conforming to CAN/CGSB-1.81-(latest edition).

PART 3: EXECUTION

3.1 FABRICATION

.1 Include in Work of this Section sheet steel angles, curbs, cover plates, cell closures, fasteners, stiffeners and accessories, all as required. Fabricate sheet metal accessories of same material and finish as deck and in not less than 1.22mm thick material.

.2 Fabricate metal deck to meet specified requirements of CSA S136-01 and to support superimposed loading as shown on Structural Drawings.

.3 Form metal deck units to provide male and female interlocking side lap joints..

.4 Fabricate units to provide for joints between abutting panel ends with:

.1 50 overlap, swaged and sized to provide smooth joint.

.2 Ends squared and finished to ensure minimum space between panels.

.5 Provide for ribs to bear on beams parallel to flutes when tops of such beams are at same elevation as deck bearing.

.6 Incorporate reinforcing stiffeners for unsupported edges of metal deck.

.7 Holes in Deck:

.1 Incorporate holes in deck as required for services. Verify size and location of holes before commencing fabrication.

.2 For holes greater than 450mm in dimension across flutes, separate framing is included under Work of another Section.

.3 Steel deck contractor shall reinforce all openings in deck 450mm in size or smaller.

3.2 ERECTION

.1 Erect deck by its fabricator.

.2 Include hoisting and erection equipment in Work of this Section.

.3 Level and align deck units with panels parallel to each other and perpendicular to supports. Locate panel ends only over supports and to provide minimum 45mm bearing. Install steel packing to level units if necessary. Install cover plates to provide full extent of deck surface to support roofing over each area, including expansion joints and intersections of panels that span in different directions.

.4 Lap ends of panels no less than 50mm.

.5 Reinforce cell elements at top and bottom by a continuous web where they are cut longitudinally 50mm or more from a vertical web.

.6 Deck contractor shall supply and install closures and cover plates at edges of roof deck. Provide deck closures at all areas where deck edges are weak.

.7 Secure closures, plates and accessories by either sheet metal screws or welding.

.8 Install interior cell closures in flutes intersecting vertical surfaces exposed to view, at tops of interior walls and partitions extended to deck, at intersections of roof deck with exterior walls, and as otherwise indicated on drawings. Secure cell closures by welding, sheet metal screws or adhesive as suitable for material.

.9 Wedge the flutes of the steel roof deck under wood sleepers and metal curbs carrying roof top units.

.10 No mechanical or electrical equipment/accessories shall be hung from the steel deck.

.11 Hangers for suspension of ceiling are to be attached to the structural steel framing members. These may, however, be attached in between the framing members to the side of the deck flutes and by looping and tying around, but on no account should these hangers be punched through the bottom of the flutes.

3.3 ADJUSTMENT AND CLEANING

.1 Touch-up adjacent primed surfaces burned, scratched or otherwise damaged during erection with prime paint to match shop coat, when erection is completed.

.2 Paint over bare areas on galvanized surfaces and welds with zinc rich paint.

.3 Replace dented, punctured or weld-perforated deck where exposed to view.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Design, labour, Products, equipment and services necessary for the miscellaneous and metal fabrication Work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 ANSI, H35.1M Alloy and Temper Designation Systems for Aluminum (Metric).

.2 ASTM A53, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

.3 ASTM A123, Specification for Zinc (Hot Dip Galvanized) Coatings on Iron & Steel Products.

.4 ASTM A153, Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

.5 ASTM A480/A480M-15, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.

.6 ASTM A307, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.

.7 ASTM A653/A653M, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.

.8 CISC/CPMA 1.73a, A Quick-Drying One-Coat Paint for Use on Structural Steel.

.9 CAN/CSA-G40.20/G40.21-M, General Requirements for Rolled or Welded Structural Quality Steel/ Structural Quality Steels.

.10 CAN/CSA S16.1-M, Limit States Design of Steel Structures.

.11 CSA S136.1-M, Commentary on CAN/CSA S136-M, Cold Formed Steel Structural Members.

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

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

.14 CSA W59-M, Welded Steel Construction (Metal Arc Welding).

.15 CAN/CSA W117.2-M, Safety in Welding, Cutting and Allied Processes.

.16 CAN/CGSB 1.40-M, Primer, Structural Steel, Oil Alkyd Type.

.17 CGSB 1-GP-181, Organic Zinc Rich Primer.

.18 CGSB 85-GP-16M, Painting Galvanized Steel.

.19 NAAMM, The National Association of Architectural Metal Manufacturers.

.20 Steel Structures Painting Council (SSPC), Steel Structures Painting Manual, Vol. 2.

1.3 DESIGN REQUIREMENTS

.1 Design details and connections, where not shown on Drawings, in accordance with CAN/CSA-S16.1 and CSA S136.1.

1.4 SUBMITTALS

.1 Shop drawings:
- .1 Submit shop drawings for fabrication and erection of miscellaneous and metal items in accordance with Section 01 33 00 indicating:
  - .1 Materials, core thicknesses, class of finish (AMP 555), connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.
  - .2 Ensure shop drawings are of one uniform size and based on field measurements.

1.5 QUALITY ASSURANCE

.1 Retain a Professional Engineer, licensed in the Province of Ontario, with experience in Work of comparable complexity and scope, to perform the following services as part of the Work of this Section:
- .1 Design metal fabrication items that are required to resist live, dead, lateral, wind, or seismic loads.
- .2 Review, stamp, date, and sign shop drawings.

.2 Workmanship: Fabricate Work of this Section to meet the required class of workmanship indicated below in accordance with AMP 555, Section 8.
- .1 Class 2: for use on exposed to view (at a distance) fabricated items.
- .2 Exposed surfaces retain mill marks and moderate irregularities not visible by naked eye at 10 metres. Ensure burrs and sharp edges are filed down or ground off.
- .3 Exposed welds are ground with uniform sized cove.
- .4 Minor distortions are permitted.
- .5 Exposed joints have a maximum gap of 1.5 mm.

.3 Execute welding by firms certified in accordance with CSA W47.1 Division 1 or 2.1. Ensure welding operators are licensed per CSA W47.1 for types of welding required by Work.

.4 Perform stainless steel work in accordance with NAAMM, Code of Standard Practice for the Metal Industry, Workmanship, Class 1.

2 Products

2.1 **MATERIALS**

.1 General:
- .1 All materials under Work of this Section, including but not limited to, primers and paints are to have low VOC content limits.
- .2 Unless detailed or specified herein, standard products will be acceptable if construction details, and installation meet intent of Drawings and Specifications.
- .3 Include all materials, products, accessories, and supplementary parts necessary to complete assembly and installation of Work of this Section.
- .4 Incorporate only metals that are free from defects which impair strength or durability, or which are visible. Install only new metals of best quality, and free from rust or waves and buckles, and that are clean, straight, and with sharp defined profiles.

.2 Structural shapes, plates, and similar items: CAN/CSA-G40.20/G40.21-M, Grade 350W. Hollow structural sections: CAN/CSA-G40.20/G40.21-M, Grade 350W, Class H.

.3 Galvanized sheet steel: ASTM A653/A653M Grade A, Z275 Commercial Quality zinc coating, size and shape as shown.

.4 Stainless steel sheet and plate: ASTM A480/A480M, Type 316L, finish to AISI No. 4. Size as shown.

.5 Protection Posts: ASTM A53/A53-M, Schedule 40 standard weight steel pipe in quantity and sizes shown.

.6 Welding materials: CSA W48 and CSA W59-M.

.7 Fasteners: Conforming to ASTM A307, Grade A, in areas not exposed to view, use unfinished bolts with hexagon heads and nuts. In areas exposed to view, use bolts, nuts, washers, rivets, lock washers, anchor bolts, machine screws and machine bolts Z275 zinc coated in accordance with ASTM A653/A653M. Supply bolts of lengths required to suit thickness of material being joined, but not projecting more than 6 mm beyond nut, without the use of washers.

.8 Primer paint: CAN/CGSB-1.40-M or CPMA 1.73a.

.9 Galvanized primer paint: Inorganic zinc rich primer. For use on galvanized fabrications where touch up is to remain unpainted in finished work; Carbozinc 11WB by Carboline Company, Catha-Coat 305 by Devoe Coatings or Zinc Clad XI by Sherwin Williams.

.10 Drilled inserts: Mega by ITW Construction Products or HSL by Hilti Inc. heavy-duty anchors, sizes as shown.

2.2 FABRICATION

.1 Verify dimensions of existing Work before commencing fabrications and report any discrepancies to the Consultant.

.2 Fit and assemble Work in shop where possible. Execute Work in accordance with details and reviewed shop drawings.

.3 Use self-tapping shake-proof screws on items requiring assembly by screws or as indicated. Use screws for interior metal work. Use welded connections for exterior metal Work unless otherwise found acceptable by the Consultant.

.4 Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush. Seal exterior steel fabrications against corrosion in accordance with CAN/CSA S16.1-M.

.5 Execute shop welding to requirements specified.

.6 Carefully make and fit details. Take special care with exposed finished Work to produce a neat and correct appearance to the Consultant's acceptance.

.7 Assemble members without twists or open joints.

.8 Correctly size holes for connecting Work of other trades where such can be determined prior to fabrication. Where possible, show holes on shop drawings. Place holes not to cause appreciable reduction in strength of member.

.9 Draw mechanical joints to hairline tightness and seal countersunk screw and access holes for locking screws with metal filler where these occur on exposed surfaces.

2.3 FABRICATED ITEMS

.1 Refer to Drawings for details of metal fabrication work and related items not specifically listed in this Section.

.2 Where work is required to be built into work of other Sections supply such members to respective Sections.

.3 Provide metal fabrication items indicated below and items not indicated to be supplied under other Sections. The following items includes miscellaneous and metal fabrication including but not limited to the items listed below.

.4 Lintels: Fabricated from CAN/CSA-G40.20/G40.21-M, Grade 350W, size and location as shown, width to be not less than 25 mm less than width of wall and extend 200 mm beyond opening at each end. Unless otherwise shown, fabricate lintels in block walls of steel sections. Prime and paint all exposed surfaces, colour to be determined by Architect at a later date.

.5 Masonry lateral support angles:
- .1 Supply only, to Section 04 20 00 for installation, all horizontal lateral support anchors at top of non-load-bearing masonry walls.
- .2 Refer to Structural Drawings for size and spacing of required support anchors. Provide drilled holes as required for anchorage.
- .3 Galvanized for all exterior wall and unheated and high humidity locations.

.6 Shelf Angles: Of size indicated on Drawings and as specified in structural steel specifications, with adjustable inserts for vertical adjustment and slotted holes for horizontal; galvanized.

.7 Steel ladders:
- .1 Fabricate complete with steel stiffeners, rungs, angle rails, bent plate straps or angle brackets as shown or as provided in shop drawings.
- .2 Provide safety cages around ladders where indicated on Drawings and in accordance with Ministry of Labour requirements.
- .3 Provide hot dipped galvanized exterior ladders. Prime and paint regular steel interior ladders, colour to be selected by Architect at a later date.

.8 Bollards:
- .1 Provide protection posts as indicated on drawings. Posts to be 200 mm diameter with a wall thickness of 8 mm (min.). Place posts into a 1500 mm foundation (where indicated), fill with 20 Mpa concrete and round top. Project pipes 914 mm above finished grade. Finish prime coat.
- .2 Material: Type galvanized steel.
- .3 Finish: Primed and painted in colour to be selected by Architect.

.9 Brake shape trim elements:
- .1 Provide brake shape trim elements around overhead doors and entrance tower openings as indicated on drawings.
- .2 Material: Type 316L Stainless steel.
- .3 Finish: Primed and painted in colour to be selected by Architect.

.10 Miscellaneous steel brackets, supports and angles:
- .1 Supply and install or supply for installation by trades responsible, all loose steel brackets, supports and angles where indicated, except where such brackets, supports and angles are specified under work of other Sections. Drill for countersunk screws, expansion anchors and anchor bolts.
- .2 Unless otherwise specified, prime paint for interior installation, galvanized finish for exterior installation.

2.4 ANCHORS AND FASTENING

.1 Use weld studs of size not larger than 10 mm for attaching miscellaneous materials and equipment to building steel. If weight of item requires larger fasteners use clips or brackets and secure by welding or through bolting.

.2 Use self-drilling expansion type concrete anchors for attaching to masonry and concrete.

.3 Do not secure items to steel deck.

.4 Use steel beam clamps of two bolt design to transmit load to beam web. Do not use C and I clamps.

2.5 WELDING

.1 Perform welding by electric arc process.

.2 Execute welding to avoid damage or distortion to Work. Execute welding in accordance with following standards:
- .1 CSA W48 - for Electrodes. If rods are used, only coated rods are allowed.
- .2 CSA W59-M and CSA W59S1-M for design of connections and workmanship.
- .3 CAN/CSA W117.2-M - for safety.

.3 Thoroughly clean welded joints and expose steel for a sufficient distance to perform welding operations. Finish welds smooth. Supply continuous and ground welds which will be exposed to view and finish paint.

.4 Test welds for conformance and remove Work not meeting specified standards and replace to Consultant's acceptance.

2.6 SHOP PAINTING

.1 Clean steel to SSPC SP6 and remove loose mill scale, weld flux and splatter.

.2 Shop prime steel with one coat of primer paint to dry film thickness of 0.07 mm. Paint on dry surfaces, free from rust, scale, grease. Do not paint when temperature is lower than 7 deg C. Paint items under cover and leave under cover until primer is dry. Follow paint manufacturer's recommendations regarding application methods, equipment, temperature, and humidity conditions.

.3 Shop prime galvanized steel in accordance with CGSB 85-GP-16M.

.4 Clean but do not paint surfaces being welded in field.

.5 Do not paint surfaces embedded in concrete, but clean as if they were to be primed.

.6 Do not prime steel to be fireproofed or to receive intumescent paint coating.

.7 Do not prime machine finished surfaces but apply an effective anti-rust compound.

.8 Take precautions to avoid damage to adjacent surfaces.

2.7 **HOT DIP GALVANIZING**

.1 After fabrication, hot dip galvanize specific miscellaneous steel items as indicated. After galvanizing, plug relief vents air tight with appropriate aluminum plugs as suitable and required for intended metal fabricated item. Straighten shapes and assemblies true to line and plane after galvanizing. Repair damaged galvanized surfaces with zinc rich primer in accordance with manufacturer's printed directions.

.2 Hot-dip galvanize members in accordance with requirements of the following ASTM, with minimum coating weights or thicknesses as follows:

.1 Rolled, pressed and forged steel shapes, plates, bars and strips: ASTM A123; average weight of zinc coating per square/metre of actual surface, for 4.8 mm and less thickness members 600 g/m^2 for 6 mm and heavier members 640 g/m^2.

.2 Iron and steel hardware: ASTM A153; minimum weight of zinc coating, in ounces per square foot of surface, in accordance with ASTM A153, Table 1 for the various classes of materials used in the Work.

3 Execution

3.1 **EXAMINATION**

.1 Examine previously installed Work, upon which this Section depends, verify dimensions and condition of existing Work, and coordinate repairs, alterations, and rectification if necessary. Commencement of Work of this Section is deemed to signify acceptance of existing, prior conditions.

.2 Obtain Consultant's written approval prior to field cutting or altering of structural members.

3.2 **ERECTION**

.1 Install metal fabrications in accordance with reviewed shop drawings and manufacturer's written instructions.

.2 Fit joints and intersecting members accurately. Make Work in true planes with adequate fastenings. Build and erect Work plumb, true, square, straight, level and accurate to sizes detailed, free from distortion or defects detrimental to appearance or performance.

.3 Perform drilling of concrete and steel as required to fasten Work of this Section.

3.3 TOUCH UPS

.1 Paint bolt heads, washers, nuts, field welds and previously unpainted items. Touch up shop primer damaged during transit and installation, with primer to match shop primer.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services necessary for rough carpentry Work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 ASTM A153, Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

.2 ASTM A325, Specification for Bolts Quenched/Tempered Steel Nominal Thread Diameter M16 - M36 For Structural Steel Joints.

.3 ASTM A653, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.4 ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials.

.5 ASTM F1667, Driven Fasteners: Nails, Spikes and Staples.

.6 CAN/CSA O80 Series M, Wood Preservation.

.7 CSA O121-M, Douglas Fir Plywood.

.8 CAN/CSA O141, Softwood Lumber.

.9 CSA O151-M, Canadian Softwood Plywood.

.10 NLGA, Standard Grading Rules for Canadian Lumber, National Lumber Grades Authority.

1.3 **QUALITY ASSURANCE**

.1 Lumber identification: Grade stamp of an agency certified by the Canadian Lumber Standards Accreditation Board.

.2 Plywood identification: Grade mark in accordance with applicable CSA standards.

.3 Lumber quality: Carefully select individual pieces so that knots and obvious defects will not interfere with placing bolts, proper nailing or making proper connections.

.4 Moisture Content of wood at time of construction shall be 19% maximum.

.5 Each piece of fire retardant treated lumber shall be shop marked with the pressure treatment brand and ULC monogram respectively, in accordance with CAN/CSA O80-M.

.6 Dimensions of lumber shall conform to dressed sizes specified in CAN/CSA-0141 unless actual dimensions are otherwise indicated or specified.

.7 Dimensional references to lumber on Drawings and in Specifications are to nominal sizes unless actual dimensions are indicated. Such actual dimensions shall be dry size.

.8 Lumber defects: Discard wood with defects which will render a piece unable to serve its intended function. Lumber will be rejected by Consultant for excessive warp, twist, bow, crook, mildew, fungus, or mould, as well as for improper cutting and fitting, whether or not it has been installed.

1.4 **ENVIRONMENTAL REQUIREMENTS**

.1 When it is required that wood maintain dimensional stability and tolerances to ensure accurate installation of later work, store and install it only in dry areas, and where no further installation of moist materials is contemplated.

1.5 **PRODUCT DELIVERY, STORAGE AND HANDLING**

.1 Store materials in a dry area. Cover materials with tarpaulins or polyethylene sheets to prevent moisture absorption and impairment of structural and aesthetic properties. Vent to allow air movement. Tie covering to keep in place.

2 Products

2.1 **MATERIALS**

.1 General: All materials under Work of this Section, including but not limited to, adhesives are to have low VOC content limits.

.2 Lumber: Softwood, G4S, moisture content 19% or less at time of installation, in accordance with the following:
- .1 Lumber shall be of same species and grade, equally seasoned and shall be processed and stamped at same mill.
- .2 CSA O141 and NLGA Standard Grading Rules for Canadian Lumber.
- .3 Board quality: Construction or better.
- .4 Dimension quality:
  - .1 Structural joists, planks, and framing: No. 1 Select Structural.
  - .2 Light framing: Construction..

.3 Plywood: CSA O121-M, G1S, T & G, standard construction, laminated with waterproof adhesive, exterior grade, Thickness as indicated on drawings.

.4 Sheathing: Douglas Fir, CSA 0121-M or CSA O151-M; Select-Tight Face, exterior grade, T & G.

.5 Roof lumber: NLGA, Construction grade light framing, Jack Pine, S4S, pressure treated to CAN/CSA-O80 series using copper based waterborne preservative treatment, impregnated to a net retention of 4 kg/ m^3 of preservative unless otherwise specified by preservative manufacturer.

.6 Surface applied wood preservative: Green coloured copper napthenate or 5% pentachlorophenol solution, water repellant preservative or same copper based preservative as used for shop impregnation, in accordance with CAN/CSA O80.

.7 Fire retardant treatment of lumber and plywood (interior and protected locations): 'Dricon FRT' fire retardant treatment by Biewer Lumber or approved alternative, conforming to ASTM E84, to provide a flame spread rating of 25 or less.

.8 Rough hardware: Conforming to ASTM F1667; Nails, bolts, screws, anchors, expansion shields, and other fastenings required to frame and fix rough carpentry as follows:

.1 Nails, spikes and staples: Spiral type.
.2 Bolts: ASTM A325; 12.7 mm diameter minimum with nuts and washers unless noted otherwise.
.3 Screws: Countersunk head, full thread type.
.4 Proprietary fasteners: Toggle bolts, expansion shields, lag bolts, screws, inorganic fibre plugs, recommended for purpose by manufacturer.
.5 Galvanize rough hardware used in fire treated wood and hardware exposed to the atmosphere.

.9 Fasteners for use in pressure treated wood: Provide hot dipped galvanized fasteners complying to ASTM A153 and connectors in accordance with ASTM A653, Class G185 for non-structural members. Provide type 304 or 316 stainless steel fasteners and connectors for use in Structural, pressure treated wood.

3 Execution

3.1 EXAMINATION

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

3.2 **GENERAL**

.1 Lay out work carefully and to accommodate work of others. Cut and fit accurately: erect in position indicated by Drawings.

.2 Install rough carpentry to allow for expansion and contraction of the materials.

.3 Cut work into lengths as long as practicable and with square ends. Align, level, square, plumb, and secure work permanently in place. Brace work temporarily as required. Join work only over solid backing.

.4 Bore holes true to line and to same size as bolts. Drive bolts into place for snug fit, and use plates or washers for bolthead and nut bearings. Turn up bolts and lag screws tightly when installed, and again just before concealed by other work or at completion of Work.

.5 Provide anchors, bolts, and inserts required for attachment of the work of this Section, to those performing the work of other Sections and who are responsible for their installation.

.6 Do not attach work by wood plugs or blocking in concrete or masonry. Use lead shields, expansion shields, or similar methods only as approved by Consultant.

3.3 **MISCELLANEOUS WOODWORK**

.1 Fit and install wood furring, strapping, grounds and blocking. Adequately size, correctly place and conceal members for finishes, fitments and for Work under other Sections. Do not assume that Drawings show required work exactly or completely. Anchor wood members securely in place.

.2 Install rough bucks, nailing strips and linings to rough openings as required for backing for frames and other Work.

.3 Except where steel supports are specifically shown, provide wood blocking and supports in metal stud partitions for fastening of items such as casework and other wall mounted accessories. Have respective trades approve the location of such wood blocking.

.4 Bolt wood blocking or nailing strips to steel framing.

.5 Align and plumb faces of furring and blocking to tolerance of 1:600.

.6 Use fire retardant lumber for blocking/framing in ceiling\ spaces, partitions and bulkheads.

3.4 ROOF WOODWORK

.1 Install continuous wood nailers around roof perimeters, curbs and roof openings larger than 150 x 150 mm, and at edges of insulation as detailed. Install cut cant strips and continuous nailers on copings and curbs as detailed.

.2 Install wood backing, dressed, tapered and recessed slightly below top surface of roof insulation and roof hopper.

3.5 BACKBOARDS

.1 Install plywood backboards, primed and painted white on both sides, with fire retardant paint.

.2 Use minimum 19 mm thick plywood on 19 x 38 mm furring around perimeter and at maximum 300 mm intermediate spacing.

3.6 FASTENERS

.1 Frame, anchor, fasten, tie and brace members for required strength and rigidity.

.2 Use hot dipped galvanized fasteners for exterior Work and Work below grade.

.3 Countersink bolts and bolt heads as required for clearance of other Work.

.4 Size fasteners to penetrate base member by half of fastener length minimum. Minimize splitting of wood members by staggering nails in direction of grain.

.5 For plywood use spiral, annular or resin coated nails and staples.

3.7 SURFACE-APPLIED WOOD PRESERVATIVE

.1 Treat raw surfaces, drilled holes and cut ends of pressure treated wood with 2 coats of wood preservative immediately after cutting.

.2 Apply preservative by dipping, by brush or by pouring into plugged holes to completely saturate surface.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products equipment and services necessary for the finish carpentry Work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 ANSI A208.1, Particleboard.

.2 ANSI A208.2, Medium Density Fibreboard for Interior Use.

.3 ANSI/NEMA LD 3, High-Pressure Decorative Laminates.

.4 ASTM F1667, Driven Fasteners: Nails, Spikes and Staples.

.5 Architectural Woodwork Manufacturers Association of Canada (AWMAC).

.6 Architectural Woodwork Standards (AWS) - Quality Standards for Architectural Woodwork.

.7 CSA O115-M, Hardwood and Decorative Plywood.

.8 CAN/CSA O141, Softwood Lumber.

.9 CSA O151-M, Canadian Softwood Plywood.

.10 National Hardwood Lumber Association (NHLA) Rules for the Measurement and Inspection of Hardwood and Cypress.

.11 National Lumber Grades Authority (NLGA) Standard Grading Rules for Canadian Lumber.

1.3 **SUBMITTALS**

.1 Shop drawings: Submit shop drawings of finish carpentry Work in accordance with Section 01 33 00 indicating materials, thicknesses, sizes, finishes, wood species, grades, profiles, connection attachments, shop jointing, field jointing, reinforcing, anchorage, fastener types and sizes, location of exposed fastenings, mechanical and electrical service routes, service outlets, cutout locations, and sizes. Include erection drawings, plans, elevations, sections, and details as applicable.

.2 Samples: Submit samples of the following in accordance with the requirements of Section 01 33 00:

.1 Two representative pieces of each type of wood to receive a stained or natural finish.

.2 Two representative pieces of each type of wood finished as specified.
.3 Two of each colour, pattern, gloss, and texture of plastic laminate, in manufacturer's standard tag size.
.4 Two samples of laminated plastic joints, edging, cutouts and postformed profiles.
.5 Two of each solid surface, in 100 x 75 x 10 mm samples.
.6 Two samples of melamine surfaced board, edging and postformed profiles.
.7 One of each item of finish carpentry hardware.

1.4 QUALITY ASSURANCE

.1 Execute Work of this Section by member of AWMAC, with 5 years' experience in finish carpentry Work of comparable complexity and scope. Submit proof of experience upon Consultant's request.

.2 Fabricate finish carpentry Work in accordance with AWS Quality Standards, Premium Quality materials and installation unless otherwise indicated. Perform Work in accordance with the definition of Good Workmanship as defined in the AWS Quality Standards.

.3 Remove and replace finish carpentry Work which does not conform to the AWS Quality standards or as amended by these Specifications.

.4 Mock-up:
.1 Shop fabricate one mock-up of a base cabinet, wall cabinet, and counter top for each type of surfacing specified, complete with hardware and shop applied finishes, installed in location acceptable to Consultant.
.2 Arrange for Consultant's review and acceptance, allow 48 hours after acceptance before proceeding with Work.
.3 When accepted, mock-up will demonstrate minimum standard for this work. Mock-up may remain as part of Work if accepted by Consultant. Remove and dispose of mock-ups which do not form part of Work.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store, and handle finish carpentry in accordance with the AWS Quality Standards. Control the temperature and humidity in accordance with the AWS recommendations, before, during, and after finish carpentry delivery, and also during storage and installation.

.2 Cover finished plastic laminated work with heavy kraft paper or put in cartons during shipment. Protect installed surfaces by approved means. Do not remove until immediately before final inspection.

1.6 **EXTENDED WARRANTY**

.1 Submit a extended warranty for plastic laminate work of this Section in accordance with General Conditions, except that warranty period is extended to 2 years from date of Substantial Performance of the Work.
- .1 Warrant against defects in material and workmanship including but not limited to opening of joints, cracking, shrinkage, warpage, and delamination of plastic laminate.
- .2 Coverage: Complete replacement including affected adjacent Work.

2 Products

2.1 **MATERIALS**

.1 General: All materials under Work of this Section, including but not limited to, adhesives and mastics, are to have low VOC content limits.
SEE ARCHITECTURAL DRAWINGS for Millwork Material Finish Schedule.

.2 Concealed framing lumber and plywood:
- .1 Eastern Spruce, Balsam Fir, or Jack Pine, to CAN/CSA O141, NLGA, and AWS Custom Grade, S4S, average moisture content 7% +/- 2% at installation.
- .2 Softwood plywood: CSA O151-M; 19 mm unless indicated otherwise, (G2S). Provide exterior grade at stainless steel counters or counters with plumbing fixtures.

.3 Hardwood lumber: Maple, unless otherwise indicated, to NHLA and AWS Premium Grade, S4S, average moisture content 7% +/- 2% at installation.

.4 Softwood plywood: CSA O151-M; 19 mm unless indicated otherwise, (G2S).

.5 Medium Density Fibreboard (MDF): ANSI A208.2; omnidirectional, light coloured with uniform density throughout ‘Superior MDF’ by G-P Flakboard Ltd. or ‘Panfibre Excel MDF’ by Uniboard Canada Inc., meeting the following minimum criteria:
- .1 Density: 740 kg/m^3.
- .2 Internal bond: 0.8 N/mm^2.
- .3 Modulus of rupture: 30 N/mm^2.
- .4 Modulus of elasticity: 3400 N/mm^2.
- .5 Face screw holding: 1450 N.
- .6 Core screw holding: 1300 N.
- .7 Moisture content: 4-7%

.6 Thermofoil coating, provide thermofoil coating from a reputable manufacturer c/w heat shields adjacent to all ranges, and dishwashers. Colour shall be “White”

.7 Draw bolts and splines: Type as recommended by fabricator.

.6 Nails and staples: Conforming to ASTM F1667; Size and type to suit application, galvanized for exterior work, interior humid areas and for treated lumber; plain finish elsewhere.

.7 Bolts, nuts, washers, blind fasteners, lags and screws: Size and type to suit application. Stapling is not acceptable.

.8 Adhesive and bituminous mastic: Selected by the millwork fabricator with low VOC content.

.9 Miscellaneous metals: In accordance with Section 05 50 00.

.19 Fire retarded coating: Provide clear fire retardent coating to decorative wood panels as indicated. Two component, VOC free coating providing Class A Flame Spread rating to ASTM E84. 'Safecoat Clear Fire Retardant Coating' as manufactured by Quantum Group of Companies or approved alternative.

.10 Finishing: In accordance with Section 09 91 00.

2.2 **HARDWARE**

.1 The following hardware is the minimum quality standard for the work of this Section. Alternatives may be considered provided they are approved by Consultant prior to ordering of products.
If not otherwise noted on ARCHITECTURAL DRAWINGS.

.2 Drawer slides: Full extension, 8400 Series by Knape & Vogt.

.3 Pilasters: Clear anodized aluminum recessed shelf standards with 12 mm divisions, Model 233 by Knape & Vogt.

.4 Clips: Bright zinc plated, adjustable height shelf supports, Model 256 by Knape & Vogt.

.5 Cabinet hinges: Heavy duty, concealed 170 degree, clip, self closing, Model UC71650180 by Blum.

.6 Drawer and cabinet pulls: 10 mm dia. x 106 mm wide, stainless steel with matt finish, 115.61.601 by Hafele.

.7 Magnetic catches: Model 918 by Knape & Vogt.

.8 Locks: Cam locks/deadbolt locks complete with lock core by Hafele, type to suit application and installation.

.9 Closet rail: 27 mm diameter wardrobe rail stainless steel finish >Model 660 Round Tubing' and tubing flange >Model 734' by Knape & Vogt.

2.3 **FABRICATION**

.1 Be responsible for methods of construction and for ensuring that materials are rigidly and securely attached and will not be loosened by the work of other sections.

.2 Coordinate locations of concealed supports and blocking with other parts of Work. Provide cutouts for outlet boxes and other fixtures.

.3 Fabricate work in a manner which will permit expansion and contraction of the materials without visible open joints. Conceal joints and connections in wherever possible.

.4 Set nails and countersink screws, apply wood filler to indentations, sand smooth and leave ready to receive finish.

.5 Mitre exposed corners, no end grain shall be visible in completed installation.

.6 Finish millwork in accordance with Section 09 91 00. Finished millwork shall be free from bruises, blemishes, mineral marks, knots, shakes and other defects and shall be selected for uniformity of colour, grain and texture.

.7 Shelving to cabinetwork to be adjustable unless otherwise noted.

.8 Recess shelf standards, unless noted otherwise. Stagger recessed shelf standards on opposite sides of divider.

.9 Do not exceed maximum 760 mm unsupported span for 19 mm thick shelving. House fixed shelving into gables and divisions.

.10 Shop assemble finish carpentry to accommodate delivery and handling and to ensure passage through building openings.

.11 Shop install cabinet hardware for doors, shelves and drawers. Recess shelf standards unless noted otherwise.

.12 Fabricate base from paint grade wood 100 mm high x 16 mm thick, finished in accordance with Section 09 91 00.

.13 Fabricate sills, screens, frames and moldings to profiles shown.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

3.2 **INSTALLATION**

.1 Install Work in accordance with AWS Quality Standards and tolerances for Architectural Woodwork. Set and secure finish carpentry in place, rigid, plumb, square, and level.

.2 Scribe and cut as required, fit to abutting walls, and surfaces, fit properly into recesses and to accommodate columns, fixtures, outlets, or other projecting, intersecting or penetrating objects leaving a 0.8 mm gap maximum.

.3 Coordinate cutouts for plumbing fixtures, inserts, appliances, outlet boxes, and other fixtures, in finish carpentry. Round internal corners of cut-outs and seal exposed cores.

.4 Form joints to conceal shrinkage.

.5 Install draw bolts and splines in laminated plastic counter top joints at maximum spacing 450 mm o.c., and 75 mm from edge. Make joints flush, hairline butt joints.

.6 Install finishing hardware accurately and securely in accordance with manufacturer's directions, adjust and clean.

.7 Install prefinished millwork at locations shown on drawings. Position accurately, level, plumb straight.

.8 Apply bituminous coating over wood framing members in contact with masonry or cementitious construction.

.9 Melamine panels: Assemble melamine millwork using dowelled/wafered-and-glue construction. Installed melamine panels shall not show any exposed fasteners on finished/exposed surfaces..

.10 Mouldings: Install in locations indicated on Drawings in accordance with manufacturer's recommendations. Fill holes with wood putty and sand for finishing material.

.11 Install solid surfacing in accordance with manufacturer's instructions.

.12 Install wood panelling in locations indicated on drawings and ensuring that it is securely fastened in true vertical and horizontal manner.

.13 Install window sills level, plumb and even in locations as indicated and ensure that sills are securely fastened.

.14 Fastening:
- .1 Coordinate wall securement, anchorage, and blocking for finish carpentry items.
- .2 Position items of finished carpentry work accurately, level, plumb, true and fasten or anchor securely.
- .3 Design and select fasteners to suit size and nature of components being joined. Use proprietary devices as recommended by manufacturer.
- .4 Provide heavy duty fixture attachments for wall mounted cabinets.
- .5 Set finishing nails to receive filler. Where screws are used to secure members, countersink screw in round cleanly cut hole and plug with wood plug to match material being secured.

.15 Remove and replace damaged, marked, or stained finish carpentry.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products equipment and services necessary for spray applied waterproofing Work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 ASTM C836, Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course.

.2 ASTM E96, Standard Test Methods for Water Vapor Transmission of Materials.

1.3 **SUBMITTALS**

.1 Product data:
- .1 Submit manufacturer's Product data in accordance with Section 01 33 00 indicating:
  - .1 Materials list of items to be provided under this Section.
  - .2 Manufacturer's specifications and other data needed to ensure compliance with the specified requirements including but not limited to installation details and physical properties.
  - .3 Manufacturer's current recommended installation procedures.

.2 Shop drawings:
- .1 Submit shop drawings in accordance with Section 01 33 00 indicating:
  - .1 Adjacent construction and typical details, dimensions, thickness, crack and joint treatment, method of attachment, protection and penetration details.
  - .2 Location of each membrane penetration.

.3 Certificates:
- .1 Submit certifications for items required at least 4 weeks prior to installation of Work of this Section.
- .2 Submit manufacturer's certification that waterproofing system materials and accessories supplied are compatible, meet Specification requirements and that installer is licensed/approved by membrane manufacturer.
- .3 Submit manufacturer's certification that waterproofing components are approved for use as complete waterproofing system.
- .4 Submit Contractor's certification that waterproofing installers and quality control supervisors meet Specification requirements. Submit names of successful membrane installations in which certified personnel have performed tasks of comparable complexity and scope within preceding 5 years.
- .5 Submit inspection reports and certification by manufacturer confirming that installations are in accordance with manufacturer's requirements.

1.4 QUALITY ASSURANCE

.1 Perform Work of this Section by company, approved by Product manufacturer and having 5 years recent experience in Work of comparable complexity and scope.

.2 Applicator qualifications:
- .1 Applicator shall have at written approval from the manufacturer as recommended for the installation of spray-applied waterproofing.
- .2 Applicator shall designate a single individual as project foreman who shall be on site at all times during installation.

.3 Mock-up:
- .1 Construct one 1 m^2 mock-up of waterproofing system in a location acceptable to the Consultant. Show stages of application and crack and joint preparation and treatment.
- .2 Obtain Consultant's acceptance. Accepted mock-up may become part of the Work. Mark mock-up to Consultant's acceptance and match remainder of work to accepted mock-up. Remove unacceptable mock-up.

.4 Pre-installation meeting: Arrange with Consultant and manufacturer's representative to inspect substrates and review drawings and specifications affecting work of this Section, verify all conditions, review installation procedures, and coordinate scheduling with interfacing portions of the Work minimum 48 hours in advance of installation.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Deliver materials to job site in manufacturer's unopened containers with all labels intact and legible at time of use.

.2 Maintain the products in accord with manufacturer's recommendations with proper precautions to ensure fitness of material when installed.

.3 Comply with pertinent provisions of Section 01 60 00.

1.6 SITE CONDITIONS

.1 Maintain air and substrate temperature at waterproofing installation area above 40EF for 24 h before, during and 4 hrs after installation.

.2 Do not apply waterproofing in wet weather.

1.7 EXTENDED WARRANTY

.1 Submit a extended written warranty for fluid applied waterproofing in accordance with the General Conditions, except that warranty period is extended to 5 years from date of Substantial Performance of the Work.
- .1 Warrant Work against defects including adhesive failure, cohesive failure, waterproofing failure, and water leakage.

.2 Coverage: Complete replacement including effected adjacent Work.

2 Products

2.1 **MATERIALS**

.1 All materials under Work of this Section, including but not limited to, sealants and primers are to have low VOC content limits.

.2 Spray applied waterproofing: ASTM E96, Type 1, 100% rubber copolymer liquid applied membrane which is non-toxic and non-carcinogenic. Rub-R-Wall by Advanced Coatings or approved alternative.

.3 Concrete repair, mastic, backer rod, sealants, primers, elastomeric sheet, protection boards and other accessory materials: As recommended by manufacturer.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition of previously installed Work upon which this Section depends. Verify conformance with manufacturer's requirements. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

3.2 **SUBSTRATE PREPARATION AND PROTECTION**

.1 Allow concrete substrates to cure 24 to 48 hours prior to surface preparation.

.2 Verify substrate surfaces are solid, free from surface water, frozen matter, dust, oil, grease, scaling or laitance, projections and foreign matter detrimental to the adhesion of the hot rubberized asphalt.

.3 Clean all surfaces to receive membrane system in accord with manufacturer's instructions; vacuum clean or blow clean with oil-free compressed air all surfaces to receive waterproofing membrane and accessories. Protect adjacent surfaces not being waterproofed.

.4 Rout, clean, prepare and detail surface cracks form tie holes, honeycombed areas, and other voids and holes which may impair performance of waterproofing membrane in accord with manufacturer's instructions; install backer rod where required.

.5 Clean metal surfaces to bright metal by wire brushing or mechanical etching; scuff-sand lead flashing and plastic surfaces..

.6 Install detail cants, detail coats, joint and crack treatments, and liquid flashings in accord with manufacturer's instructions.

.7 Allow detail applications to cure in accord with manufacturer's instructions prior to general application of membrane.

.8 Prime surfaces in accordance with manufacturer's instructions.

.9 Supply and install temporary protection to adjacent surfaces to prevent damage resulting from Work of this Section.

3.3 APPLICATION

.1 Apply waterproofing in accordance with manufacturer's instructions.

.2 Grid surfaces to assure proper coverage rates and verify membrane wet-film mil thickness with gauges as work progresses.

.3 Apply membrane in uniform passes by spray to wet film thickness of 60 - 70 mils on vertical surfaces unless more stringent requirements are indicated in submitted data.

.4 Spray the top of the footing 75 mm away from the wall, do not spray the entire top surface of the footing.

.5 Continue membrane up wall to a minimum of 150 mm above final grade line or previously determined elevation.

.6 Ensure complete coverage to substrate, around flashings and protrusions and at changes in direction of surface. Re-spray thin spots and voids to obtain proper thickness. Work material into any fluted rib forming indentations.

.7 Feather terminating edge when entire area cannot be completed in one day; clean area 150 mm wide along terminating edge of membrane with Xylene solvent on clean white rags prior to start-up on next working day; overlap existing work by 150 mm with new work.

.8 Allow minimum 15 minute cure time before application of protection board, insulation, drainage board. Ensure proper initial placement, without overlap of protection boards.

3.4 FIELD QUALITY CONTROL

.1 Do not cover or permit to be covered any portion of the membranes until they have had full cure of 48 hours and been inspected by the Consultant or by an inspection agency appointed by the Consultant.

3.5 PROTECTION AND CLEAN-UP

.1 Promptly remove overspray of membrane system material from adjacent surfaces with cleaner approved by membrane manufacturer. Leave work area in broom clean condition.

.2 Prohibit traffic over completed work and protect against work overhead until protection course is installed.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services necessary for the thermal insulation Work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 CAN/ULC-S702, Mineral Fibre Thermal Insulation for Buildings.

.2 CAN/ULC-S704, Thermal Insulation, Polyurethane and Polyisocyanurate, Boards, Faced.

1.3 **SUBMITTALS**

.1 Product data: Submit manufacturer's Product data in accordance with Section 01 33 00 indicating characteristics, performance criteria, and limitations. Indicate installation requirements and techniques, storage, and handling criteria and installation procedure acceptable to manufacturer.

.2 Certification: Submit installer's certification verifying compliance with specification requirements.

1.4 **QUALITY ASSURANCE**

.1 Qualifications: Execute Work of this Section by company specializing in thermal insulation Work with minimum of three years, recent, documented experience, on Work of comparable complexity and scope.

2 Products

2.1 **MATERIALS**

.1 All materials under Work of this Section, including but not limited to, adhesives are to have low VOC content limits.

.2 Batt Insulation: CAN/ULC-S702, Type 1, friction fit. ‘ComfortBatt’ by Roxul, or approved alternative.

.3 Semi-rigid insulation: Semi-rigid mineral wool conforming to CAN/ULC-S702, Type 1, minimum density 70 kg/m^3, thickness as indicated. ‘CavityRock MD’ by Roxul.

.4 Cavity wall insulation: Mineral wool fibre insulation conforming to CAN/ULC-S702, Type 1, minimum density 100 kg/m^3, thickness as indicated. ‘CavityRock DD’ by Roxul.

.5 Polyisocyanurate Board Insulation: CAN/ULC S704; Type 2, Class C, Rigid polyisocyanurate foam core board to meet specified requirements, faced both sides with glass fibre reinforced polymer facers or foil faces. 'Energy Shield' by Atlas Roofing Corporation or approved alternative.

.6 Acoustic Insulation: In accordance with Section 09 21 16.

.7 Insulation retainers: In accordance with Section 04 20 00.

.8 Spray Foam Insulation: CAN/ULC S770-09; Walltite XL01 by BASF.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

.2 Ensure substrate surfaces are dry, clean, suitable to receive adhesive and free from other deleterious substances.

3.2 **INSTALLATION**

.1 Install thermal insulation in longest panel sizes possible in accordance with manufacturer's instructions.

.2 Butt insulation with moderate contact and, cut and fit them tightly around other construction elements. Offset single layer vertical joints and both vertical and horizontal joints in multiple layer applications.,

.3 Make thermal insulation continuous, maintain thermal protection continuity and secure to prevent displacement. Ensure that insulation is tight to substrate without air gaps.

.4 Cut and fit thermal insulation tightly around electrical boxes, plumbing and heating pipes and ducts, exterior doors and windows, and other protrusions.

.5 Leave 75 mm separation between thermal insulation and heat emitting devices such as recessed light fixtures.

.6 Cut and trim thermal insulation neatly to fit spaces; do not excessively compress insulation to fit. Install only thermal insulation boards which are free from chipped or broken edges.

.7 Pack miscellaneous cavities with insulation to maintain continuity of thermal barrier.

.8 Arrange for Consultant to review thermal insulation before it is enclosed.

.9 Ensure compatibility and continuity of the vapour barrier at smoke seal and firestop location.

3.3 **SECUREMENT**

.1 Batt insulation: Install batt insulation in partitions, between studs, and as indicated on Contract Drawings and in accordance with the manufacturer's instructions. Fill stud cavities to full height of partitions and carefully cut and fit batt insulation around services and protrusions.

.2 Cavity wall insulation:
- .1 Provide insulation tight to the inner wythe starting at the base of the wall in parallel courses with tight butt joints. Stagger end joints in adjacent course.
- .2 Provide finish work level, plumb and true.
- .3 Provide securement for cavity wall insulation with wedge type retainers in accordance with manufacturer’s written instructions.

.3 Rigid insulation: Apply adhesive to thermal insulation foam boards in accordance with manufacturer's recommendations. Omit adhesive bonding of foam board insulation over expansion and control joints.

.4 Perimeter foundation insulation:
- .1 Exterior application: unless otherwise indicated, extend boards from finish grade down to top of footing. Install on exterior face of perimeter foundation wall with clips and adhesive. Protect entire face of insulation exposed to backfill with protection board. Terminate protection board 100 mm below finish grade level.

.5 Underslab insulation:
- .1 Install insulation boards in locations shown in accordance with manufacturer’s instructions.
- .2 Protect insulation board from damage by placing 200 mm layer of 19 mm crusher-run limestone over insulation board.
- .3 In drainage trenches, place insulation board to size and location as shown in Contract Drawings, with joints butted tight.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services necessary for vapour retarders Work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 ASTM E1643, Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.

.2 ASTM E1745, Standard Specification for Water Vapour Retarders used in contact with Soil or Granular Fill under Concrete Slabs.

.3 CAN/CGSB 19.21-M, Sealing and Bedding Compound, Acoustical.

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

1.3 **SUBMITTALS**

.1 Product data:
- .1 Submit duplicate copies of manufacturer's Product data in accordance with Section 01 33 00 indicating:
  - .1 Performance criteria, compliance with appropriate reference standard, characteristics, and limitations.
  - .2 Product transportation, storage, handling and installation requirements.

.2 Samples: Submit following samples in accordance with Section 01 33 00:
- .1 Two 300 x 300 mm samples of vapour retarders.
- .2 Two samples, 300 mm long, of fastening bar.
- .3 Duplicate samples of pipe and conduit boot.

1.4 **QUALITY ASSURANCE**

.1 Mock-up:
- .1 Construct one 10 m^2 mock-up of each type vapour retarder in location acceptable to Consultant indicating as a minimum one lap joint, one inside corner, one window interface, and one electrical box.
- .2 Arrange for Consultant's review and acceptance.
- .3 Mock-up may remain as part of Work if accepted by Consultant. Remove and dispose of mock-ups which do not form part of Work.

1.5 **SITE CONDITIONS**

.1 Do not install the Work of this Section outside of environmental ranges as recommended by manufacturer without Consultant's and Product manufacturer's written acceptance.

.2 Supply and install temporary protection and facilities to maintain Product manufacturer's, and above specification, environmental requirements before, during, and after installation.

2 Products

2.1 **MATERIALS**

.1 All materials under Work of this Section, including but not limited to, primers and sealants are to have low VOC content limits.

.2 Membrane vapour retarder: 1.0 mm thick, single-ply, self-adhering, self-sealing, rubberised asphalt, bonded to a cross-laminated high density polyethylene film.
- .1 'CCW 705' by Carlisle Coatings & Waterproofing.
- .2 'Blueskin SA' by Henry Company Canada Inc.
- .3 'Sopraseal Stick 1100 T' by Soprema.
- .4 'Exo-Air 110' by Tremco.
- .5 'Air-Shield' by W. R. Meadows.

.3 Primer:
- .1 'CCW-AWP Primer' by Carlisle Coatings & Waterproofing.
- .2 'Aquatac' by Henry Company Canada Inc.
- .3 'Elastocol Stick H20' by Soprema.
- .4 'ExoAir WB Primer' by Tremco
- .5 'Mel-Prime Water Base' by W.R. Meadows.

.4 Mastic:
- .1 'CCW 704 Mastic' by Carlisle Coatings & Waterproofing.
- .2 'Polybitume 570-05' by Henry Company Canada Inc.
- .3 'Sopramastic' by Soprema.
- .4 'Acoustical Sealant' by Tremco
- .5 'Sealtight Pointing Mastic' by W.R. Meadows.

.5 Fastening bar: Continuous 25 mm wide x 3 mm thick aluminum bar, predrilled for mechanical attachment.

.6 Fasteners: As specified herein or manufacturer's recommended fastener for attaching to Substrate.

.7 Sheet vapour retarder 'Super Six' Polyethylene film to CAN/CGSB-51.34, 0.15 mm (6 mil) thick.

.8 Joint sealing tape: Air resistant pressure sensitive adhesive tape, type recommended by sheet vapour retarder manufacturer, 50 mm wide for lap joints and perimeter seals, 25 mm wide elsewhere.

.9 Sealant: CAN/CGSB 19.21; One-part, non-sag, non-bleeding, non-drying, non-hardening, sealant shall remain tacky for permanent bonding to all surfaces; 'Tremco Acoustical Sealant' by Tremco Ltd. or approved alternative.

.10 Vapour retarder (under slab): ASTM E1745, Class A, 0.38 mm (15 mil) thick; 'Stego Wrap Vapor Barrier' by Stego Industries or 'Perminator' by W.R. Meadows.

.1 Joint sealing tape: High density polyethylene tape with pressure sensitive adhesive with minimum width 100 mm. Type recommended by sheet vapour retarder manufacturer.

.2 Pipe and conduit boots: Construct pipe and conduit boots from vapour retarder material and pressure sensitive tape as recommended by manufacturer.

3 Execution

3.1 EXAMINATION AND COORDINATION

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions..

.2 Verify that existing substrates to receive vapour retarder are clean, dry, sound, smooth, and continuous.

.3 Coordinate installation of vapour retarders with work of other Sections to achieve a vapour tight building envelope.

3.2 SHEET VAPOUR RETARDER INSTALLATION

.1 Ensure substrates and services are installed and inspected prior to installation of retarder.

.2 Install sheet vapour retarder on the warm side of roof assembly, prior to installation of roof insulation to form a continuous vapour retarder.

.3 Use sheets of largest practical size to minimize joints.

.4 Inspect for continuity. Repair punctures and tears with sealing tape before work is concealed.

.5 At exterior surface openings, cut vapour retarder to form openings and ensure material is lapped and sealed to frame.

.6 Ensure continuity of vapour retarder is maintained at junctures with other materials.

.7 At perimeter seals, seal perimeter of sheet vapour retarder as follows:
- .1 Apply continuous bead of sealant to substrate at perimeter of sheets.
- .2 Lap sheet over sealant and press into sealant bead.
- .3 Install fasteners through lapped sheets at sealant bead into substrate.
- .4 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.

.8 Seal lap joints of sheet vapour retarder as follows:
- .1 Attach first sheet to substrate.
- .2 Apply continuous bead of sealant over solid backing at joint.
- .3 Lap adjoining sheet minimum 150 mm and press into sealant bead.
- .4 Install fasteners through lapped sheets at sealant bead into substrate.
- .5 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.

.9 Seal electrical switch and outlet device boxes that penetrate vapour retarder as follows:
- .1 Wrap boxes with film sheet providing minimum 300 mm perimeter lap flange.
- .2 Apply sealant to seal edges of flange to main vapour retarder and seal wiring penetrations through box cover.

3.3 MASTIC AND PRIMER

.1 Fill substrate voids, gaps, depressions, cracks, and joints with mastic until continuous, smooth, substrate for vapour retarder is achieved.

.2 Prime substrate surfaces to receive vapour retarder in accordance with manufacturer's instructions, at recommended application rate, allow to dry. Vary coverage to suit surface porosity.

.3 Prime surfaces. Re-prime surfaces if not covered with vapour retarder within 4 hours.

3.4 UNDER SLAB VAPOUR RETARDER INSTALLATION

.1 Install sheet vapour retarder under the floor slab prior to installation of floor slab, to form a continuous vapour retarder in accordance with ASTM E1643 and manufacturer’s written instructions.

.2 Lap vapour barrier over footings and seal to foundation walls.

.3 Overlap joints 150 mm and seal with manufacturer approved sealing tape.

.4 Seal all penetrations (including conduits and pipes) with manufacturer's pipe boot.

.5 Use sheets of largest practical size to minimize joints.

.6 Inspect for continuity. Repair punctures and tears with sealing tape before work is concealed.

.7 Ensure continuity of vapour retarder is maintained at junctures with other materials.

3.5 MEMBRANE VAPOUR RETARDER INSTALLATION

.1 Install mastic where required to ensure integrity of vapour retarder installation at protrusions and other complex details.

.2 Install vapour retarder in accordance with manufacturer's instructions in locations indicated.

.3 Lap vapour retarder ends and edges 50 mm minimum. Roll vapour retarder and laps for continuous adhesion over entire substrate area; use manufacturer's recommended roller.

.4 Extend vapour retarder as required to connect to roof parapets, windows, doors frames, aluminum work and other components of Work comprising vapour retarder system.

.5 Cut and fit vapour retarder as required for passage of protrusions, ensuring continuous adherence to substrate.

.6 At end of days' Work, trowel mastic water cut-off along uppermost edge of incomplete vapour retarder assembly, to prevent loss of adhesion and damage to vapour retarder.

3.6 FASTENING BARS

.1 Supply and install continuous mechanical fastening bar to clamp vapour retarder both sides of unfilled gaps, cracks, and joints.

3.7 FIELD QUALITY CONTROL

.1 Inspect vapour retarder continuity immediately prior to installation of subsequent construction. Repair punctures, rips and tears to ensure continuity of vapour retarder.

.2 Where punctures and tears are extensive, replace entire damaged section.

.3 Do not cover or permit to be covered any portion of vapour retarder until it has been inspected by Consultant.

END OF SECTION

1 General

1.1 SECTION INCLUDES

.1 Surface preparation.

.2 Application of an underslab vapour retarder.

1.2 RELATED SECTIONS

.1 Section 03 30 00 - Concrete.

.2 Section 07 10 00 – Dampproofing and Waterproofing.

.3 Section 09 65 00 - Resilient Flooring.

1.3 REFERENCES

.1 ASTM D1709 - 09 Standard Test Methods for Impact Resistance of Plastic Film by the Free-Falling Dart Method.

.2 ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

.3 ASTM E154 - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs.

.4 ASTM E1643 - Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.

.5 ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.

.6 ASTM F1249-01 Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor.

1.4 SUBMITTALS

.1 Comply with Section 01 33 00 - Submittal Procedures.

.2 Submit manufacturer's product data and application instructions.

1.5 QUALITY ASSURANCE

.1 Use an experienced installer and adequate number of skilled personnel who are thoroughly trained and experienced in the application of the vapour retarder.

.2 Obtain vapour retarder materials from a single manufacturer regularly engaged in manufacturing the product.

.3 Provide products which comply with all state and local regulations controlling use of volatile organic compounds (VOCs).

1.6 PRECONSTRUCTION MEETING

.1 Pre-Construction Meeting: Convene one week prior to installation of underslab vapour retarder. Attendees to be as follows: - Architect, Engineer, General Contractor, Vapour Retarder Installer, and Vapour Retarder Manufacturer to discuss the application in detail.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

.2 Store materials in a clean, dry area in accordance with manufacturer's instructions.

.3 Protect materials during handling and application to prevent damage or contamination.

.4 Ensure membrane is stamped with manufacturer’s name, product name, and membrane thickness at intervals of no more than 220cm (85”).

1.8 ENVIRONMENTAL REQUIREMENTS

.1 Product not intended for uses subject to abuse or permanent exposure to the elements.

.2 Do not apply on frozen ground..

2 Products

2.1 MANUFACTURER

.1 W. R. MEADOWS OF CANADA, 70 Hannant Court, Milton, Ontario, Canada L9T 5C1. (800) 563-3618. Fax (905) 878-4125. Web Site: www.wrmeadows.com.

2.2 MATERIALS

.1 Plastic Vapour Retarder

.1 PERMINATOR 15 mil by W. R. MEADOWS.

2.3 ACCESSORIES

.1 Seam Tape
.1 High Density Polyethylene Tape with pressure sensitive adhesive. Minimum width 4” (100 mm).
.1 Perminator Tape by W.R. Meadows.

.2 Pipe Collars
.1 Construct pipe collars from vapour retarder material and pressure sensitive tape per manufacturer’s instructions.

3 Execution

3.1 SURFACE PREPARATION

.1 Prepare surfaces in accordance with manufacturer’s instructions.

.2 Level, tamp, or roll earth or granular material beneath the slab base.

3.2 EXAMINATION

.1 Examine surfaces to receive membrane. Notify architect if surfaces are not acceptable. Do not begin surface preparation or application until unacceptable conditions have been corrected.

3.3 APPLICATION

.1 Install the vapour retarder membrane in accordance with manufacturer's instructions and ASTM E 1643–98.

.2 Unroll vapour retarder with the longest dimension parallel with the direction of the pour.

.3 Lap vapour retarder over footings and seal to foundation walls.

.4 Overlap joints 152mm (6") and seal with manufacturer's tape.

.5 Seal all penetrations (including pipes) with manufacturer's pipe boot.

.6 No penetration of the vapour retarder is allowed except for reinforcing steel and permanent utilities.

.7 Repair damaged areas by cutting patches of vapour barrier, overlapping damaged area 152mm (6") and taping all four sides with tape.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products equipment and services necessary for spray applied air/vapour barrier Work in accordance with the Contract Documents.

1.2 **SUBMITTALS**

.1 Product data:
- .1 Submit manufacturer's Product data in accordance with Section 01 33 00 indicating:
  - .1 Materials list of items to be provided under this Section.
  - .2 Manufacturer's specifications and other data needed to ensure compliance with the specified requirements including but not limited to installation details and physical properties.
  - .3 Manufacturer's current recommended installation procedures.

.2 Shop drawings: Submit shop drawings in accordance with Section 01 33 00 indicating locations and extent of air/vapour barrier system including details for terminations flashings, penetrations, window and door openings and treatment of substrate joints and cracks.

.3 Certificates:
- .1 Submit manufacturer's certification that air/vapour barrier system materials and accessories supplied are compatible, meet Specification requirements and that installer is licensed/approved by membrane manufacturer.
- .2 Submit manufacturer's certification that air/vapour barrier components are approved for use as complete air/vapour barrier system.
- .3 Submit inspection reports and certification by manufacturer confirming that installations are in accordance with manufacturer's requirements.

1.3 **QUALITY ASSURANCE**

.1 Qualifications: Perform Work of this Section by a company that has a minimum of five years proven experience in installations of a similar size and nature and that is approved by manufacturer.

.2 Mock-up:
- .1 Construct one 10 m^2 mock-up of spray applied air/vapour barrier in location acceptable to Consultant.
- .2 Demonstrate verify details, tie-ins and to demonstrate the required quality of materials and installation.
- .3 Arrange for Consultant's review and acceptance, allow 48 hours after acceptance before proceeding with Work.
- .4 Mock-up may remain as part of Work if accepted by Consultant. Remove and dispose of mock-ups which do not form part of Work.
- .5 Upon acceptance, mock-up shall serve as a minimum standard of quality for the balance of the work of this Section.

.3 Pre-installation meetings:
.1 Minimum 48 hours in advance of installation, arrange a meeting with manufacturer's representative, Consultant and all Subtrades affected by the work of this Section. Agenda should include but not be limited to the following:
.2 Review of submittals
.3 Review of surface preparation, minimum curing period and installation procedures
.4 Review of special details and flashings.
.5 Sequence of construction, responsibilities and schedule for subsequent operations.
.6 Review of inspection, testing, protection and repair procedures.

1.4 **DELIVERY, STORAGE, AND HANDLING**

.1 Deliver materials to job site in manufacturer's unopened containers with all labels intact and legible at time of use..

.2 Maintain the products in accord with manufacturer's recommendations with proper precautions to ensure fitness of material when installed.

.3 Comply with pertinent provisions of Section 01 60 00.

1.5 **SITE CONDITIONS**

.1 Maintain air and substrate temperature at air/vapour barrier installation area above -4 degrees Celsius (25 degrees Farenheit) for 24 h before, during and 24 hrs after installation.

.2 Do not apply air/vapour barrier in wet weather.

2 Products

2.1 **MATERIALS**

.1 All materials under Work of this Section, including but not limited to, sealants and primers are to have low VOC content limits.

.2 Spray applied air/vapour barrier: One component, water-based coating, 100% silicone elastomeric air and weather-barrier. No primer required. ‘Defendair 200' by Dow Corning or ‘Air-shield LMP’ by WR Meadows.

.3 Joint Treatment:
.1 Joint Tape: Self-adhered fiberglass mesh tape as recommended by weather barrier manufacturer.
.2 Joint Compound: Fluid-applied, vapour permeable, elastomeric flashing material; trowel applied.

.4 Flashing: Vapour permeable fluid-applied elastomeric flashing.
.5 Sealant: Elastomeric; non-vapor permeable sealant; compatible with weather barrier

3 Execution

3.1 **EXAMINATION**

.1 Verify condition of previously installed Work upon which this Section depends. Verify conformance with manufacturer's requirements. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

.2 New concrete should be cured for a minimum of 14 days and must be dry before membrane installation.

.3 Verify that existing substrates to receive air/vapour barrier are clean, dry, sound, smooth, continuous, sound and free of voids, spalled areas, loose aggregate, and sharp protrusions. Remove contaminants such as grease, oil and wax from exposed surfaces. Remove dust, dirt, loose stone and debris. Use repair materials and methods that are acceptable to membrane manufacture.

.4 Coordinate sealing of interruptions in, and protrusions through air/vapour barrier. Verify that other Work items projecting through air/vapour barrier are in place and are securely installed.

3.2 **SUBSTRATE PREPARATION AND PROTECTION**

.1 Verify substrate surfaces are solid, free from surface water, frozen matter, dust, oil, grease, scaling or laitance, projections and foreign matter detrimental to the adhesion of the hot rubberized asphalt.

.2 Clean all deck surfaces to receive membrane system in accord with manufacturer's instructions; vacuum clean or blow clean with oil-free compressed air all surfaces to receive air/vapour barrier membrane and accessories. Protect adjacent surfaces not being waterproofed.

.3 Rout, clean, prepare and detail surface cracks form tie holes, honeycombed areas, and other voids and holes which may impair performance of air/vapour barrier membrane in accord with manufacturer's instructions; install backer rod where required.

.4 Clean metal surfaces to bright metal by wire brushing or mechanical etching; scuff-sand lead flashing and plastic surfaces.

.5 Install detail cants, detail coats, joint and crack treatments, and liquid flashings in accord with manufacturer's instructions.

.6 Allow detail applications to cure in accord with manufacturer's instructions prior to general application of membrane.

.7 Joints between panels of exterior grade gypsum, plywood and other panel type substrates shall be sealed prior to the application of membrane.

.8 Prime surfaces in accord with manufacturer's instructions. Apply primer to all areas to receive transition membrane.

.9 Supply and install temporary protection to adjacent surfaces to prevent damage resulting from Work of this Section.

3.3 **APPLICATION**

.1 Apply air/vapour barrier in accordance with reviewed shop drawings and manufacturer's written instructions in locations indicated.

.2 Grid surfaces to assure proper coverage rates and verify membrane wet-film mil thickness with gauges as work progresses.

.3 Apply membrane in uniform passes by spray to recommended wet film thickness unless more stringent requirements are indicated in submitted data.

.4 Extend air/vapour barrier as required to connect to other components of Work comprising air/vapour barrier system.

.5 Ensure complete coverage to substrate, around flashings and protrusions and at changes in direction of surface. Re-spray thin spots and voids to obtain proper thickness. Work material into any fluted rib forming indentations.

.6 Seal around masonry reinforcing or ties and all penetrations with termination mastic.

3.4 **FIELD QUALITY CONTROL**

.1 Do not cover or permit to be covered any portion of the membranes until they have had full cure of 48 hours and been inspected by the Consultant or by an inspection agency appointed by the Consultant.

3.5 **PROTECTION AND CLEAN-UP**

.1 Promptly remove overspray of membrane system material from adjacent surfaces with cleaner approved by membrane manufacturer. Leave work area in broom clean condition.

.2 Prohibit traffic over completed work and protect against work overhead until protection course is installed.

END OF SECTION

1 General

1.1 SECTION INCLUDES

.1 Design, labour, Products, equipment and services necessary for metal siding and soffit Work in accordance with the Contract Documents.

1.2 REFERENCES

.1 ANSI B18.6.4, Screws, Tapping and Metallic Drive, Inch Series, Thread Forming and Cutting.

.2 ASTM A653/A653M, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.

.3 ASTM C920, Specification for Elastomeric Joint Sealants.

.4 CAN/CGSB-1.40-M, Primer, Structural Steel, Oil Alkyd Type.

.5 CAN/CSA-G40.20/G40.21M, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steels.

.6 CSA S136, Cold Formed Steel Structural Members.

.7 CSA S136.1, Commentary on CAN/CSA S136-M, Cold Formed Steel Structural Members.

1.3 DESIGN REQUIREMENTS

.1 Design metal siding and soffit system in accordance with CSA S136, S136.1, and to withstand live, dead, lateral, wind, seismic, handling, transportation, and erection loads.

.2 Design metal siding and soffit system in accordance with following Climatic Design Data for Peterborough contained in Ontario Building Code.
- .1 Design Temperature: January 1%, July 2 ½%.
- .2 Wind (Hourly Wind Pressures): 1 in 50 year occurrence.
- .3 Earthquake: Seismic Data as listed.

.3 Design metal siding and soffit system to limit deflection under design loads, to L/240.

.4 Design metal siding and soffit system to prevent restriction of thermal induced movement which would induce deformation such as warping, buckling, and failure of joint seals and fasteners. Design metal siding and soffit system to prevent vibration when subject to the effects of wind.

.5 Design miscellaneous, additional structural framing members and sag rods, required to complete metal siding and soffit system, where not indicated on Contract Drawings.

1.4 SUBMITTALS

.1 Product data:
- .1 Submit copies of manufacturer's Product data in accordance with Section 01300 indicating:
  - .1 Performance criteria, compliance with appropriate reference standard, characteristics, limitations.
  - .2 Product transportation, storage, handling and installation requirements.

.2 Shop drawings: Submit shop drawings indicating dimensions, profiles, Products, wall elevations, details, arrangements of sheets and joints, thicknesses, dimensions, locations of supports and fasteners and special shapes in accordance with Section 01300.

.3 Samples: Submit samples 600 x 600 mm samples of siding and soffit system showing fully assembled components including but not limited to face sheets, sub-girts, and concealed sealant. Sample to be fabricated using exact colour and gauges specified in accordance with Section 01300.

.4 Reports: Submit written field inspection and test report results after each inspection.

1.5 QUALITY ASSURANCE

.1 Retain a licensed Professional Engineer, registered in Province of Ontario, to perform following services for metal siding and soffit Work:
- .1 Design of metal siding and soffit Work.
- .2 Review, stamp, and sign shop drawings.
- .3 Conduct shop and field inspections and prepare and submit inspection reports.

.2 Mock-up:
- .1 Fabricate, deliver, and erect one full scale 1200 mm wide x 1800 mm high mock-up panel of metal siding and soffit construction, in location acceptable to Consultant.
- .2 Demonstrate finish, colours, and quality of workmanship.
- .3 Mock-up may form part of final Work, if acceptable to Consultant. Remove and dispose of mock-ups which do not form part of Work.

.3 Pre-installation meeting: Arrange with manufacturer's representative, Contractor, and Consultant to inspect substrates, and to review installation procedures 48 hours in advance of installation.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Stockpile panels tilted to provide water run-off, free from ground contact on firm, level, non-staining supports extending full width of sheet and spaced not more than 450 mm apart. Cover components with opaque polyethylene sheet. Vent to allow air movement.

1.7 EXTENDED WARRANTY

.1 Submit warranty for metal siding and soffit Work in accordance with General Conditions, except that warranty period is extended to 3 years.
- .1 Against warping, twisting, joint, finish failure and water penetration.
- .2 Coverage: Complete replacement including affected adjacent parts.

2 Products

2.1 MATERIALS

.1 Metal siding and soffit: ASTM A653/A653M, Z275 galvanized steel, 0.76 mm minimum base metal thickness.

Diamond Rib profile by VicWest Steel, 24 Ga, exposed fasteners.

Finish: WeatherX by Vicwest Steel. Types as follows:
- .1 Type 1: Regent Grey ‘56082’

.2 Structural shapes, plates, sag rods, and similar items: CAN/CSA-G40.20-G40.21-M, Grade 300W.

.3 Hollow structural sections: CAN/CSA-G40.20/G40.21-M Grade 350W, Class H.

.4 Z girts and C channels: CAN/CSA S136-M; Minimum 1.2 mm thick, Z275 galvanized. Depth as indicated on Contract Drawings.

.5 Fascia, trim, closures, and flashings: Material, finish, colour, and fasteners to match siding and soffit material, 0.76 mm minimum base metal thickness minimum.

.6 Screw fasteners: ANSI B18.6.4, stainless steel Type 304. Exposed locations: With coloured nylon heads to match metal siding and soffit.

.7 Primer paint: CAN/CGSB-1.40-M.

.8 Isolation coating: Black bituminous coating, acid and alkali resistant material. ‘410-02' by Bakor Inc. or approved alternative.

.9 Joint backing: Product as recommended by and soffit sealant manufacturer.

.10 Siding and soffit sealant: ASTM C920, Type S, Grade NS; One-part, ultra-low modulus, moisture curing silicone sealant, 790 Silicone by Dow Corning or Spectrem 1 by Tremco Ltd. Colour: As selected by Consultant.

.11 Thermal Separation: Continuous 3 mm thick x 38 mm wide self adhering cork.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

3.2 **STRUCTURAL FRAMING**

.1 Supply and install miscellaneous, additional structural framing members, required to complete metal siding and soffit system, where not indicated on Contract Drawings.

3.3 **GIRTS AND CHANNELS**

.1 Notch Z girts and C channels as required to allow drainage of cavity.

.2 Install Z girts, fastened into structural framing beneath. Orient Z girts to drain water from cavity.

.3 Install C channels to frame openings such as doors, windows, and louvre openings, and orient channel webs to form heads, jambs and sills of openings.

3.4 **FASCIA, TRIM, CLOSURES, AND FLASHINGS**

.1 Install fascia and trim including inside and outside corners, flashing, edgings, cap strips, drips, under-sill trim, fillers, closure strips, starter strips, and window or door trim, carefully formed and profiled.

3.5 **METAL SIDING AND SOFFIT**

.1 Install metal siding vertically and soffit in accordance with reviewed shop drawings and manufacturer's written instructions.

.2 Install metal siding and soffit in one piece, full height, except as indicated otherwise.

.3 Maintain joints in exterior siding and soffit, plumb, true to line, tight fitting, hairline joints.

.4 Attach metal siding and soffit system components to prevent warping, buckling, and deformation induced by restriction of thermal induced movement.

.5 Install corner pieces, closures, flashings, etc, where shown and where required. Provide formed steel closures around opening.

.6 Bed flashings, closures, and corner pieces in sealant to provide a weathertight installation.

3.6 JOINT BACKING AND SEALANT

.1 Prepare substrate surface and mask as recommended by sealant manufacturer.

.2 Install joint backing and sealant at siding and soffit system joints and perimeter for weathertight installation. Tool sealant to concave profile.

3.7 TOUCH UP

.1 Touch up marred surfaces with air dry formulation to match pre-finished siding and soffit if approved by Consultant, otherwise remove and replace damaged metal siding and soffit.

.2 Clean and touch up marred galvanized surfaces after installation, with zinc rich primer.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Design, labour, Products, equipment and services necessary for exterior composite panel Work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 AAMA 2605, High Performance Organic Coatings on Architectural Extrusions and Panels.

.2 AAMA CW-10, Care and Handling of Architectural Aluminum from Shop to Site.

.3 ANSI B18.6.4, Screws, Tapping and Metallic Drive, Inch Series, Thread Forming and Cutting.

.4 ASTM C920, Specification for Elastomeric Joint Sealants.

.5 ASTM D1781, Standard Test Method for Climbing Drum Peel for Adhesives.

.6 CAN/CSA-G40.20/G40.21M, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steels.

.7 CSA S136, Cold Formed Steel Structural Members.

1.3 **DESIGN REQUIREMENTS**

.1 Design composite panels in accordance with following Climatic Design Data for the Municipality contained in the Ontario Building Code:
.1 Design temperature: January 1%, July 2 1/2%.
.2 Hourly wind pressures: 1 in 50 year occurrence.

.2 Design exterior metal wall panel system as a “dry joint system” and to withstand live, dead, lateral, wind, seismic, handling, transportation, and erection loads, imposed and other loads.

.3 Prevent rain penetration through wall system. Design system based on “Rain Screen Principle” in accordance with the National Research Council. Volume to vent ratio should not exceed 25 m. Panels should be compartmentalized at joints. Incorporate means of draining to the exterior.

.4 Design exterior metal wall panel system to support its own weight and the wind load, positive and negative, prevalent for the location of the building, but no less than windgust pressure calculated from National Building Code using 1-10 year probability factor. To minimize the potential for “dished” panels after loading, permanent set of the panel, measured normal to the panel surface after application and removal of the design load, must not exceeding L/800 of distance between supported edges of panel or distance between stiffeners where stiffeners are used. Stiffeners, where used, must not deflect more than L/90 of span under load.

.5 Design exterior metal wall panel system to accommodate thermal movements of the components and structural movements to provide an installation free of oil canning, buckling, delamination, failure of joint seals, excessive stress on fasteners or any other detrimental effects.

.6 Design composite panel system to prevent rattling and vibration of panels, overstressing of fasteners and clips, and other detrimental effects on the system.

.7 Panel removal: System design to allow removal of individual panels within wall system.

.8 Design miscellaneous, additional structural framing members as required to complete composite panel system, where not indicated on Contract Drawings.

.9 The attachment face of subgirts supporting the panel system must not deflect vertically more than 3 mm due to the dead load of the panel system.

.10 Design soffit system to accommodate expansion and contraction of soffit elements without causing buckling, failure of joints, undue stress on fasteners or other effects detrimental to appearance or performance.

1.4 SUBMITTALS

.1 Product data:
- .1 Submit copies of manufacturer's Product data in accordance with Section 01 33 00 indicating:
  - .1 Performance criteria, compliance with appropriate reference standard, characteristics, limitations.
  - .2 Product transportation, storage, handling and installation requirements.

.2 Shop drawings:
- .1 Submit shop drawings in accordance with Section 01 33 00 indicating:
  - .1 Elevations, details, profiles, dimensions, thickness of materials, finishes, methods of joining, joint location, special shapes, methods of anchoring, anchor and clip details, types of sealants and gaskets, waterproof connections to adjoining work, details of other pertinent components of the work (i.e. windows, penetrations, membranes, etc), and compliance with design criteria and requirements of related work.
  - .2 Seismic anchors, supports and accessories for complete installation.

.3 Complete design data to confirm that soffit system meet design requirements specified.

.3 Samples: Submit two 300 x 300 mm samples of wall panels in the selected colours and finish for approval.

.4 Closeout Submittals: Provide maintenance instructions for incorporation into Operation and Maintenance Manual, specified in section 01 78 23.

1.5 **QUALITY ASSURANCE**

.1 Retain a licensed Professional Engineer, registered in Province of Ontario, to perform following services for composite panel Work:
.1 Design of composite metal panel system.
.2 Design of anchors, supports and accessories to meet seismic requirements.
.3 Review, stamp, and sign shop drawings.
.4 Conduct shop and field inspections and prepare and submit inspection reports.

.2 Perform work of this Section only by a Subcontractor of recognized standing who has adequate plant, equipment, and skilled workers to perform it expeditiously, and is known to have been responsible for satisfactory installations similar to that specified during a period of at least the immediate past ten years.

.3 Execute steel welding to CSA W59-M by fabricators certified by the Canadian Welding Bureau to CSA W47.1.

.4 Execute aluminum welding by fabricators certified by the Canadian Welding Bureau to CSA W47.2-M.

.5 Execute finishing coatings and metal pre-treatments by applicators approved in writing by the manufacturer of the coatings and under the supervision of the manufacturer's qualified representative.

.6 Mock-up:
.1 Fabricate, deliver, and erect a 1200 mm wide x 1800 mm high mock-up panel of composite panel system in location acceptable to Consultant.
.2 Construct one 3000 mm minimum mock-up of soffit system in location acceptable to Consultant.
.3 Demonstrate finish, anchoring devices, air barrier sealing, and quality of workmanship.
.4 Mock-up may form part of final Work, if acceptable to Consultant. Remove and dispose of mock-ups which do not form part of Work.

1.6 **DELIVERY, STORAGE, AND HANDLING**

.1 Handle aluminum Work in accordance with AAMA CW-10. Protect aluminum surfaces with strippable coating. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather. Do not remove before final cleaning of building.

..2 Remove and replace all damaged and unsatisfactory materials which are deemed unsuitable for use at this Section's own expense.

1.7 **EXTENDED WARRANTY**

.1 Submit a extended warranty for composite panel Work in accordance with General Conditions, except that warranty period is extended to 3 years from date of Substantial Performance of the Work.
.1 Warrant against leaking, warping, twisting, joint, and finish failure.
.2 Coverage: Complete replacement including affected adjacent parts.

.2 Manufacturer's Warranty: Provide panel manufacturer's written warranty naming Owner as beneficiary and covering failure of factory-applied exterior finish on composite metal panels within the warranty period; warrant finish per ASTM D 4214 for chalk not in excess of 8 NBS units and fade not in excess of 5 NBS units. Warranty period for finish: 10 years from date Work is certified as substantially performed.

2 Products

2.1 **ACCEPTABLE PRODUCT AND MANUFACTURER**

.1 System shall be based on ‘Alucobond FR ACM 4 mm Panel System’ by Sobotec. Metal composite material panel system with matching reveals and concealed fasteners as distributed by Modern Architectural Products or approved alternative (subject to Architect’s pre-bid/tender approval).

2.2 **MATERIALS**

.1 All materials under Work of this Section, including but not limited to, sealants, paints, and coatings are to have low VOC content limits.

.2 Composite Material: Two sheets of 0.51 mm thick aluminum alloy 3003, sandwiching a core of extruded thermoplastic formed in a continuous process without the use of glues or adhesives between dissimilar materials. Panel thickness: 4 mm. Bond integrity testing to adhere to ASTM D1781.

.3 Finish: Exposed to view: PPG Duranar XL Plus, 3 coat, coil coated fluoropolymer thermal setting enamel containing Kynar 500 resin, meeting requirements of AAMA 2605, minimum thickness 2.4 mil. Colour: In accordance with Materials Legend. Concealed aluminum finish: Mill finish.

.4 Structural shapes, plates, sag rods, and similar items: CAN/CSA-G40.20-G40.21-M, Grade 350W.

.5 Vapour barrier: In accordance with Section 07 26 00.

.6 Z-girts and C channels: CAN/CSA S136-M; Minimum 1.2 mm thick, Z275 galvanized. Depth as indicated on Contract Drawings. Z-girts to be thermally broken at mid-point of insulation thickness.

.7 Provide all additional structural supports not shown on Drawings as required.

.8 Seismic anchors, supports and accessories: In accordance with reviewed shop drawings.

.9 Fasteners: Concealed, ANSI B18.6.4, stainless steel Type 304.

.10 Insulation: In accordance with Section 07 21 00.

.11 Flashings, Closure Pieces, Trim: Same material and colour as panels.

.12 Clips and Panel Reinforcement: Extruded aluminum.

.13 Sealants: ASTM C920, Type M, Grade NS, Class 25; Two-part, Polyurethane non-sag type, Sikaflex 2C-NS by Sika Canada Inc. or Dymeric 240 by Tremco Ltd. Colour: As selected by Consultant.

.14 Joint backing: Product as recommended by siding sealant manufacturer.

.15 Touch-up paint: as recommended by panel manufacturer.

.16 Isolation coating: Bituminous coating, acid and alkali resistant material.

2.3 FABRICATION

.1 Fabricate facings and concealed support members in a manner which will provide an installation free of exposed fastenings, with sufficient support and allowance for thermal movement to prevent facing distortion. Take site measurements before proceeding with production.

.2 Fabricate components of the system at factory, ready for field installation. Include full continuous joint reveals within system.

.3 Fabricate facings flat, true, free of marks, without visible distortion and with edges straight and true. Make all planes true, and corners square and bend of minimum radius.

.4 Changes of plans, parallel or transverse to longitudinal axis shall be accomplished as detailed on shop drawings in the factory wherever practical and with a minimum of field fabrication.

.5 Form panels to dimensions indicated with tolerances to accommodate expansion and contraction between panels and structure members. Accurately form shaped panels.

.6 Provide proprietary aluminum extrusions to manufacturer's standard profiles for a complete installation. Extrusions shall be full length around panel perimeter for panel reinforcement and alignment. Intermittent clips are unacceptable.

.7 Changes of plans, parallel or transverse to longitudinal axis shall be accomplished as detailed on shop drawings in the factory wherever practical and with a minimum of field fabrication.

.8 Form panels to dimensions indicated with tolerances to accommodate expansion and contraction between panels and structure members. Accurately form shaped panels.

.9 Fabricate panels with flanges on all sides.

.10 Factory fabricate accessory and trim components ready for installation.

.11 Joint filler strip shall be same material and colour as panels. Use of caulking at joints is not acceptable.

.12 Plastic shims shall be used as thermal separator between extrusions and sub-girts.

.13 Maximum allowable tolerances shall be as follows:

- .1 Panel bow: In a concave or convex direction to be 0.5% of panel dimension width and length.
- .2 Panel flatness: Rises and falls across the panel, (local bumps and depressions) will not be accepted.
- .3 Panel tolerance:
  - .1 Width: 2 mm.
  - .2 Length: 4 mm.
  - .3 Thickness: 0.2 mm.
  - .4 Squareness: 5 mm maximum.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

.2 Verify that backup construction is aligned for proper installation of wall panels before commencing erection.

.3 Protect metal surfaces in contact with concrete, masonry mortar, plaster or other cementitious surface with isolation coating.

3.2 **INSTALLATION**

.1 Supply and install miscellaneous, additional structural framing members, required to complete composite panel system, where not indicated on Contract Drawings.

.2 Install seismic anchors, supports and accessories in accordance with reviewed shop drawings.

.3 Apply isolation coating to supporting structural framing to isolate airseal liner panel and to prevent galvanic corrosion.

.4 Supply and install vapour barrier in accordance with Section 07 26 00.

.5 Erect wall panels complete with girts, clips, and fasteners, to meet design criteria. Anchor each individual panel over solid backing. Ensure that all penetrations through air/vapour barrier are sealed.

.6 Install panels, support and anchoring system, fasteners, trim and related items to lines and elevations indicated and in strict accordance with reviewed shop/erection drawings and manufacturer's printed instructions. Carefully co-ordinate work with other Sections.

.7 Anchor component parts to transmit wind loading and other stresses to anchorage system.

.8 Install insulation in continuous contact with air barrier and neatly fitted between girts, supports, and anchoring system. Adhere insulation with temporary adhesive recommended by air barrier manufacturer.

.9 Erect wall panel system in accordance with manufacturer's instructions and under direct supervision of the manufacturer.

.10 Erect panels and joint filler strip in accordance with manufacturer’s details to meet specified design criteria and performance. Use concealed fastening only.

.11 Finished work shall be securely anchored, free of distortion, free of surface imperfections and uniform in colour.

.12 Cut and flash wall penetrations.

.13 Erect wall panels in straight lines, true, level, and plumb.

.14 Site Tolerances: Erection tolerances apply to each individual panel and shall not be accumulative:

.1 Maximum deviation from vertical and horizontal alignment of erected panels 3 mm in 6 m.

.2 Maximum offset from alignment between adjacent wall panels: 1.5 mm.

3.3 SOFFIT SYSTEM

.1 Install soffit system in accordance with reviewed shop drawings and manufacturer's written instructions. Comply with system manufacturer’s requirements regarding terminations at end of each days work and resumption of work.

3.4 JOINT BACKING AND SIDING SEALANT

.1 Prepare substrate surface and mask as recommended by sealant manufacturer.

.2 Install joint backing and sealant at perimeter of composite panel system and where indicated on drawings for weathertight installation. Tool sealant to concave profile.

.3 Seal around all openings and all other locations indicated or required to provide weathertight and watertight seal.

3.5 REPAIR

.1 Remove damaged, dented, defaced, defectively finished, or tool marked components and replace with new, unless minor blemishes are approved by Consultant.

.2 Only with approval of Consultant, refinish shop applied finishes in field with compatible materials to manufacturer’s written instructions.

3.6 CLEANING

.1 Remove all strippable protective film from the work as it is erected and prior to moving on to the next bay or grid.

.2 Wash down exposed exterior surfaces using solution of mild non-acidic detergent in warm water, applied with soft clean wiping cloths.

.3 As work progresses, remove excess sealant with recommended solvent and which will not affect metal, finished surfaces, or adjacent surfaces and materials.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Built-up rubberized asphalt membrane roofing, hot-applied method.

1.2 **RELATED SECTIONS**

.1 Section 05 31 00 - Steel Decking: Structural metal roof deck.

.2 Section 06 10 00 - Rough Carpentry: [Structural wood deck,] cants, blocking and curbs.

.3 Section 07 22 00 - Roof and Deck Insulation: Roof insulation.

.4 Section 07 26 00 - Vapour Retarders: Roof vapour retarder.

.5 Section 07 27 00 - Air Barriers: Connection of wall air barrier system to roofing system.

.6 Section 07 62 00 - Sheet Metal Flashing and Trim.

.7 Section 07 71 00 - Roof Specialties: Manufactured gravel stops, fascias, expansion joints, reglets and scuppers.

.8 Section 07 72 00 - Roof Accessories: Manufactured vents, hatches, and walkways.

.9 [Section 07 76 00 - Roof Pavers: Roof [ballast] [decking] pavers.]

.10 Section 07 92 00 - Joint Sealants.

.11 Section 22 14 26 - Facility Storm Drains: Roof drains.

1.3 **REFERENCES**

.1 ASTM C931/931M-01: Standard Specification for Exterior Gypsum Soffit Board.

.2 ASTM D2178-97a: Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing.

.3 ASTM D6152-99: Standard specification for SEBS-Modified Mopping Asphalt Used in Roofing.

.4 CGSB 37-GP-9Ma: Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing and Waterproofing.

.5 CGSB 37-GP-52M: Roofing and Waterproofing Membrane, Sheet Applied, Elastomeric.

.6 CAN/CGSB-51.33-M89: Vapour Barrier Sheet, Excluding Polyethylene, for Use In Building Construction.

.7 CAN/ULC-S704-2001: Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.

.8 CAN/ULC-S706-02: Standard for Wood Fibre Thermal Insulation for Buildings.

.9 ASTM C726: Standard Specification for Mineral Fiber Roof Insulation Boards

1.4 PERFORMANCE REQUIREMENTS

.1 Roofing System: four-ply hot-applied built-up roofing system with mechanically fastened thermal barrier underlay board, vapour barrier, rigid board insulation, overlay board, composite ply base membrane and fibreglass roofing felts set in rubberized asphalt modified hot melt adhesive and aggregate surfacing;

.2 Manufacturer's Extended Warranty: a written guarantee that the manufacturer will replace, at no cost to the Owner, any portion of the roofing membrane which experiences actual leaks resulting from defects in the manufacture of the membrane for a period of 25 years, commencing from the date of Substantial Performance of the Work.

.3 Provide Products that are compatible with one another under field conditions, as demonstrated by roofing manufacturer.

.4 Provide watertight roofing system capable of resisting specified uplift pressures, thermally induced movement and exposure to weather without failing during the specified warranty period.

1.5 SUBMITTALS

.1 Submit Product data as specified in Section [01 00 00][01 33 00]

.2 Product Data: for each major component, including roofing and flashing membrane, thermal barrier underlay board, vapour retarder, rigid board insulation, and adhesives. Highlight critical criteria for proper installation.

.3 Submit Shop Drawings for prefabricated work and details as specified in Section [01 00 00][01 33 00]

.4 Shop Drawings: Include plans, sections, details in accordance with performance requirements, and for attachment to other portions of the Work.

.5 Shop Drawings for Sloped Insulation: Indicate degree of slope and layout of sloping insulation on roof surfaces. Ensure positive drainage to roof drains.

1.6 CERTIFICATES

.1 Manufacturer Certificates: Signed by roofing manufacturer verifying that installer is approved, authorized or licensed by manufacturer to install specified Products.

.2 Installer Certificates: Signed by installer verifying that they have the specified qualifications described below.

1.7 TEST REPORTS

.1 Manufacturer Field Inspection Reports: manufacturer's written acceptance of roofing installation based on regular inspections.

1.8 QUALITY ASSURANCE

.1 Manufacturer: qualified manufacturer having roofing systems listed by UL and approved for use by Factory Mutual.

.2 Installer: a company and persons specializing in the application of hot applied Built Up Roofing, with minimum 5 years documented experience and licensed or approved to apply roofing system by manufacturer.

.3 Installer must be a member of the Ontario Industrial Roofing Contractors Association (OIRCA).

.4 Conform to CRCA Roofing Specifications and roofing membrane manufacturer's instructions.

1.9 **PRE-INSTALLATION MEETINGS**

.1 Conduct pre-installation meeting as specified in Section [01 00 00][01 31 00].

.2 Meeting: prior to commencement of deck installation, review and document methods and procedures related to roof deck and roofing system construction , including the following:
- .1 Participants: authorized representatives of the Contractor, [Construction Manager,] [Owner,] Consultant, roofing Subcontractor, roofing manufacturer, and installers of roof accessories and roof-mounted equipment.
- .2 Review methods and procedures related to roofing installation, including manufacturer's written installation instructions.
- .3 Review construction schedule and confirm availability of Products, Subcontractor personnel, equipment and facilities.
- .4 Review deck installation criteria and finishes for conformance with roofing system criteria, including issues of flatness and fastening.
- .5 Review structural loading conditions and limitations of roof deck both during and after roofing application.
- .6 Review flashing details, special roofing details, roof drainage, roof penetrations, equipment curbs, and other conditions affecting roofing installation.
- .7 Review governing regulatory requirements, and requirements for insurance and certificates as applicable.
- .8 Review safety requirements, including temporary fall-arrest measures.
- .9 Review field quality control procedures.

1.10 **DELIVERY, STORAGE AND HANDLING**

.1 Deliver and store Products undamaged in original containers with manufacturer's labels and seals intact.

.2 Store Products in designated areas elevated off the ground and protected from ultra-violet radiation, inclement weather and construction activities.

.3 Store solvent-based liquids away from excessive heat and open flame.

.4 Store adhesives and sealants at temperature above 5 degrees Celsius.

.5 Store membrane rolls on end, dry, and protected from moisture and damage. Cover rolls, insulation and other moisture-sensitive Products with tarpaulins.

.6 Store Products on roof deck in a manner to prevent overloading the structure and properly secured to prevent movement due to wind or other forces. [Prevent permanent deformation of deck.]

1.11 **ENVIRONMENTAL REQUIREMENTS**

.1 Do not apply any roofing materials during inclement weather.

.2 Comply with manufacturer's recommendations for minimum and maximum temperatures and humidity during application.

.3 Do not install Products when temperatures are below -18 degrees C.

.4 Consider effects of wind chill on adhesives, and ensure they will not prematurely set before proper adhesion takes place.

.5 Keep water-based Products from freezing. Do not apply water-based Products if temperatures are below 5 degrees C.

1.12 **WARRANTY**

.1 Submit extended warranties in accordance with the General Conditions of the Contract.

.2 Installer's Extended Warranty: standard 2 year warranty, commencing from the date of Substantial Performance of the Work.

.3 Manufacturer's Extended Warranty: a written guarantee that the manufacturer will replace, at no cost to the Owner, any portion of the roofing membrane which experiences actual leaks resulting from defects in the manufacture of the membrane for a period of 25 years, commencing from the date of Substantial Performance of the Work.

1.13 **MAINTENANCE**

.1 Arrange for roofing manufacturer to conduct periodic visual inspections of roof surface during the second, fifth tenth, fifteenth and twentieth year after Substantial Performance of the Work.

.2 Record noted deficiencies and arrange for their proper repair under warranty.

1.14 **SAFETY**

.1 For purposes of the installation, the roofing installer and not the manufacturer shall act as the Constructor (as that role is defined in the health and safety legislation of Ontario, Yukon, Prince Edward Island and Nova Scotia) *or* Prime Contractor (as that role is defined in the health and safety legislation of British Columbia, Alberta and Manitoba) *or* Principal Contractor (as that role is defined in the health and safety legislation of Newfoundland, Quebec and North West Territories) *or* Contractor (as that role is defined in the health and safety legislation of New Brunswick and Saskatchewan) and as such is fully responsible for directing and controlling all roofing installation work and the safety of the work on the jobsite.

.2 As Constructor / Prime Contractor / Principal Contractor/Contractor the roofing installer and not the manufacturer shall be fully and solely responsible for ensuring that all applicable occupational health and safety laws, regulations, rules and orders are complied with in the course of the installation. Entry of manufacturer personnel to ensure quality installation in accordance with the manufacturer's specifications and to perform warranty inspections shall not be for purposes of monitoring the safety of the work at the job site.

2 Products

2.1 **MANUFACTURERS**

.1 Manufacturers of hot-applied rubberized asphalt membrane roofing systems having Products considered acceptable for use:

2.2 **MATERIALS**

.1 Primer: non-fibrated, asbestos free, water-based, low-VOC formulation; to CGSB 37-GP-9Ma.

.1 Asbestos Content, EPA 600/R13/116: None.
.2 Non-Volatile Content, minimum, ASTM D 2823: 30 percent.
.3 Volatile Organic Compounds (VOC), maximum, ASTM D 3960: 65 g/L.

.2 Thermal Barrier Underlay Board: 13 mm thick glass mat faced gypsum panel with water-resistant core, and meeting the following criteria:
.1 Combustibility: Noncombustible to ASTM E136.
.2 Surface Burning Characteristics: to ASTM E84, maximum flame spread of 0, smoke developed of 0.
.3 Manufacturer and Product Name: Dens-Deck by G-P Gypsum.

.3 Roof Vapour Retarder: 2 Plies NO. 15 asphalt saturated perforated, organic felts to CSA-A123.3M. adhered in Type III Asphalt.

4 Roof Insulation: Polyisocyanurate rigid board; to CAN/ULC-S704, Type 2, Class 3, closed cell type:
.1 Compressive Strength (ASTM D1621): 138 kPa.
.2 Dimensional Stability (ASTM D2126): < 2 percent linear change.
.3 Water Absorption (ASTM C209): < 1 percent by volume.

.4 Edges: square.
.5 Faces: non-asphaltic, fibre-reinforced felt facers both sides.
.6 Maximum board size: 1,220mm X1,220 mm
.7 Combustibility: meets CAN/ULC-S107-M87 and CAN/ULC-S126-M86.
.8 Thickness: 102 mm Installed in minimum of two layers.

.5 Overlay Board: 76 mm thick mineral fiber roof insulation board with bitumen coated surface: Roxul Toprock DD Plus

.1 Dimensional Stability : Linear Shrinkage 0.71% @1200°F (650°C): ASTM C 356
.2 Moisture Resistance < 1.0% ASTM C 209
.3 Compressive Strength ASTM C 165 (@10%) 11 psi (75 kPa)
.4 Density (MD): – 10 lb/ft³ (160 kg/m³) ASTM C 612
,5 Thermal Resistance: 3.8 hr.ft².F º /Btu (0.68 m²K/W)

.6 Membrane Ply Sheet. Glass Fibre Felt: Type IV High Tensile, non absorbent glass fibre felt to CAN/CGSB 37-GP-64M

.7 Roofing Membrane Base Ply Sheet: 1.5 mm thick polyester-glass-polyester tri-laminate reinforced asphalt-coated sheet; Meeting the following requirements:

.1 Breaking Strength, minimum, ASTM D 146: machine direction, 28.5 kN/m (164 lbf/in); cross machine direction, 26.0 kN/m (145 lbf/in).
.2 Tear Strength, minimum, ASTM D 4073: machine direction, 1150 N (260 lbf); cross machine direction,1000 N (230 lbf).
.3 Pliability, 12.7 mm (1/2 inch) radius bend, ASTM D 146: No failures.
.4 Thickness, minimum, ASTM D 146: 1.5 mm (0.060 inch).
.5 Weight, minimum, ASTM D 228: 1.85 kg/sq. m. (38 lb/100 sq. ft.).
.6 Mass of desaturated polyester/glass/polyester mat, ASTM D 228: 0.95 g/sq. m. 3.0 lb/100 sq. ft.).
.7 Asphalt, minimum, ASTM D 228: 488 g/sq. m. (10 lb/100 sq. ft.).

.8 Adhesive for Membrane Plies, Base Sheet, Gravel and Flashing Plies: Polymer-Modified Roofing Asphalt**:** SEBS-modified, hot-melt, asphalt adhesive, with the following physical properties.

.1 Softening Point, min/max, ASTM D 36: 88-105 deg. C.
.2 Flash point, minimum, ASTM D 92: 287 deg. C .
.3 Elongation at 25 deg. C , minimum, ASTM D 412: 800 percent.
.4 Low Temp. Flex, CGSB 37.50-M89, pass at -8 degrees C.

.9 Aggregate Ballast: pea gravel free of fines, long splinters, dust or foreign matter, nominal 9 mm diameter.

2.3 ACCESSORIES

.1 Adhesive for Insulation Baords, Overlay Boards, Vapour Barrier: Type III Asphalt for Constructing Built-Up Roof Coverings and Waterproofing Systemst to CAN/CSA A123.4-04.

.2 Mechanical Fasteners: Flat-head, countersunk, self-tapping screws; size, type and length in accordance with FMG; corrosion resistant coating in accordance with FM 4470, with locking plastic or metal plates.

.3 Flashing Base Ply: Saturated roofing felts, NO. 15 asphalt saturated perforated, organic felts to CSA-A123.3M.

.4 Flashing Membrane: 1.14 mm thick, reinforced EPDM/SBR flashing sheet; TRA Elastomeric Sheeting.

.1 Low temperature flexibility: -40 C (no cracking), CGSB 37GP-52
.2 Breaking strength: MD 1446 N, XMD 1288 N, to CGSB 37GP-52
.3 Tear strength: MD 313 N, XMD 348 N, to CGSB 37GP-52

.5 Reinforcing Mesh: Vinyl-coated fibreglass mesh conform to CAN/CGSB 42.M87 (tensile – XD: exceed 25 kg., MD – exceed 35 kg.)

.6 Polymer-Modified Mastic: conform to CAN/CGSB 37.29-M89

.7 Termination Bar: 3 mm thick aluminum bar, 25 mm wide profile, pre-drilled for mechanical attachment.

.8 Cant Strips: purpose made asphalt impregnated wood fibreboard, 75 x 75 mm size.

.9 Sealing Tape: as recommended by flashing membrane manufacturer

.10 Stack Flashings: Prefabricated aluminum sleeves; sizes to suit applications.

.11 Sealant: One part elastomeric urethane based caulking compound to CAN/CGSB 19.13-M87; Dymonic by Tremco Canada: Silicone based caulking compound to CAN/CGSB 19.13-M87; Spectrum 2 by Tremco.

.12 Roof Drains: Flat body straight outlet 16 oz. Copper With 350 mm (14 inch) Diameter Flange.

.13 Metal Flashing: 24 Gauge pre-finished commercial galvanized to ASTM A525M. Coating designation G90, PPD 800 Paint Series from standard colour chart. Paint finish to match existing or as requested by owner.

.14 Starter Strips: Starter strips to be manufactured from the same type of material used for cap and counter flashings and shall be 22 gauge galvanized steel. Starter strips are to be continuous. Exposed starter strips to match prefinished sheet metal in colour.

3 Execution

3.1 **EXAMINATION**

.1 Inspect existing conditions to ensure they are suitable for roofing work to begin. Do not proceed until unacceptable conditions are corrected.

.2 Ensure substrate is solid, clean, dry and free of any contaminants prior to commencing any roofing work.

.3 Ensure Products are dry prior to installation. Replace damaged Products.

3.2 PREPARATION

.1 Protect existing roofing from damage with minimum 13 mm thick plywood runways.

.2 Prime metal and concrete surfaces designated to be covered with asphaltic Products.

.3 Apply primer at an average rate of 4.3 m^2/litre. Allow to cure.

.4 Ensure primer does not enter building through cracks and other openings.

3.3 THERMAL BARRIER UNDERLAY BOARD (Metal Deck Areas)

.1 Mechanically fasten thermal barrier, to roof deck with screws and plates using the following density: one fastener per 3ft^2 0.27 m^2 in the field of the roof; one fastener per 2ft^2 0.2 m^2 at the perimeter of the roof; one fastener per 1.5ft^2 0.14 m^2 in the corners of the roof. Roof perimeters are defined by the smaller of either 10% of the least building dimension or 40% of the building height but never less then 900mm. Corners are the squares defined by the dimension of the perimeter.

.2 Stagger boards 300 mm.

.3 Install thermal barrier underlay boards with long axis perpendicular to ribs, with end joints fully supported.

.4 Firmly butt each board to surrounding boards. Do not jam or deform boards.

.5 Cut and fit boards where roof deck intersects vertical surfaces.

.6 Provide filler boards every 450 mm in both directions and secure.

.7 Tape joints of thermal barrier underlay board with 50 mm wide tape.

3.4 VAPOUR RETARDER

.1 Adhere two plies NO. 15 asphalt saturated organic felts adhered in Type III Asphalt.roof vapour retarder over thermal barrier underlay board with approved adhesive at a rate of 1.22 kg/ m^2

.2 Extend vapour retarder under cant strips and blocking. Extend to perimeter and deck protrusions.

.3 Seal roof vapour retarder to wall air/vapour barrier system with flexible flashing membranes to ensure continuity of building air/vapour barrier envelope.

3.5 INSULATION AND OVERLAY BOARD

.1 Install insulation boards to maintain continuity of thermal envelope. Minimize joints.

.2 Adhere base layer of roof insulation to vapour retarder with approved adhesive at a rate of 1.22 kg/ m^2

.3 Adhere additional layers of insulation as required to previous layers of insulation with approved adhesive at a rate of 1.22 kg/ m^2

.4 Adhere tapered roof insulation where indicated and in accordance with approved Shop Drawings.

.5 Fit insulation tight to roof penetrations.

.6 Firmly butt insulation boards. Do not jam or deform boards.

.7 Minimize lipping between adjacent boards.

.8 Stagger joints minimum 300 mm.

.9 Adhere single layer of overlay board over roof insulation with approved adhesive at a rate of 1.22 kg/ m^2

.10 Stagger overlay board seams with insulation board seams.

3.6 **CANT STRIPS**

.1 Install cant strips at intersections of roofing and vertical surfaces.

.2 Embed in a continuous bed of approved adhesive applied to overlay boards.

.3 Lay true to line, level and with flush, butt joints and accurately mitred corners.

3.7 **ROOF MEMBRANE**

.1 Install 1 ply of base ply in shingle fashion, starting at roof low point. Apply membrane perpendicular to overlay board joints. Conform to manufacturer's recommended method

.2 Install three plies of roof membrane in shingle fashion, starting at roof low point. Apply membrane perpendicular to overlay board joints. Conform to manufacturer's recommended method.

.3 Overlap starter strips 660 mm with first ply, then overlap each succeeding ply 625 mm.

.4 Place ply sheets to ensure water will flow over or parallel to, but not against, exposed edges.

.5 Shingle in direction to shed water. Extend ply membranes over and terminate beyond cants and cut evenly.

.6 Embed plies in bitumen, at a minimum rate of 1.22 kg/ m^2, and solidly coating each ply for full width.

.7 Ensure complete and continuous seal and contact between bitumen and ply membranes, including ends, edges and laps without wrinkles, fish mouths or blisters.

.8 Do not step or walk on felts during or immediately after application until bitumen has set.

.9 Install each ply so that it shall be firmly and uniformly set, without voids, into bitumen. Thoroughly and effectively broom or roll each membrane application to ensure full adhesion.

.10 Lap ply membrane ends 150 mm. Stagger end laps 1.0 metres minimum.

.11 Overlap previous day's work 600 mm, as required.

.12 Terminate all ply layers to outer edge of roof perimeter.

3.8 ELASTOMERIC FLASHINGS

.1 Provide membrane flashings in accordance with manufacturer's written installation guidelines.

.2 Install flashings to ensure the roof is watertight at the end of each Working Day.

.3 Extend base ply of flashing membrane minimum 100 mm over roof membrane. Extend elastomeric cap ply of flashing membrane 50 mm beyond edge of base ply flashing.

.4 Extend flashing membranes minimum 200 mm up vertical surfaces.

.5 Secure flashings at 200 mm OC. Secure vertical flashings through termination bar.

.6 Overcoat end lap edges with one-part rubberized elastomer stripping adhesive and membrane.

.7 Tie-in leading edge of elastomeric sheet flashing with stripping ply membrane embedded between alternate courses of stripping ply adhesive.

3.9 SURFACING

.1 Install concrete pavers on pedestals where indicated on Drawings.

.2 Flood coat roof surface with bitumen applied at a rate of 2.9 kg/m2.

.3 Immediately broadcast aggregate ballast into bitumen at a rate of 24 kg/m^2, covering flood coat completely.

.4 Rake out aggregate to a neat, even surface.

3.10 FIELD QUALITY CONTROL

.1 Contractor Inspection: Prior to application of aggregate surfacing, inspect completed membrane and flashing for punctures, tears, and discontinuously sealed seams.

.2 Apply additional layer of membrane over punctures and tears, extending minimum 50 mm beyond damaged area in all directions, and seal seams.

.3 Manufacturer's Field Service: arrange for manufacturer's technical representative to regularly inspect the roofing application (minimum twice per week) and confirm that the roofing system installation is in strict accordance with manufacturer's recommendations.

3.11 CLEANING

.1 Refer to Section [01 74 00]

.2 Clean drains, gutters and downspouts of debris, ensuring free drainage.

.3 Clean adjacent roof surfaces, levels and ground level areas of debris and excess Products.

3.12 **PROTECTION**

.1 Adequately protect Products and work from damage by weather, traffic and other causes.

.2 At the end of each Working Day, seal exposed edges of roofing membrane to be watertight.

.3 Protect adjacent Work from damage. Repair damage.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services necessary for flashing and sheet metal Work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 ASTM A653/A653M, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.

.2 ASTM C920, Specification for Elastomeric Joint Sealants.

.3 CRCA Roofing Manual, Canadian Roofing Contractors Association.

1.3 **SUBMITTALS**

.1 Shop drawings:
.1 Submit shop drawings in accordance with Section 01 33 00 indicating:
.1 Proposed method of shaping, forming, jointing.
.2 Fastening, and application of flashing and sheet metal Work.

.2 Samples:
.1 Submit following samples in accordance with Section 01 33 00:
.1 50 x 50 mm samples of sheet metal material, colour and finish.
.2 Representative sample section of prepainted metal flashing illustrating S locking jointing method, minimum 600 mm long..

2 Products

2.1 **MATERIALS**

.1 All materials under Work of this Section, including but not limited to, sealants and paints are to have low VOC content limits.

.2 Prepainted sheet steel: ASTM A653/A653M; Classification LFQ, Grade A, Z275 zinc coating designation, 0.60 mm minimum base steel thickness, commercial quality, prefinished with Perspectra Series coating system by U.S. Steel Canada, or WeatherX by Vicwest Steel. Colour as selected by Consultant.

.3 Plastic cement: Trowel grade asphalt mastic.

.4 Sealant: ASTM C920, Type S, Grade NS, Class 25; High-performance, medium-modulus, one-part, neutral-cure silicone sealant. ‘CWS’ by Dow Corning or approved alternative.

.5 Cleats and starter strips: Starter strips to be continuous, of same material as flashing used, 1.2 mm thick.

.6 Fasteners: Flat head roofing nails of length, type and thickness suitable for metal flashing application.

.7 Washers: of same material as sheet metal, 1 mm thick with rubber packings.

.8 Touch-up paint: Same colour and material as prepainted sheet steel, as recommended by prefinished coating manufacturer.

2.2 **FABRICATION**

.1 Fabricate copings, flashings, curb counter flashings, starter strips, scuppers and miscellaneous flashings in accordance with CRCA and to details shown.

.2 Form prepainted sheet material at shop to shapes shown. Make end joints where adjacent lengths of metal flashing meet, in accordance with jointing method specified.

.3 Form pieces in 2400 mm maximum practical lengths. Make allowance for expansion at joints.

.4 Hem exposed edges 13 mm minimum on underside for appearance and stiffness. Mitre and seal corners with sealant.

.5 Reglets and Cap flashing: Form flashings as detailed and in accordance with CRCA. Provide slotted fixing holes and steel/plastic washer fasteners.

.6 Scuppers:
- .1 Form scuppers from prefinished steel sheet metal.
- .2 Sizes and profiles as indicated.
- .3 Provide necessary fastenings.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

3.2 **INSTALLATION**

.1 Install coping flashings, curb counter flashings, starter strips, scuppers and miscellaneous flashings to details shown on the Contract Drawings and in accordance with CRCA.

.2 Use concealed fasteners where indicated.

.3 Apply isolation coating to metal surfaces in contact with concrete or mortar.

.4 Install continuous starter strips to present a true, non-waving, leading edge. Anchor to back-up for a rigid, secure installation.

.5 Counterflash bituminous flashings at intersections of roof with vertical surfaces and curbs. Flash joints using S-lock forming tight fit over hook strips.

.6 Make end joints using an S lock joint. Execute by inserting end coping length in 25 mm deep S lock formed in end of adjacent length. Extend concealed portion of S lock 25 mm outwards and nail to substrate. Face nailing of joints will not be permitted.

.7 Seal where necessary to form weathertight seal between flashing and adjoining surfaces and between flashing and other Work. Sealing Work consists of bedding between members where possible. Tool sealant to concave profile where exposed.

.8 Insert metal flashing under cap flashing to form weathertight junction.

.9 Caulk flashing at cap flashing with sealant.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services necessary for firestopping and smoke seals Work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 ASTM C303, Standard Test Method for Dimensions and Density of Preformed Block and BoardBType Thermal Insulation.

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

.3 ASTM C1104, Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation.

.4 ASTM E814, Test Method for Fire Tests of Through-Penetration Fire Stops.

.5 ASTM E2174, Standard Practice for On-Site Inspection of Installed Fire Stops.

.6 ASTM G21, Standard Test for Determining Resistance of Synthetic Polymeric Materials to Fungi.

.7 CAN/CGSB 19.13, Sealing Compound, One Component, Elastomeric, Chemical Curing.

.8 CAN/ULC S102, Surface Burning Characteristics of Building Materials and Assemblies.

.9 CAN/ULC S114, Standard Method of Test for Determination of Non-Combustibility in Building Materials.

.10 CAN/ULC S115, Standard Method of Fire Tests of Firestop Systems.

.11 CAN/ULC S129, Standard Method Of Test For Smoulder Resistance Of Insulation (Basket Method).

.12 CAN/ULC S702, Thermal Insulation, Mineral Fibre for Buildings.

1.3 **DEFINITIONS**

.1 Fire Separation: A construction assembly, plane or device, either vertical or horizontal, which is required to prevent the passage of fire and smoke for a prescribed period of time. Proof of compliance to required time rating shall be by ULC, Warnock Hersey (or similar approved) certification or shall be as listed in the Ontario Building Code Supplementary Standard SB-2.

.2 Smoke Separation: A construction assembly, plane or device, either vertical or horizontal, which is not required to prevent the passage of fire for a prescribed period of time but is required to prevent the passage of smoke. A "Smoke Separation" is also known as a "Fire Separation with No Rating" or a "Zero Hour Rated Separation".

.3 Non-Rated Separation: A construction assembly, plane or device, either vertical or horizontal, which is not required to prevent the passage of fire for a prescribed period of time and is not required to prevent the passage of smoke.

1.4 SYSTEM DESCRIPTION

.1 Firestopping and smoke seals: ULC or Intertek Testing Services listed Products and systems in accordance with CAN/ULC S115 suitable to actual application and installation conditions.

.2 Firestop applications that exist for which no ULC or cUL tested system is available through a manufacturer, a manufacturer's engineering judgment derived from similar ULC or cUL system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineer judgment drawings must follow requirements set forth by the International Firestop Council.

.3 Firestop and smoke seal system shall achieve a fire resistance rating and smoke seal rating equal to that of assemblies into which they are installed.

.4 Provide smoke sealants over firestopping materials or combination smoke seal/firestop seal material to form air tight barriers to retard the passage of gas and smoke.

.5 Firestopping and smoke seals located at movement joints shall be designed with movement capability.

.6 Provide penetration firestoppping with mould and mildew resistance rating of 0 in accordance with ASTM G21.

.7 Firestopping and smoke seals within mechanical and electrical assemblies shall be provided as part of the work of Divisions 21, 22, 23, 26, 27, and 28 respectively.

1.5 SUBMITTALS

.1 Product data:

.1 Submit copies of manufacturer's Product data in accordance with Section 01 33 00 indicating:

.1 Performance criteria, compliance with appropriate cUL or ULC reference standard, characteristics, limitations.

.2 Product transportation, storage, handling and installation requirements.

.3 Submit firestop and smoke seal manufacturer's Product data for materials and prefabricated devices, including manufacturer's printed installation instructions.

.2 Shop drawings:
.1 Submit shop drawings in accordance with Section 01 33 00 indicating:
.1 Fire rated and smoke sealed systems for each typical application.
.2 Construction details, accurately reflecting actual job conditions.
.3 ULC or Intertek Testing assembly listing.
.4 Each floor and wall assembly requiring firestop system with each corresponding ULC firestop system.

.3 Certification:
.1 Submit certified documentation from manufacturer for each worker performing Work of this Section.
.2 Submit installer's and Product manufacturer's certification verifying compliance with the Contract Documents and conformance with ASTM E814 and CAN/ULC S115.

1.6 QUALITY ASSURANCE

.1 Installers qualifications: Perform Work of this Section by a company that has a minimum of five years proven experience in the installation of firestopping and smoke seal Work of a similar size and nature and that is approved by manufacturer. Submit to Consultant, applicator’s current certificate of approval by the material manufacturer as proof of compliance.

.2 Manufacturer's direct representative and/or fire protection specialist shall be on-site during initial installation of firestop systems to train appropriate contractor personnel in proper selection and installation procedures conforming to manufacturer's written recommendations published in their literature and drawing details.

.3 Pre-construction meetings: Arrange with manufacturer's representative, Contractor, Consultant and Field Engineer to determine responsibility for handling such issues as FT rated partitions, firestop custom details, compatibility, mixed penetrations, and to review installation procedures 48 hours in advance of installation.

1.7 DELIVERY STORAGE AND HANDLING

.1 Deliver materials to Place of Work in manufacturer’s unopened containers, containing classification label with labels intact and legible at time of use.

.2 Do not use damaged or adulterated materials exceeding their expiry date.

1.8 SITE CONDITIONS

.1 Conform to manufacturer's requirements and maintain a minimum temperature of 5^0 C for a minimum period of 24 h before application, during, and until application is fully cured.

.2 Maintain sealant at a minimum 18E C for best workability.

2 Products

2.1 **ACCEPTABLE MANUFACTURERS**

.1 Acceptable manufacturers of rated systems include:
.1 AD Fire Protection Systems Inc.
.2 Hilti Canada Corporation.
.3 3M Canada Inc.
.4 Tremco Ltd.

2.2 **GENERAL SYSTEM REQUIREMENTS**

.1 All materials under Work of this Section, including but not limited to, primers and sealants are to have low VOC content limits.

.2 Do not use Products containing asbestos.

.3 Firestopping components shall not contain volatile solvents or require special application to protect plastic pipe from firestopping compound.

.4 Provide smoke seal sealant in following colours: Rust Red, unless indicated otherwise.

.5 Smoke sealant for overhead and vertical joints for floor to be self-levelling and non-sagging sealant.

.6 Smoke sealant at vertical through penetrations in areas with floor drains shall be waterproof type.

2.3 **MATERIALS**

.1 Following materials have been provided for convenience. Contractor shall provide complete system with all components and accessories as required for fire resistant and smoke seal installation.

.2 Firestop sealant: single component, low modulus, silicone rubber, moisture curing sealant to ASTM C920, ULC labelled to CAN/ULC S115.

.3 Pre-Installed firestop devices for use with non-combustible and combustible pipes, conduit and/or cable bundles penetrating concrete floors and walls.
.1 Cast-in place firestop device complete with aerator adaptor when used in conjunction with aerator system. Model CP 680-P by Hilti or approved alternative.
.2 Cast-in place firestop device for use with noncombustible penetrants. Model CP 680-M by Hilti or approved alternative.

.3 Speed sleeve for use with cable penetrations. Model CP 653 by Hilti or approved alternative.
.4 Firestop block. Model CFS-BL by Hilti or approved alternative.

.4 Re-penetrable, round cable management devices for use with new or existing cable bundles penetrating walls:
.1 Speed sleeve with integrated smoke seal fabric membrane. Model CP 653 by Hilti or approved alternative.
.2 Firestop Sleeve. Model CFS-SL SK by Hilti or approved alternative.
.3 Retrofit sleeve for use with existing cable bundles. Model CFS-SL RK by Hilti or approved alternative.
.4 Gangplate for use with multiple cable management devices. Model CFS-SL GP by Hilti or approved alternative.
.5 Gangplate Cap for use at blank openings in gangplate for future penetrations. Model CFS-SL GP CAP by Hilti or approved alternative.

.5 Firestop insulation: to CAN/ULC S702, Type 2; mineral fibre manufactured from rock or slag, suitable for manual application.
.1 Density: Minimum 64 kg/m^3 when tested to ASTM C303.
.2 Combustibility: Noncombustible to CAN/ULC S114.
.3 Melt temperature: >1175 degrees C.
.4 Surface burning characteristics: to CAN/ULC S102, maximum flame spread of 0, smoke developed of 0.
.5 Moisture Absorption: 0.04 percent when tested to ASTM C1104.
.6 Smoulder Resistance: 0.01 percent when tested to CAN/ULC S129.

.6 Damming, back-up, supports, and anchorage: In accordance with manufacturer's fire rated systems and to acceptance of authorities having jurisdiction.

.7 Primer: As recommended by firestopping sealant manufacturer.

3 Execution

3.1 EXAMINATION

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

.2 Verify that substrates and surfaces to receive firestopping and smoke seals are clean, dry, and frost free.

3.2 PREPARATION

.1 Prepare, modify, and adjust void sizes, proportions, and conditions to conform to fire rated and smoke sealed assembly requirements such as assembly opening size and dimensional restrictions.

.2 Clean surfaces to remove material detrimental to bond including dust, paint, rust, oil, grease, moisture, frost and other foreign matter to manufacturers recommendations.

.3 Mask adjacent surfaces to avoid spillage and over-coating of adjacent surfaces. Remove stains from adjacent surfaces.

3.3 INSTALLATION

.1 Install firestopping and smoke seal systems in accordance with reviewed Shop Drawings, manufacturer's instructions and fire rated assembly to establish continuity and integrity of fire separations.

.2 Install firestop insulation in compacted thicknesses required by ULC design. Compress insulation approximately 50 percent.

.3 Install primers as recommended by firestop and smoke seal Product manufacturers.

.4 Install temporary forming, damming, back-up as required, remove after materials have achieved initial cure and will resist displacement.

.5 Install firestop and smoke seal filler in horizontal joints providing 25% compression fit.

.6 Use resilient, elastomeric firestopping and smoke seal systems in following locations:
- .1 Openings and sleeves for future use.
- .2 Penetration systems subject to vibration or thermal movement.
- .3 Penetration systems in acoustical containment enclosures.

.7 Trowel and tool exposed firestop and smoke seal. Product surfaces to uniform, smooth finish..

.8 Seal joints to ensure an air and water resistant seal capable of withstanding compressions and extensions due to thermal wind or seismic joint movement.

.9 Taped joints will not be acceptable.

.10 Repair damaged firestopped and smoke sealed surfaces to acceptance of Consultant.

.11 Identify each firestop and smoke seal penetration assembly with permanent label listing following:
- .1 Assembly and rating in hours.
- .2 Date of installation.
- .3 Installing company's name and telephone number.

.12 Do not cover materials until full cure has taken place.

3.4 INSPECTION AND TESTING

.1 Inspection of through-penetration firestopping shall be performed in accordance with ASTM E2174 to ensure that firestopping and smoke seals have been installed in accordance with Contract documents and to tested and listed firestop system.

3.5 CLEAN-UP

.1 Clean all surfaces adjacent to sealed holes and joints to be free of excess firestop materials and soiling as work progresses.

.2 Remove excess materials and debris immediately after application.

3.6 SCHEDULE OF FIRESTOP AND SMOKE SEAL LOCATIONS

.1 Following firestop and smoke seal location schedule is included for convenience and may not be complete. Examine Contract Drawings and other specification sections and determine entire extent of Work of this Section. Generally provide systems with required fire and smoke ratings at following locations:

.1 Gaps at intersections of fire-resistance rated walls and partitions.
.2 Control and sway joints in fire-resistance rated walls and partitions.
.3 Gaps at top of fire-resistance rated partitions and walls.
.4 Penetrations through fire-resistance rated walls and partitions including mechanical and electrical services and openings and sleeves for future use.
.5 Penetrations through fire-resistance rated floor slabs, ceilings, and roofs.
.6 Gaps at edge of floor slabs at exterior walls.
.7 Perimeter of retaining angles on rigid ducts greater than 0.012 m^2, firestopping material between retaining angle and fire separation and between retaining angle and duct, on each side of fire separation.
.8 Where indicated on drawings.
.9 At non-rated assemblies that require a smoke seal.
.10 Where required by Ontario Building Code.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services necessary for sealant Work in accordance with the Contract Documents.

.2 Work of this Section does not include sealants in firestopping and smoke sealed assemblies.

.3 Work of this Section does not include sealant work identified in individual specification sections.

1.2 **REFERENCES**

.1 ASTM C834, Specification for Latex Sealants.

.2 ASTM C920, Specification for Elastomeric Joint Sealants.

.3 ASTM C1330, Specification for Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants.

1.3 **SUBMITTALS**

.1 Product data: Submit copies of Product data in accordance with Section 01 33 00 describing type, composition and recommendations or directions for surface preparation, material preparation and material installation.

.2 Samples:
.1 Submit following samples in accordance with Section 01 33 00.
.1 Two samples of sealant/caulking, for colour selection.
.2 Two samples of back-up material and primer for physical characteristics.

1.4 **QUALITY ASSURANCE**

.1 Qualifications: Work of this Section shall be executed by trained applicators approved by sealant manufacturer and having a minimum of 5 years proven experience.

1.5 **SITE CONDITIONS**

.1 Do not install materials when ambient air temperature is less than 5EC, when recesses are wet or damp.

.2 Install materials to manufacturer's recommendations.

1.6 **DELIVERY, STORAGE AND HANDLING**

.1 Arrange delivery of materials in original, unopened packages with labels intact, including batch number, and ensure that on-site storage is kept to a minimum. Do not store materials on site where there exists any danger of damage from moisture, direct sunlight, freezing and other contaminants.

1.7 **EXTENDED WARRANTY**

.1 Submit an extended warranty for Sealant Work in accordance with General Conditions, except that warranty period is extended to 2 years from date of Substantial Performance of the Work.
- .1 Warrant against leakage, cracking, crumbling, melting, shrinkage, running, loss of adhesion and staining adjacent surfaces.
- .2 Coverage: Complete replacement including affected adjacent Work.

2 Products

2.1 **MATERIALS**

.1 General:
- .1 All materials under Work of this Section, including but not limited to, primers and sealants are to have low VOC content limits.
- .2 Use materials as received from manufacturers, without additives or adulterations. Use one manufacturer's Product for each kind of Product specified.

.2 Sealant **Type A**: ASTM C920, Type S, Grade NS, Class 25; One-part, non-sag type, silicone sealant, in standard colours selected.
- .1 'DC CWS' by Dow Corning Inc.
- .2 'Sikasil 305CN' by Sika.
- .3 'Tremsil 400' by Tremco..

.3 Sealant **Type B**: ASTM C920, Type S, Grade NS; One-part mildew-resistant silicone, in standard colours selected.
- .1 '786 Mildew Resistant Silicone Sealant' by Dow Corning Inc.
- .2 'Sikasil GP Mildew Resistant' by Sika.
- .3 'Tremsil 200 Silicone Sealant' by Tremco Ltd.

.4 Sealant **Type C**: ASTM C834; Pure acrylic siliconized sealant; in standard white colour (paintable).
- .1 'Tremflex 834 Silconized Sealant' by Tremco Ltd.

2.2 **ACCESSORIES**

.1 Primers: Type recommended by material manufacturers for various substrates, primers to prevent staining of adjacent surfaces encountered on project.

.2 Joint backing: ASTM C1330; Round, solid section, closed cell, skinned surface, soft polyethylene foam gasket stock, compatible with primer and sealant materials, 30 to 50% oversized, Shore A hardness of 20, tensile strength 140 to 200 kPa. Bond breaker type surface.

.3 Bond breaker: Type recommended by material manufacturers.

.4 Void filler around the window frames to be one part expanding polyurethane foam.

.5 Cleaning agents: As recommended by material manufacturer, non-staining, harmless to substrates and adjacent finished surfaces.

2.3 **MIXING**

.1 Follow manufacturers instructions on mixing, shelf and pot life.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

3.2 **PREPARATION**

.1 Protect adjacent exposed surfaces to prevent smearing, staining or other damage, by masking or other means, prior to performing Work. Make good any damage caused by sealant application. Remove protection upon completion and clean adjacent, exposed surfaces of any compound deposited upon such surfaces.

.2 Erect scaffolding and rigging required to perform sealant Work in accordance with reviewed Shop Drawings.

.3 Prepare joints to receive sealants to manufacturer's instructions. Ensure that joints are clean and dry and ferrous surfaces are free from rust and oil.

.4 Clean recesses to receive sealant, to be free of dirt, dust, loose material, oil, grease, form release agents and other substances detrimental to sealant's performance.
- .1 Remove lacquer or other protective coatings from metal surfaces, without damaging metal finish, using oil-free solvents. Remove rust, mill scale and coatings from ferrous metals by wire brush, grinding or sand blasting.
- .2 Ensure recess is dry.
- .3 Do not apply sealants to joint surfaces treated with sealer, curing compound, water repellent, or other coatings. Remove incompatible coatings as required.

.5 Ensure that all materials in contact with sealant are compatible. Test substrate for adhesion.

.6 Depth of recess: Maintain depth to 2 joint width up to a maximum of 13 mm and not less than 6 mm at centre of joint. For greater depth, use joint backing under. Where recess is less than specified depth, cut back surface of recess to specified recess depth.

.7 Install polyethylene backing rod in joints 6 mm or more in width. Roll backing rod into joint. Do not stretch or bend backing rod. Install bond breaker to back of recess.

.8 Prime sides of recess, in accordance with sealant manufacturer's instructions.

.9 Condition products for use in accordance with manufacturer’s recommendations.

3.3 **INSTALLATION**

.1 Apply sealant immediately after adjoining Work is in condition to receive such Work. Apply sealant in continuous bead using gun with correctly sized nozzle. Use sufficient pressure to evenly fill joint.

.2 Ensure sealant has full uniform contact with, and adhesion to, side surfaces of recess. Superficial painting with skin bead is not acceptable. Tool sealant to smooth surface, free from ridges, wrinkles, sags, air pockets, embedded impurities, dirt, stains or other defects.

.1 At recesses in angular surfaces, finish sealant with flat profile, flush with face of material at each side.

.2 At recesses in flush surfaces, finish compound with concave face, flush with face of material at each side.

.3 Make sealant bead uniform in colour.

.4 Cure sealants in accordance with sealant manufacturer's instructions. Do not cover up sealants until proper curing has taken place.

.5 Immediately remove excess compound or droppings which would set up or become difficult to remove from adjacent finished surfaces, using recommended cleaners, as work progresses. Do not use scrapers, chemicals or other tools which could damage finished surfaces. Remove defective sealant.

.6 Clean recesses and re-apply sealant.

.7 Remove masking tape immediately after joints have been sealed and tooled.

3.4 CLEANING

.1 Clean surfaces adjacent to joints, remove sealant smears or other soiling resulting from application of sealants. At metal surfaces, remove residue. Do not mar or damage finishes on materials adjacent to joints. Repair or replace marred or damaged materials.

3.5 SCHEDULE OF LOCATIONS

.1 Following sealant location schedule is included for convenience and may not be complete. Examine Contract Drawings and other specification sections and determine entire extent of Work of this Section. Generally seal following locations:
- .1 Concrete, masonry and wood to metal.
- .2 Wood to masonry and concrete.
- .3 Metal to metal.
- .4 All dissimilar materials.
- .5 Where ‘sealant’ or ‘caulking’ is indicated on drawings.

.2 Sealant **Type A**:
- .1 Exterior joints between masonry and steel or aluminum.
- .2 Exterior joints between masonry and shelf angle.
- .3 Exterior joints between steel or aluminum and concrete or masonry.
- .4 Interior and exterior control joints, except in floors.
- .5 Door frames, louvre frames, interior and exterior side.
- .6 Protrusions through interior and exterior walls and floors, interior and exterior side, except where fire rated seals are required.
- .7 Seal thresholds.

.3 Sealant **Type B:**
- .1 Control joints in tiled areas.
- .2 Between vanity and tile.
- .3 Between vanity and mechanical fixtures/fittings.
- .4 Between access panels and tile.
- .5 Between tiles and adjacent materials.

.4 Sealant **Type C:**
- .1 Perimeter of kitchen counters.
- .2 Perimeter of interior windows.
- .3 Perimeter of firehose cabinets.
- .4 Junction between drywall and masonry.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services necessary for the metal doors and frames Work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 ASTM A653/A653M, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.

.2 ASTM A568/A568M, Specification for General Requirements for Steel, Carbon and High-Strength Low-Alloy, Hot-Rolled Sheet and Cold-Rolled Sheet.

.3 CAN4-S104M, Standard Method for Fire Test of Door Assemblies.

.4 CAN4-S105M, Standard Specification for Fire Door Frames, Meeting the Performance Required by CAN4-S104M.

.5 CAN/CGSB-1.198, Cementitious Primer, (for Galvanized Surfaces).

.6 CGSB 41-GP-19Ma, Rigid Vinyl Extrusions for Windows and Doors.

.7 CAN/ULC-S702, Thermal Insulation, Mineral Fibre for Buildings.

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

.9 CSA W59-M, Welded Steel Construction (Metal Arc Welding).

.10 NFPA 80, Standard for Fire Doors and Other Opening Protectives.

1.3 **DESIGN REQUIREMENTS**

.1 Design exterior frame assemblies to accommodate expansion and contraction when subjected to minimum and maximum surface temperature of -35 degrees Celsius to 35 degrees Celsius.

1.4 **SUBMITTALS**

.1 Product data: Submit manufacturer's Product data in accordance with Section 01 33 00 indicating door and frame construction.

.2 Shop drawings:
- .1 Submit shop drawings in accordance with Section 01 33 00 for each type of door and frame indicating:
  - .1 Thickness and type of steel.
  - .2 Thickness and type of core.

.3 Thickness and type of steel stiffeners and location of them within the door.

.4 Thickness and type of metal facing on edges of door and method of fastening.

.5 Location of mortises, reinforcement, anchorages, joining, welding, sleeving, exposed fasteners, openings and arrangement for hardware.

.2 Include schedule identifying each unit with door marks and numbers relating to numbering on Contract Drawings and in door schedule. Indicate doors and frames to be fire rated.

1.5 **QUALITY ASSURANCE**

.1 Perform Work in accordance with requirements by a member of the Canadian Steel Door and Frame Manufacturers Association.

.2 Label and list fire rated doors and frames by an organization acceptable to authorities having jurisdiction and accredited by the Standards Council of Canada in conformance with CAN4-S104M and CAN4-S105M for ratings indicated, Labelling shall be in accordance with NFPA 80.

2 Products

2.1 **ACCEPTABLE MANUFACTURERS**

.1 Baron Metal Industries Inc.

.2 Daybar Industries Limited

.3 Fleming Doors Products.

.4 Vision Hollow Metal Ltd.

2.2 **MATERIALS**

.1 General: All materials under Work of this Section, including but not limited to, primers are to have low VOC content limits.

.2 Steel: ASTM A568/A568M, Class 1; Commercial grade steel, hot dip galvanized to ASTM A653/A653M, ZF120 galvanized coating.

.3 Minimum base steel thickness:

.1	Frames	1.6 mm
.2	Typical doors	1.2 mm
.3	Lock/strike reinforcements	1.6 mm
.4	Hinge reinforcements	2.7 mm
.5	All other reinforcement	1.6 mm
.6	Top and bottom channels	1.2 mm
.7	Glazing stops	0.9 mm

.8	Guard boxes	0.9 mm
.9	Jamb spreaders	0.9 mm

.4 Top caps and thermal breaks: CGSB 41-GP-19Ma; Rigid PVC extrusions.

.5 Primer: CAN/CGSB 1.198.

.6 Core material:
- .1 Interior doors: Mineral fibre insulation with a minimum face density of 24 kg/m^3.
- .2 Exterior doors: Rigid poly/isocyanurate, closed cell insulation, 32 kg/m^3, thermal value: RSI 1.9.
- .3 Fire rated doors: Mineral fibre insulation to CAN/ULC S702, Type 1A; 24 kg/m^3.

.7 Screws: Stainless steel screws with countersunk flat head.

.8 Door silencers: Type 6-180, black neoprene.

.9 Frame anchors:
- .1 Frames in masonry: 1.2 mm minimum, adjustable T-strap jamb anchors.
- .2 Labelled frames: In accordance with ULC requirements.

.10 Floor anchors: 1.6 mm minimum adjustable floor clip angles with 2 holes for anchorage to floor.

.11 Labels for fire doors and door frame: Brass plate, riveted to door and door frame.

.12 Glass and glazing: In accordance with Section 08 80 00.

2.3 FABRICATION

.1 General
- .1 Fabricate doors and frames in accordance with reviewed shop drawings.
- .2 Welding: CSA W59-M to produce a finished unit with no visible seams or joints, square, true and free of distortion.
- .3 Welding: Continuous unless specified otherwise. Execute welding by a firm fully acceptable to the Canadian Welding Bureau to requirements of CSA W47.1.
- .4 Form profiles accurately to details shown on Contract Drawings.
- .5 Ream and remove burrs from drilled and punched holes.
- .6 Grind welded corners and joints to a flat plane and fill with metallic filler and sand to a uniform smooth finish. Apply one coat of primer.
- .7 Provide weather strip for exterior doors in accordance with Section 08700 and door manufacturer.

.2 Frames, windows, and screens:

.1 Fabricate frames of welded construction. Cut mitres and joints accurately and weld continuously on inside of frame profile. Exterior frames to be thermally broken.

.2 Construct large frame sections with provision for on Site assembly to suit Site conditions.

.3 Blank, reinforce, drill and tap frames for mortised, templated hardware. Protect mortised cut-outs with guard boxes.

.4 Reinforce frames where required for surface mounted hardware.

.5 Reinforce frames over 1200 mm wide with roll formed steel channels or hollow structural sections specified in Section 05 50 00 and as indicated on drawings.

.6 Furnish exterior door frames with a continuously welded integral steel weather drip at head of frame.

.7 Prepare each door opening for single stud rubber door silencers, 3 for single door openings located in strike jamb, and 2 for double door openings located in head.

.8 Install 2 channel or angle spreaders per frame, to ensure correct frame alignment. Install stiffener plates or spreaders between frame trim where required, to prevent bending of trim and to maintain alignment when setting in place.

.9 Form channel glazing stops minimum 16 mm height, accurately cut, mitred, fitted and fastened to frame sections with stainless steel counter-sunk, flat head screws spaced at maximum 450 mm throughout and 50 mm from each end.

.3 Anchorage:

.1 Anchor units to floor and wall construction. Locate each wall anchor immediately above or below each hinge reinforcement on hinge jamb and directly opposite on strike jamb, minimum number of anchors for each jamb:

.1 Frames up to 2285 mm 3 anchors.

.2 Frames from 2285 mm to 2440 mm 4 anchors.

.2 Where frames are to be set in masonry or concrete, supply adjustable anchors to trade installing frame.

.4 General Door Requirements:

.1 Hollow steel construction, flush swing type, of sizes to conform to details, schedules and reviewed shop drawings with provisions for cut-outs for glass and reinforced to receive hardware fastenings.

.2 Blank, reinforce, drill and tap doors for mortised, templated hardware. Where required, reinforce doors for surface mounted hardware and door closers.

.3 Reinforce oversized doors with steel channels and plates specified in Section 05 50 00 and as indicated on drawings.

.4 Where openings are required, form integral cut-outs with framing, glass stop moldings and division bars.

.5 Bevel both stiles of single doors 1 in 16.

.6 Reinforce doors with galvanized metal stiffeners at 150 mm o.c.

.5 Interior Doors:
- .1 Supply and install inverted, recessed, mechanically interlocked with tack welded channels at top and bottom of doors.
- .2 Fabricate doors with joints between front and back panels meeting on stile edges. Make joints mechanically interlocked and tack welded for entire height of door. After welding has been completed, grind joints smooth to match metal. Ensure that no filler is used in joints.
- .3 Fill hollow space within door and vertical stiffeners from top to bottom with mineral fibre batt insulation.

.6 Exterior Doors:
- .1 Supply and install inverted, recessed, mechanically interlocked with tack welded channels at top and bottom of doors. Supply and install PVC top caps.
- .2 Fabricate doors with joints between front and back panels meeting on stile edges. Make joints mechanically interlocked and tack welded for entire height of door. After welding has been completed, grind joints smooth to match metal. Ensure that no filler is used in joints.
- .3 Fill hollow space within door from top to bottom with rigid polyisocyanurate insulation.

.7 Fire Rated Doors:
- .1 Supply and install inverted, recessed, spot welded channels at top and bottom of doors. Supply and install steel flush top caps on exterior doors.
- .2 Fabricate doors with joints between front and back panels meeting on stile edges. Make joints mechanically interlocked and tack welded for entire height of door. After welding has been completed, grind joints smooth to match metal. Ensure that no filler is used in joints.
- .3 Fabricate doors to achieve fire rating as indicated on drawings and in accordance with ULC. Provide ULC label plate on door at hinged edge midway between top hinge and head of door.

3 Execution

3.1 EXAMINATION

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

3.2 HOLLOW METAL DOOR, FRAME, WINDOW AND SCREEN INSTALLATION

.1 Install hollow metal doors, frames, windows, and screens plumb, square, level, secure, and at correct elevation.

.2 Install doors clear of floor finishes, and with the correct rebate opening for the door installation. Install door silencers.

.3 Secure anchorages and connections to adjacent construction. Brace frames rigidly in position while building-in. Remove temporary steel shipping jamb spreaders. Install wood spreaders at third points of frame rebate height to maintain frame width. Supply and install vertical supports as indicated on drawings for openings over 1200 mm in width. Remove wood spreaders after frames have been built-in.

.4 Allow for structural deflection and prevent structural loads from being transmitted to hollow metal frames.

.5 Touch-up areas where galvanized coating has been removed or damaged with primer.

.6 Install fire rated doors and frames in accordance with requirements of NFPA 80.

3.3 ADJUSTING AND CLEANING

.1 Adjust doors for smooth and balanced door movement.

.2 Clean doors, frames and screens.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services necessary for the wood doors Work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 ANSI A208.1, Particleboard.

.2 AWMAC, Architectural Woodwork Manufacturers' Association of Canada. Quality Standards for Architectural Woodwork.

.3 CSA O112 Series, Wood Adhesives.

.4 CAN4 S104-M, Standard Method for Fire Tests of Door Assemblies.

.5 CAN4 S105-M, Fire Door Frames.

.6 NFPA 80, Standard for Fire Doors and Other Opening Protectives.

1.3 **SUBMITTALS**

.1 Shop drawings: Submit shop drawings of wood doors in accordance with Section 01300 indicating detail thicknesses, core construction, veneers, finish, door sizes, quantities, fastenings and finishes.

.2 Samples: Submit the following samples in accordance with Section 01300:
.1 Two minimum 300 x 300 mm door samples for each type of finish and cut-a-way corners showing construction and materials.

1.4 **QUALITY ASSURANCE**

.1 Perform Work in accordance with requirements of AWMAC, Quality Standards for Architectural Woodwork, Premium Grade, except as indicated otherwise.

.2 Label and list fire rated doors by an organization accredited by the Standards Council of Canada in conformance with CAN4 S104-M and CAN4 S105-M for ratings indicated.

1.5 **DELIVERY, STORAGE, AND HANDLING**

.1 Deliver, store, and handle wood doors in accordance with the AWMAC Quality Standards amended as follows:
.1 Wrap wood doors individually in protective wrapping for shipment and Site storage.
.2 Handle wood doors carefully to prevent damage; replace damaged doors.

.3 Store doors flat on a dry, level surface. Ventilate and maintain recommended relative humidity before, during and after installation.

2 Products

2.1 **MATERIALS**

.1 General: All materials under Work of this Section, including but not limited to, adhesives are to have low VOC content limits.

.2 Wood doors (solid core):
- .1 5 ply wood door: As manufactured by Baillargeon Doors Inc. or Lambton Doors.
- .2 Core: To ANSI A208.1, minimum density 513 kg/m^3 minimum, sanded faces, of thickness to fill void. Extruded particle board cores with voids are not permitted.
- .3 Rails:
  - .1 Top: 35 mm structural composite lumber.
  - .2 Bottom: 35 mm structural composite lumber.
- .4 Stiles
  - .1 16 mm hardwood laminated to 19 mm structural composite lumber.
  - .2 Edge detail: AWMAC No.2.
- .5 Crossbanding: 1.6 mm thick minimum wood based composite.
- .6 Door facing: 1.5 mm birch Veneer in **Lambton 'Indonesian Teak PLS-102'**

.3 Wood doors (fire rated):
- .1 'Fire Door Series' by Baillargeon Doors Inc. or 'Fire Door' by Lambton Doors.
- .2 Core: Fire rated mineral core.
- .3 Internal blocking: AWMAC Option #3; Manufacturers' standard fire resistant blocking.
- .4 Rails:
  - .1 Top: 20 mm minimum.
  - .2 Bottom: 45 mm, 70 mm where drop seal occurs, minimum.
- .5 Stiles:
  - .1 Hinge: 19 mm minimum.
  - .2 Lock: 19 mm minimum..
- .6 Crossbanding: 1.5 mm thick HDF composite.
- .7 Door facing: 1.5 mm birch Veneer in **Lambton 'Indonesian Teak PLS-102'**

.4 Edge finish: To match door facings.

.5 Adhesive: CSA O112 Series, Type I; Waterproof.

.6 Grilles: Corrosion resistant steel with baked enamel finish. Model 61DG Series by Nailor Industries Inc or approved alternative by Hart and Cooley.

.7 Door Frames:
- .1 Metal door frames in accordance with Section 08100.
- .2 Wood door frames in accordance with Section 06200.

.8 Glass and glazing: In accordance with Section 08800.

2.2 FABRICATION

.1 Fabricate doors to sizes indicated on drawings.

.2 Fabricate doors square, true, and free from distortion waves, ridges or core ghost lines. Factory machine doors for finish hardware and flooring.

.3 Fabricate doors using hot press construction technology. Bond stiles and rails to core using adhesive. Sand for uniform thickness. Laminate door facing and trim, to assembled core in hot press.

.4 Cut and bevel stile edges as follows:
.1 Lock side: 3 mm in 50 mm.
.2 Hinge side: 1.5 mm in 50 mm.

.5 Finish wood doors in factory and deliver to site ready for hanging.

2.3 **FIRE RATED DOORS**

.1 Fabricate and label fire rated wood doors with fire protection rating indicated on door schedule.

3 Execution

3.1 **INSTALLATION**

.1 Install doors plumb, rigid, square, clear of floor finishes, and with correct rebate opening for door installation.

.2 Conform to requirements of AWMAC Quality Standard, for wood door installation.

.3 Install door grilles plumb and level, where indicated.

3.2 FIRE RATED DOORS

.1 Install fire rated doors in accordance with the requirements of ULC and NFPA 80.

3.3 ADJUSTING AND CLEANING

.1 Replace the following wood doors:
- .1 Warped more than 3 mm, measured at any point on door, relative to perfectly flat surface.
- .2 Core telegraphing visible at 1500 mm distance, under final Site lighting conditions.

.2 Adjust doors for smooth and balanced door movement.

END OF SECTION

GENERAL

1.1 RELATED DOCUMENTS

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

2. Basis of Design is Door Engineering and Manufacturing Company, Tel: 1-800-959-1352 “Four- Fold” Metal Door, Model FF300. Equipment and Four-Fold Doors of other manufacturers shall equal or exceed specified manufacturer's standard.

1.2 SUMMARY

1. This Section includes four-fold metal doors with surface mounted tube frames; motorized.

2. Operation of Four-Fold metal doors includes overhead mounted electro-mechanical operators.

1.3 SUBMITTALS

1. Submit under provisions of Section 01330. Shop drawings shall bear the stamp and signature of the Engineer, responsible for the design of the work of this Section.

2. Shop drawings shall clearly show door assemblies, hardware, operating components including adjacent construction. Show elevations, sections and details of door, hardware and operating components, dimensions, gauges, anchor details, finishes and relationship of door, hardware, and operating components to adjacent construction.

3. Shop drawings shall be of best quality craftsmanship, specifically prepared on standard size drawing sheet.

4. Door manufacturer shall provide complete installation instructions for doors and hardware.

5. Provide Manufacturer's Certificate indicating that the doors are installed in accordance with the drawings, the specifications and meet or exceeds specified requirements.

6. Verification Samples: For each colour specified, provide two samples, minimum size 6 inches (150 mm) square representing actual product and color.

7. Provide **reference** list including (5) successful installations of this type of door within the past two (2) years.

8. Product Data: Manufacturer's data sheets on each product to be used, including:

    1. Preparation instructions and recommendations.

    2. Storage and handling requirements and recommendations.

    3. Installation methods.

    4. Operation and Maintenance Data

1.4 DESIGN / PERFORMANCE REQUIREMENTS

1. Wind Loads: Design and size components to withstand loads caused by pressure and suction of wind acting normal to plane of wall as indicated under 1.5.1 below. Doors must be designed to meet **post-disaster** requirements. Shop drawings shall bear the stamp and signature of the Engineer, responsible for the design of the work of this Section.
2. Wiring Connections: Requirements for electrical characteristics.

    1. 208 volts, single-phase.

3. Single-Source Responsibility: Provide doors, tracks, motors, and accessories from one manufacturer for each type of door. Provide secondary components from source acceptable to manufacturer of primary components.

1.5 QUALITY ASSURANCE:

1. Doors shall be designed to withstand external or internal horizontal wind loads of 30 psf minimum in order to meet post-disaster requirements.

2. Door manufacturer shall have at least 10 years experience in manufacturing door type specified for applications of similar type in this section.

3. Installer Qualifications: Authorized representative of the manufacturer with minimum five years documented experience.

1.6 DELIVERY, STORAGE & HANDLING

1. Store delivered materials and equipment in dry locations with adequate ventilation, free from dust and water; in such way as to permit access for inspection and handling.

2. Handle materials carefully to prevent damage.

1.7 PROJECT CONDITIONS

1. Pre-Installation Conference: Convene a pre-installation conference just prior to commencement of field operations, to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work.

1.8 WARRANTY

1. The door manufacturer shall provide a written standard limited warranty for material and workmanship.

2 PRODUCTS

2.1 MANUFACTURER

3 Standard of Acceptance: Doors manufactured by Door Engineering Four-Fold Doors (Model FF330) as distributed by Northern Dock Systems Inc. which is located at 415 Ambassador Dr., Mississauga, Ontario L5T 2J3; Tel: 416-891-9345; Email arussell@northerndocksystems.com. Equipment and doors of other manufacturers shall equal or exceed specified manufacturer's standard.

4 Alternates will be considered by the Architect provided they meet the requirements indicated under Item 1.5.2 and Item 1.5.3 under Quality Assurance.

2.3 PERFORMANCE / DESIGN REQUIREMENTS

1. Exterior door construction shall be designed to withstand wind load as indicated under item 1.5.1.

2.3 MATERIALS

1. General:

    a. Single-source responsibility: Provide doors, tracks, motors, and accessories from one manufacturer for all doors. Provide secondary components from source acceptable to manufacturer of primary components.

2. Steel:

    a. Steel Tube: ASTM A513 and ASTM A500/A500M.

    b. Steel Sheets: Steel sheets of commercial quality, complying with ASTM A1011/A1011M hot-rolled steel sheet.

5 Hardware: Door manufacturer’s standard heavy duty hardware components, galvanized.

4. Fasteners: Zinc-coated steel.

2.3 FOUR-FOLD METAL DOORS

1. **Four-Fold Doors**: Manufactured by Door Engineering as distributed by Northern Dock Systems Inc. Model FF330 Four-Fold Metal Doors Operation shall be as indicated and include sections, track, operators, controls, and hardware to suit finished door opening and headroom available

2. Construction: Door framing shall be minimum 11-gauge structural steel tube with 14-gauge steel sheet on the exterior and interior faces. Sheeting shall be formed on the vertical edges with no visible welds on the interior or exterior panel faces. All frames and framing members shall be true to dimension and square in all directions, and no door shall be bowed, warped, or out of line, in the vertical or horizontal plane of the door opening by more than 1/8 inch in 20 feet. Exposed welds and welds which interfere with the installation of various parts shall be ground smooth and flush.

3. Surface Mounted Tube Frame: Supply pre-hung tube frame system constructed of minimum TS6x4x3/16", designed to anchor to masonry wall construction or weld to steel structure. All hinges, track supports, and operator supports shall be factory attached.

    A. Factory finish: Door Panels and Tube Frames shall be finished with manufacturer's standard PPG Spectracron epoxy primer and polyurethane topcoat. Customer to select from Manufacturer's standard color chart or furnish sample to match.

        1. Operator and operating hardware shall be powder-coated manufacturer's standard gray.

4. Hardware: Hardware shall include guide tracks and brackets, trolleys, center guides, not less than three pairs of jamb and fold hinges per opening, and all bolts, nuts, fasteners, etc. necessary for complete installation and operation.

    a. All hardware, including hinges and trolleys, shall be bolted to the panel for easy removal for service or panel replacement.

    b. Top tracks shall be adjustable on the end track hangers to allow for adjustment of the door panels in the open position and easily replaceable without removal of the door framing or operators.

5. Door panels thickness: 50mm (2") minimum.

6. Hinges: Jamb hinges shall be dual shear and have two thrust bearings and two needle bearings. Fold hinges shall be stainless steel and be dual shear with two thrust bearings. All bearings shall be completely concealed within the hinge barrel and include grease zerks. All hinge pins shall be minimum ¾" diameter hardened steel.

7. Hinge Guards: Provide plastic guards at jamb hinges to prevent access through hinge space.

8. Weather-stripping: Material shall be adjustable and readily replaceable and provide a substantially weather-tight installation. Weatherstripping at center shall be 1/16" cloth inserted neoprene and include no exposed fasteners on the exterior face of the panel. Weatherstripping at sill shall include two 1/16" cloth inserted neoprene sweeps with an aluminum retainer. The retainer shall be attached to the door with adhesive.

9. Perimeter Weatherstripping: Provide jamb and head weatherstripping of 1/16" cloth-inserted neoprene bulb (or closed cell neoprene).

10. Vision Panels: Provide 1" insulated, tempered, vision panels of the size, shape and location as noted on the drawings. Quantity per opening: (8).

    a. Glazing Type: 1" Insulated tinted gray, Tempered safety glass. Pilkington's Energy Advantage Low-E or Equivalent.

11. Door Stiles for Each Door Panel: Refer to drawings for bottom rail, mid rail, top rail and side rail dimensions. Noted dimensions include window frames. Bottom 24" of each panel to be solid.

2.4 OPERATOR

1. Door opening speed: 0.6096 mm/s (2 fps).

2. Each Four-Fold door shall be operated by an overhead mounted electro-mechanical drive unit designed for high cycle operation. Operator consists of an electric motor, gear reducer, and rotating drive arm. The door shall be operated with connecting rods attached to the rotating drive arm on the operator and to control arms attached to the jamb door section and to the door lintel. The connecting rods shall be positive drive, keeping the door under firm control at all times. The connecting rods shall be fitted with spherical bearings and control arms shall be equipped with oil impregnated bronze bearings on polished shafts.

3. Operator shall be instantly reversible, open and close rapidly and start and stop gradually. Operator shall be adjustable to allow door to fully clear the opening. Operator shall automatically lock the door in the closed position. Operator shall be equipped with disengaging mechanism to convert to manual operation.

4. Electric motor shall be of sufficient size to operate doors under normal operating conditions at no more than 75 percent of rated capacity. The motor shall be wound for three phase 208V operation.

4. Electric Controls: Controls shall be furnished by the door manufacturer and shall be complete for each door and built-in accordance with the latest NEMA standards. Incoming electrical shall be 208V, Single or Three-phase based on site conditions. Site conditions to be confirmed by door installer.

    1. Controls shall include a programmable logic controller with digital message display. Controller shall include programmable close timers and programmable inputs/outputs.

    2. Motor shall be controlled by frequency converter with overload and under voltage protection. Motor shall have integrated brake system. All control components shall be enclosed in motor housing unit with wiring diagram placed on inside panel.

    3. If incoming voltage is single phase, control panel shall include a variable frequency drive to convert voltage to 3-phase for the motor.

    4. Control Panel enclosure shall be NEMA 4 with disconnect switch. The control panel shall be mounted in location as shown on drawings on Apparatus Bay side wall.

    5. Each door will require 1 – surface mount three-button push-button station marked “OPEN”, “CLOSE” and “STOP” positioned in location as shown on Apparatus Bay drawings. Push button enclosure shall be NEMA 4.

    6. Limit switches shall be provided to stop the travel of the door in its fully open or fully closed position.

    7. Safety edges: Provide wired safety edges on leading edge of all doors to reverse door upon contact with obstruction complete with a low battery alarm.

    8. Photo eyes: Provide (1) exterior, jamb mounted, light Curtain type photo eyes, NEMA 4 rated. Photo eye shall cover from floor level to 72” above floor.

9. Presence Sensor: Provide (1) interior, overhead mounted, presence sensor with pre-open and pre-close safety fields. Sensor shall be LZR-Widescan or equal.

10. Timer to Close: Timer to close will be activated once the light Curtain type photo eyes has been broken.

11. Radio controls: Provide one (1) radio receiver per and (1) single/two/three button remotes equal to the number of doors at each site. Remotes to open and close doors with single button.

12. Keypad Activation: Front & Rear Four Folds Doors are to have Exterior Keypad for activation.

12. Wiring: Door contractor shall supply all controls and electrical equipment to be integrated to the Folding Door system. Door Contractor will be responsible for power connection to Control Panel, Motor & all low voltage control & safety accessories. All surface mount conduit required by the system will be supplied and installed by the Folding Door Contractor. Door Contractor shall be responsible for main power feed, terminated in disconnect adjacent to final Control Panel location & for all required embedded conduits as detailed in the project drawings.

6 EXECUTION

3.1 INSTALLATION

1. Install Four-Fold metal doors in strict accordance with the approved drawings by qualified door erection crews. All door openings shall be completely prepared by the general contractor prior to the installation of the doors. Permanent or temporary electric wiring shall be brought to the door opening before installation is started and shall be completed so as not to delay the inspection test.

2. Doors shall be set plumb, level, and square, and with all parts properly fastened and mounted. All moving parts shall be tested and adjusted and left in good operating condition.

3.2 ADJUSTING AND CLEANING

1. Inspection of the doors and a complete operating test will be made by the installer in the presence of the general contractor or architect as soon as the erection is complete. Any defects noted shall be corrected. After door approval in the above test, the general contractor must assume the responsibility for any damage or rough handling of the doors during construction until the building is turned over to the owner and final inspection is made.

2. Clean surfaces and repaint abraded or damaged finished surfaces to match factory-applied finish.

END OF SECTION

PART 1. GENERAL

1.1 RELATED SECTIONS

.1 Section 01 33 00 – Documents and samples to be submitted.

.2 Section 01 74 21 – Construction and demolition waste management and disposal.

.3 Section 01 78 00 – Documents and items to submit upon work completion.

.4 Section 05 50 00 – Metalwork – Springs and rail brackets: Galvanized steel, type and dimensions that meet the installation requirements.

.5 Section 08 80 50 – Glazing.

.6 Section 16, with regards to power supply, connections and cables.

1.2 REFERENCES

.1 The Aluminum Association Inc. (AA).

· Aluminum Association Designation System for Aluminum Finishes-[DAF 45-03].

.2 American Society for Testing and Materials International, (ASTM).

· ASTM A1008/A1008M-[02e1], Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
· ASTM D523-[99(R1999)], Test Method for Specular Gloss.
· ASTM D822-[01], Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings.
· ASTM C518-91, Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
· ASTM A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
· ASTM E283, Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

.3 Canadian General Standards Board (CGSB).

· CAN/CGSB-1.105-[M91], Quick Drying Primer.
· CAN/CGSB-1.213-[95], Etch Primer (Pretreatment Coating) for Steel and Aluminum.
· CAN/CGSB 1-1.181-[99], Ready-Mixed Organic Zinc-Rich Coating.
· CAN/CGSB 51-GP-21M, Thermal Insulation, Urethane and Isocyanurate, Unfaced.
· CAN/CGSB-51.26-M86, Thermal Insulation, Urethane and Isocyanurate, Boards, Faced.

.4 Canadian Standards Association (CSA)/CSA International.

· CAN/`CSA-G164-M92 (C2003), Hot Dip Galvanizing of Irregularly Shaped Articles.

.5 Environmental Choice Program (PCE). · CCD-016-[97], Thermal insulation.· CCD-047a-[98],Coatings, paints.· CCD-048-[95], Recycled water-borne surface coatings.

1.3 DESCRIPTION OF THE WORKS

.1 Design requirements

- Exterior doors and associated rails shall be designed to withstand a wind load of 1 kPa, with a deflection in the horizontal plane that does not exceed 1/240 of the width of the door opening.
  They shall be designed to comply with industry standards (DASMA).
- Sectional doors shall have a thermal resistance value (RSI) of 2.81, according to standard ASTM C-518-91.
- The doors and associated rails shall be designed to withstand at least 1 000 operating cycles per year and shall have a global lifetime of 10 years.

1.4 DOCUMENTS/SAMPLES TO SUBMIT

.1 Specification sheets

Submit the products specification sheets and the manufacturer's data and documentation in accordance with Section 01 33 00.

.2 Shop Drawings

Submit the required shop drawings in accordance with Section 01 33 00 – Documents Samples to be submitted.

Shop drawings shall indicate: the door type, dimensions and service specifications; the materials; the type of operating mechanism; the location and details of the glazing; the details of hardware and accessories; and the required clearances and electrical connections.

.3 Submit the installation instructions provided by the manufacturer.

1.5 CLOSE OUT DOCUMENTS

.1 As Built Shop Drawings & Literature.

.2 Operation and maintenance manuals for the overhead doors as specified herein.

1.6 QUALITY ASSURANCE

.1 Test reports: Submit test reports certifying that the products, materials and equipment comply with the physical characteristics and performance criteria laid down in the provisions.

.2 Qualifications; Installation shall only be by an Authorized Garex Distributor in accordance with the manufactures as Built Shop Drawings and written instructions.

PART 2. PRODUCTS

2.1 SECTIONAL OVERHEAD DOORS (FULL-VIEW ALUMINUM)

.1 “Standard of Acceptance”, Model GX-175-FV, as manufactured by Garex Garage Doors. Garex is a Canadian Owned & Operated Company. Contact : Bill Brodie 647.615.2767

. 2 Alternates will be considered provided they meet the minimum requirements within, and they are approved & accepted in writing prior to tender closing.

2.2 DOORS

.1 The doors shall be manufactured with Clear Anodized Tubular aluminum rails c/w double end styles, double top & bottom rail.

.2 Glazed panels: 3 mm tempered double-glazed sealed (18mm nominal thickness) units mounted on a stainless steel spacer. The glass is inserted into a colour matched PVC frame, eliminating the need for plastic glass retainer stops. The glass is inserted into a preassembled aluminum frame and the window unit is a integral part of the complete door assembly.

.3 Kicks proof panels; made of two (2) rolled sheet steel by adhesive on plywood core. The kick proof panel is inserted into a colour matched PVC frame. The panel is inserted slide into a preassembled aluminum frame as a complete unit is a integral part of the complete door assembly.

2.3 WEATHERSTRIPPING

.1 PVC weatherstripping, full width at the top and bottom of each section to ensure thermal break and airtightness according to standard ASTM E-283.

.2 U-Shaped extruded neoprene weatherstripping (full width), to be installed in bottom extrusion of each door

.3 Aluminum perimeter weatherseal c/w high quality vinyle to be on to installed on jambs to ensure a weathertight seal against the door face.

2.4 INDUSTRIAL HARDWARE

.1 75mm (3in) in Track & Hardware, galvanized steel at 2.6mm (12guage) thick. Please reference the Architectural Drawings for hardware configuration.

.2 Continuous angle, 2.75 mm (12 gauge) thick.

.3 25mm (1in) Galvanized Solid Shaft c/w 50,000 cycle torsion springs, fitted with brackets in accordance with the manufacturers specifications

.4 Adjustable top roller brackets : 2.6mm (12 guage) thick, galvanized steel.

.5 75mm (1in) Rollers: Hardened steel, oil lubricated, free lateral movement, ball bearing,

.6 Double End Hinges, 2.6mm (12 guage), galvanized steel hinges, galvanized steel, in accordance with the manufacturer's specification.

.7 Aircraft cable, galvanized steel, in accordance with the manufacturer's specifications.

.8 Reinforcing Struts : Doors 3708 mm and over shall be provided with horizontal reinforcing struts. In accordance with the manufactures specifications.

.9 Precision bearing: High-quality ball bearing for doors over 300 kg (600lbs)

.10 Pusher springs.

2.7 ELECTRIC OPERATOR

.1 **Manaras Rapido RSI** Operators as shown on the drawings (**Model Rapido RSH)** . Speed Management Feature provides enhanced performance and speed with slow start & slow stop capabiities. The maximum door speed is 19.3 ips (average 12.4 ips) on the open & 12ips (average 9.4 ips) on the close.

.2 Jackshaft Operator : Manaras Opera industrial duty logic control type operator with on board radio receiver, model Rapido RSH (Model Rapido RSH) to NEMA 1, shall be equipped with an adjustable friction clutch, time delay on reverse, solenoid brake, integral enclosure containing the control, floor level disconnect and emergency manual chain hoist with electrical interlock.

.3 Provide Separate Control Panel complete step- up Transformer to achever 600 Volt power supply with OPEN/CLOSE/STOP Push Button Station.

.4 Entrapment Protection : Provide two (2) only Thru- Beam Photoelectric Eyes per operator. Locate the Photoelectric Eyes at different heights to ensure that they will hit Emergency Vehicles.

.5 Provide one (1) only 3 - Button Transmitter per door. Program each transmitter to operate all (3) doors.

.6 Reversing Safety Edge : Provide Manaras Sensedge along the bottom edge of door to reverse on contact with an object. **Hose type pneumatic safety edges will not be acccepted**. Power to the safety edge shall be supplied through reelite.

.7 Spreader Bar : between the drive sprocket and shaft to sprocket to ensure that the drive chain stays taught

.8 Electric motors, control devices, remote control stations with push buttons, relays and other electrical devices: CSA-approved.

.9 Electrical power supply: 600 Volt, 3 Phase

.10 Power Supply and fused disconnect located within 5'0 of the operator by Division 16. Wiring from the fused disconnect to the operator & low voltage wiring by the door contractor. Co-ordinate the location of the disconnect with the General Contractor & Door Contractor.

PART 3. EXECUTION

3.1 EXAMINATION

.1 **P**rior to commencement of work, thoroughly examine opening frames and frame extensions to receive the doors and related components for installation. Ensure that the opening frames are square and plumb. Ensure that the floor is level and square to the buiding lines. So that the door will properly will seal against the door and frame

.2 Proceed with installation of the doors when site conditions are satisfactory for the installation.

3.2MANUFACTURER'S INSTRUCTIONS

.1 Compliance: Comply with the manufacturer's written requirements, recommendations and specifications, including technical bulletins and installation instructions provided in the product catalogs and on packaging cartons, as well as indications found on specification sheets.

3.3 INSTALLATION

.1 Install doors and related hardware parts according to the manufacturer's instructions.

.2 Secure rails and door openers properly and fix the brackets to the load-bearing framework.

.3 Touch up the areas where the galvanized finish has been damaged during assembly with primer.

.4 Install electrical motors, control devices, control stations with push buttons, relays and other electrical equipment required for the operation of the doors.

.5 Lubricate springs and adjust moving parts to ensure smooth operation of doors.

.6 Adjust weatherstripping to ensure proper weathertightness.

.7 Adjust doors to ensure smooth operation.

3.4 ADJUSTMANT AND CLEANING

.1 Inspection of the doors and provide a complete operating test in the presence of the Owner and the Consultant prior to occupancy. Any defects noted shall be corrected immediately. Once the installation of doors is completed, clean the site to remove all dirt and debris resulting from construction work.

.2 Remove all traces of paint, caulking, epoxy resin and filler. Clean the doors.

.3 Clean glazing with a nonabrasive approved cleaning product.

.4 When installation work is completed, removed from site all surplus materials, waste materials, tools and safety barriers.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Design, labour, Products, tool, equipment and services necessary for Aluminum Work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 AAMA 611, Voluntary Standards for Anodized Architectural Aluminum.

.2 AAMA CW-10, Care and Handling of Architectural Aluminum from Shop to Site.

.3 AAMA/WDMA/CSA 101/I.S.2/A440, Standard Specification for Windows, Doors, and Unit Skylights.

.4 ANSI H35.1M, Alloy and Temper Designation Systems for Aluminum (Metric).

.5 ASTM A167, Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.

.6 ASTM B209M, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

.7 ASTM B221M, Specification for Aluminum-Alloy Extruded Bars, Rods, Wires, Profiles and Tubes.

.8 ASTM C920, Specification for Elastomeric Joint Sealants.

.9 ASTM E283, Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

.10 ASTM E330, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.

.11 ASTM E331, Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference.

.12 ASTM F738M, Specification for Stainless Steel Metric Bolts, Screws, and Studs.

.13 CAN/CGSB 1.108-M, Bituminous Solvent Type Paint.

.14 CAN/CGSB-82.1-M, Sliding Doors.

.15 CAN/ULC S702, Thermal Insulation, Mineral Fibre, for Buildings.

.16 NFRC 100, Procedure for Determining Fenestration Product U-factors.

.17 NFRC 200, Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence.

1.3 **DEFINITION(S)**

.1 Aluminum Work: Shall mean aluminum curtainwall, entrances, vestibules, screens, doors, and framing mentioned in Part 2 of this Specification Section.

1.4 **DESIGN REQUIREMENTS**

.1 Design Aluminum Work to meet requirements of AAMA/WDMA/CSA 101/I.S.2/A440, ASTM E283, ASTM E330, ASTM E331, NFRC 100, NFRC 200 and to meet performance and energy requirements specified herein and as required by authorities having jurisdiction.

.2 Design Aluminum Work in accordance with following Climatic Design Data for the Municipality contained in the Ontario Building Code:
.1 Design temperature: January 1%, July 2 1/2%.
.2 Hourly wind pressures: 1 in 50 year occurrence.

.3 Design Aluminum Work to accommodate following without producing detrimental effect:
.1 Cyclic 40 degree Celsius daily thermal swing of components.
.2 Cyclic, dynamic loading and release of loads such as wind loads.
.3 13 mm vertical deflection in supporting structure and movement of supporting structure due to live, dead load, and creep or deflections, seismic load, sway displacement and similar items.

.4 Design complete aluminum window systems, including glazing, to meet the following performance criteria:
.1 Ontario Building Code SB-10 Requirements for Heated Conditioned Space Climate Zone based on project location.

.5 Design complete aluminum entrance door systems, including glazing, to meet the following performance criteria:
.1 Ontario Building Code SB-10 Requirements for Heated Conditioned Space Climate Zone based on project location.

.6 Design to prevent accumulation of condensate on interior side of Aluminum Work framing under the following service conditions:
.1 Interior temperature: 25 degree Celsius.
.2 Exterior temperature: -20 degree Celsius.
.3 Interior RH: 35%.

.7 Design windows in accordance to AAMA/WDMA/CSA -101/I.S.2/ A440, to the following performance levels:
- .1 Performance class: CW.
- .2 Minimum performance grade (PG): 35.
- .3 Minimum positive design pressure: 1680 Pa.
- .4 Minimum negative design pressure: - 1680 Pa.
- .5 Minimum water penetration test pressure: 290 Pa.
- .6 Minimum air infiltration/exfiltration: A3.
- .7 Condensation resistance: I57.

.8 Restrict air infiltration/exfiltration, through Aluminum Work in accordance with ASTM E283 at pressure differential as indicated:
- .1 Curtainwalls and entrance assemblies: 0.0003 m^3/s m^2 at differential of 300 Pa.
- .2 Doors (per door): 2.78 m^3/h m per linear metre of crack at differential of 75 Pa.

.9 Design and detail controlled drainage path to actively discharge water, which enters into or forms within Aluminum Work, to exterior; prevent accumulation or storage of water within Aluminum Work. Prevent water from entering interior when tested in accordance with ASTM E331.

.10 Design and detail air barrier, vapour retarder, and rainscreen products and assemblies into continuous and integrated Aluminum Work envelope. Optimize Aluminum Work design to align envelope layers and to minimize thermal bridges.

.11 Prevent deflection and permanent or progressive glazing displacement. Restrict horizontal and vertical mullion deflection to less than L/175 and 19 mm maximum for heights under 4115 mm and L/240 and 25 mm maximum for heights over 4115 mm.

.12 When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span in accordance with ASTM E330.

.13 Design anchorage inserts for installation as part of other Sections of Work. Design anchorage assemblies to accommodate construction and installation tolerances.

.14 Provide all reinforcing within aluminum members as required by design and OBC to provide structurally sound assembly. In any case, mullion size shall not be increased due to provision of reinforcing.

.15 Design Aluminum Work and connections to substrate where the bottom of the Aluminum Work extends to a point below 1070 mm above finished floor level and separates a floor level from an adjacent interconnected space to withstand the required guard and handrail loads in accordance with the OBC and applicable local regulations. When requested by Consultant, provide a letter signed and sealed by a

Professional Engineer certifying that the Aluminum Work conforms to the OBC requirements.

.16 Design operable windows within reach of occupants with limiting stops conforming to requirements of OBC.

1.5 **SUBMITTALS**

.1 Shop drawings:
- .1 Submit shop drawings in accordance with Section 01 33 00 indicating:
  - .1 Plans, sections, details, type of extrusions, profiles, finishes, panels, spandrels, operating components, doors, related flashings, closures, fillers, and end caps, and sealants.
  - .2 Products and glazing types.
  - .3 Anchorage inserts, system installation tolerances.
  - .4 Section and hardware reinforcement, anchorage, assembly fixings.
  - .5 Detailing, locations, and allowances for movement, expansion, contraction
  - .6 Path of cavity drainage and air pressure equalization.

.2 Samples:
- .1 Submit two samples of following in accordance with Section 01 33 00.
  - .1 250 mm long samples of each type of extrusion and finish.
  - .2 250 x 200 mm samples of insulating glass unit.
  - .3 One complete corner detail of door frame, glazing, and finish for each door type.
  - .4 Each door hardware item for Consultant’s approval.
  - .5 250 x 200 mm sample of aluminum panel.
  - .6 200 x 200 mm sample of insect screen for operable windows for Consultant’s approval of fibreglass mesh.

.3 Reports:
- .1 Submit substantiating engineering data, and independent test results of pre-tested, Aluminum Work to substantiate compliance with the design criteria including air leakage and water penetration conforming to ASTM E283 and ASTM E331.
- .2 Submit documentation to substantiate ten years of experience in Aluminum Work manufacture and installation.

.4 Close-out submittals: Submit Aluminum Work data for incorporation into the Operations and Maintenance Manual as part of Section 01 78 23.

1.6 **QUALITY ASSURANCE**

.1 Retain a Professional Engineer, licensed in Province of Ontario, with experience in Aluminum Work of comparable complexity and scope to perform the following services as part of the Work of this Section:
- .1 Design of Aluminum Work.
- .2 Review, stamp, and sign shop drawings.
- .3 Conduct on-Site inspections and prepare and submit inspection reports.

.2 Mock-up:
- .1 Fabricate, deliver, and erect one, full scale mock-up of each type of Aluminum Work, in location acceptable to Consultant.
- .2 Demonstrate full range of Products, finishes, textures, quality of fabrication, and workmanship.
- .3 Mock-up may form part of final Work, if acceptable to Consultant. Remove and dispose of mock-ups which do not form part of Work.

1.7 **DELIVERY, STORAGE, AND HANDLING**

.1 Handle Aluminum Work in accordance with AAMA CW-10.

.2 Protect aluminum surfaces with strippable coating. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather. Do not remove before final cleaning of building.

1.8 **EXTENDED WARRANTY**

.1 Submit a extended warranty for Aluminum Work in accordance with General Conditions, except that warranty period is extended to 5 years.
- .1 Warrant against failure to meet the design criteria and requirements such as interior leakage, insulating glass unit failure, finish degradation, frame condensation.
- .2 Coverage: Complete replacement including affected adjacent Work.

2 Products

2.1 **ACCEPTABLE MANUFACTURER(S) AND SYSTEM(S)**

.1 Curtain Wall: ‘Therma Wall 2600 Series’ by Alumicor Limited, ‘HP3252 Series’ by CRL / U.S. Aluminum or ‘5500 HTP Series’ by Windspec Inc or approved alternative.

.2 Operable Windows (Concealed Vent): ‘5000 Series Phantom Vent’ by Alumicor Limited, ‘7500 Series’ by CRL / US Aluminum or approved alternative.

.3 Aluminum doors:
.1 Interior:
.1 'Canadiana' by Alumicor Limited.
.2 '400 Series' by CRL / U.S. Aluminum.
.3 '350 Series' by Windspec Inc.
.2 Exterior:
.1 'Therma Porte 7700' by Alumicor Limited.
.2 '400T Series' by CRL / U.S. Aluminum.
.3 'Insul 350' by Windspec Inc.

2.2 MATERIALS

.1 All materials under Work of this Section, including but not limited to, sealants are to have low VOC content limits.

.2 Aluminum extrusions and channels: ASTM B221 and ANSI H35.1 AA6063 alloy, T6 temper.
.1 Profile and dimensions: Refer to Contract Drawings.
.2 Thermal breaks in frame members: Vertically aligned with glazing.

.3 Aluminum sheet: ASTM B209 and ANSI H35.1 AA1100 aluminum alloy, H14 temper, minimum 1.29 mm for sheets less than 610 mm wide and minimum 2.05 mm for sheets of a greater dimension.

.4 Reinforcements and anchors: ASTM A167, Type 304 to AISI No. 2B finish. Size as shown.

.5 Glass and glazing materials: As specified in Section 08 80 00.

.6 Spandrel panel airseal backpan: ASTM A653/A653M; 0.9 mm thick, Z275 galvanized steel sheet. To be primed as recommended by manufacturer and painted colour as selected by Consultant at a later date.

.7 Airseal and Aluminum Work sealant: ASTM C920, Type S, Grade NS, Class 100/50; One-part, low-modulus, moisture-curing, silicone. 'Dow Corning 790' by Dow Corning; 'Spectrem 1' by Tremco. Verify compatibility with insulating glass unit manufacturer's secondary sealant. Colour as selected by Consultant. Primer as recommended by manufacturer.

.8 Frame sealant: Type as recommended by the Aluminum Work manufacturer.

.9 Joint backing: Closed cell foam polyethylene rod, outsized minimum 30-50% larger than joint width and compatible with joint sealant. Product as recommended by sealant manufacturer.

.10 Airseal transition membrane: ‘Sopraseal Stick 1100' by Soprema Inc., ‘Exoair 110’ by Tremco or ‘Air-Shield’ by W.R. Meadows. Membrane to come complete with applicable primer.

.11 Anchors, clips, and angles: Extruded aluminum or stainless steel.

.12 Shims and blocking for frame: Rigid plastic, wood is not permitted.

.13 Flashings, closures and trim: 1.0 mm minimum aluminum sheet, finish to match curtain wall extrusion finish.

.14 Screws, bolts and other fasteners: ASTM F738M; Stainless Steel Type 304.

.15 Isolation coating: CAN/CGSB-1.108-M; Bitumastic coating, acid and alkali resistant material.

.16 Spandrel panel insulation: CAN/ULC S702; Semi-rigid mineral fibre.
- .1 Type 703 by Owens-Corning.
- .2 CurtainRock by Roxul Inc.
- .3 Thickness: As required to fill void.
- .4 Insulation fasteners: Stik-Clip with retaining washer.

.17 Spray Foam Insulation: CFC free, polyurethane foam in place, closed cell low expansion, one component, minimum density 15 kg/m3.
- .1 'ENERFOAM' by Dow Chemical Canada.
- .2 'IPF All Weather Pro' by Rivenco Industries.

.18 Door hardware: Manufacturer’s standard heavy duty hardware, based on the following:
- .1 Hinging device: extruded aluminum continuous gear hinge or 1 1/2 pair of heavy duty stainless steel butts complete with back up plates.
- .2 Closing device: LCN 4040 Series closers with back up plates.
- .3 Pull handles: Alumicor 1180, 25 mm diameter, anodized aluminum offset pull handles
- .4 Push bars (for doors without panic hardware): Alumicor 246, 25 mm diameter, anodized aluminum push bar.
- .5 Locking (basic locking): Adams Rite MS1850 Dead Lock with manufacturers standard cylinder on exterior and thumbturn on interior.
- .6 Locking (panic hardware): Von Duprin 33/35A rim panic or Von Duprin 3547 vertical rod panic.
- .7 Hold open devices (where required): Glynn Johnson GJ104S for door stop only applications; Glynn Johnson GJ104H for applications that require both a stop and hold open.

.19 Insect screen (windows): Extruded aluminum frames containing heavy duty, fine fibreglass mesh in accordance with AAMA/WDMA/CSA 101/I.S.2/A440. Screen to

be retained in place with turn clip type fixings. Provide samples for the Consultant's approval.

.20 Weatherstripping: Durable, non-absorbing material resistant to deterioration by aging and weathering.

2.3 **FABRICATION**

.1 Fabricate sections true to detail, free from defects impairing appearance, strength and durability. Fabricate extrusions with sharp, well defined corners.

.2 Fabricate Aluminum Work in accordance with reviewed shop drawings and manufacturer's written instructions.

.3 Fabricate, fit, and secure framing joints and corners accurately, with flush surfaces, and hairline joints. Apply frame sealant at joints for weatherproof seams.

.4 Conceal anchors, reinforcement and attachments from view. Fabricate reinforcement in accordance with design requirements.

.5 Do not expose manufacturer's identification labels on aluminum assemblies.

.6 Fabricate continuous sill flashings with intermediate anchor clips, and joint reinforcing, form to profile shown. Fabricate filler and closure pieces as necessary for a complete and weather tight installation.

.7 Certify aluminum windows as complying with the AAMA/WDMA/CSA 101/I.S.2/A440 design criteria and requirements using an easily removable label located on the inside face of glazing.

.8 Position operable windows on main frame to provide direction of opening specified, free and smooth operation, without binding or sticking against main frame members.

.9 Fabricate doors and frames complete with internal reinforcements, cut-outs, and recesses to accommodate finish hardware. Reinforce cut-outs to assure adequate strength.

.10 Fabricate Aluminum Work closures and trim from aluminum sheet. Form to profile shown. Make weathertight.

.11 Double weatherstrip doors. Install weatherstripping in specially extruded ports and secure to prevent shrinkage or movement.

.12 Fabricate glazing recess with drainage to exterior.

2.4 ALUMINUM DOORS

.1 Fabricate doors of welded construction.

.2 Glazing stop: Aluminum, square, snap-on type, designed for glazing system.

2.5 INFILL (SPANDREL) PANELS

.1 Fabricate insulated spandrel panel, inner facing of 20 gauge aluminum sheet. Wrap edges with aluminum sheet, enabling installation and minor movement of perimeter seal.

.2 Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.

.3 Place insulation within panel, adhered to exterior face of interior panel sheet over entire area of sheet with impale fasteners.

.4 Provide integral reinforcing and stiffeners as required to reinforce panel against deflection caused by wind and suction loads.

.5 Provide spacers as necessary to separate dissimilar metals.

.6 Ventilate and pressure equalize the air space outside the exterior surface of the insulation, to the exterior.

.7 Arrange fasteners and attachments to ensure concealment from view.

.8 Glass panels: Consists of 6 mm thick spandrel glass to the exterior with insulated backpan to the inside. Insulation shall be 75 mm thick, retained with stick clips. Seal all joints in shop with high grade butyl sealant, including perimeter seal at backpan. Backpan to be primed and painted same colour as adjacent wall or colour as selected by Architect.

.9 Metal panels: Consists of an exterior prefinished flush aluminum panel with panel stiffeners as required, to match colour of window framing, with 75 mm thick insulation core and galvanized sheet back-pan. Backpan to be primed and painted same colour as adjacent wall or colour as selected by Architect.

2.6 FINISH

.1 Extrusion finish: Clear anodized to AAMA 611 per Aluminum Association Designation System for Aluminum Finishes AA-M12C22A31.

.2 Doors: Clear anodized to AAMA 611 per Aluminum Association Designation System for Aluminum Finishes AA-M12C22A31.

.3 Panel and sheet finish: As indicated on drawings to match adjacent extrusion finish.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

3.2 **INSTALLATION**

.1 Install Aluminum Work in accordance with reviewed shop drawings, manufacturer's instructions, AAMA/WDMA/CSA 101/I.S.2/A440 and to meet requirements of authorities having jurisdiction.

.2 Install Aluminum Work in accordance with reviewed shop drawings and manufacturer's written instructions.

.3 Install Work of this Section securely, in correct location, level, square, plumb, at proper elevations, free of warp or twist.

.4 Apply isolation coating at 0.8 mm dry film thickness to prevent corrosive or electrolytic action between dissimilar materials such as aluminum to concrete, masonry, galvanized steel and similar conditions.

.5 Install flashings, closures, and trim pieces.

.6 Fill voids between aluminum framing and adjacent construction with foam insulation.

.7 Install sills in maximum lengths possible. For sills over 1200 mm in length, maintain 3 mm to 6 mm space at each end.

.8 Refer to Contract Drawings for glazing type locations. Install glazing in accordance with Section 08 80 00.

.9 Spandrel panels:

.1 Set spandrel back pans to framing, apply sealant to cover screw heads to maintain air tight seal between back pans and framing.

.2 Adhere stick clips to metal back pans at 300 mm o.c. both ways. Apply insulation adhesive over entire surface of barrier and around clips held with adhesive.

.3 Cut insulation slightly over-size and press insulation boards firmly to barrier impaling them on clips without bending clips. Butt insulation boards tightly. install retainers to clips.

.10 Automatic door operators to be supplied and installed by Section 08 71 13. Install doors and hardware to manufacturers' written instructions. Clean and adjust hardware for correct performance.

.11 Install aluminum door manufacturer's standard weatherstripping at door frame perimeter. Install weatherstripping throughout entire length and width of doors at jambs and heads.

.12 Install doors and hardware to manufacturers' written instructions. Clean and adjust hardware for correct performance.

.13 Adjust operable parts for correct function.

.14 Remove damaged or unacceptable Products and assemblies from Site and replace to Consultant's acceptance.

.15 Install glass presence markers, in two cross stripes extending from diagonal corners. Maintain markers until final clean-up.

3.3 ERECTION TOLERANCES

.1 Tolerances: Non-cumulative.
- .1 Maximum variation from plumb: 1.5 mm/3 m non-cumulative or 12 mm/30 m, whichever is less.
- .2 Maximum misalignment of two adjoining members abutting in plane: 0.8 mm.
- .3 Vertical and horizontal positions: +/- 3 mm.
- .4 Racking of face: 6 mm, nil in elevation.
- .5 Operable components: Consistent with smooth operation and weatherproof performance.
- .6 Maximum perimeter sealant joint between Aluminum Work and adjacent construction: 13 mm.

3.4 GLAZING PERIMETER AIRSEAL

.1 Install glazing perimeter airseal at entire perimeter of each insulating glass unit to achieve an airseal from insulating glass unit to curtain wall frame. Do not obstruct path of cavity drainage and air pressure equalization.

.2 Perform sealant work in accordance with manufacturer's written requirements.

3.5 AIRSEAL TRANSITION MEMBRANE

.1 Install primer and airseal transition membrane in accordance with manufacturer's instructions. Install airseal transition membrane into extrusion reglet as indicated on drawings. If there is no extrusion reglet, mechanically fasten airseal transition membrane to frame with batten bar fastened at 150 mm o.c.

.2 Overlap airseal transition membrane 75 mm minimum and lap in direction of waterflow.

.3 Coordinate airseal transition to adjacent parts of Work.

3.6 JOINT BACKING AND ALUMINUM WORK SEALANT

.1 Prepare substrate surface and mask as recommended by sealant manufacturer.

.2 Install joint backing and sealant at Aluminum Work and perimeter joints for weather tight installation in accordance with sealant manufacturer's instructions. Tool sealant. Remove excess sealant.

3.7 FIELD QUALITY CONTROL

.1 Test sliding doors in accordance with ASTM E1105 for water peneteration.
- .1 Procedure A: test sliding door at 700 Pa, for uniform static air pressure difference for 15 minutes by applying water at a minimum rate of 3.4 L/m^2 minute.
- .2 Procedure B: test sliding door at 700 Pa, for static air pressure difference for 4 cycles of 5 minutes each by applying water at a minimum rate of 3.4 L/m^2 minute.
- .3 Failure criteria as per ASTM E1105.

3.8 **CLEANING**

.1 Maintain Aluminum Work, inside and outside, in clean condition throughout construction period.

.2 Remove labels, protective material, and glass presence markers from prefinished surfaces.

.3 Remove AAMA/WDMA/CSA 101/I.S.2/A440 certification labelling when directed by Consultant, in writing.

.4 Wash Aluminum Work with solution of mild detergent in warm water, with particular attention to recesses and corners. Wipe surfaces clean and dry.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services necessary for finish hardware Work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 BHMA, Builders Hardware Manufacturing Association.

.2 NFPA 80, Standard for Fire Doors and Other Opening Protectives.

1.3 **SUBMITTALS**

.1 Product data: Submit manufacturer's Product data in accordance with Section 01 33 00 indicating compliance with reference standards, transportation, storage, handling and installation requirements.

.2 Shop Drawings:
- .1 Submit Shop Drawings and 3 complete hardware lists in accordance with Section 01 33 00 indicating:
  - .1 Door locations, sizes, hardware manufacturer's catalogue numbers, finish symbols and quantities required.
  - .2 Locations and mounting heights of each type of hardware.
- .2 Supply templates and required information to door and frame manufacturer to enable accurate sizes, locations of cut-outs and reinforcement for hardware.
- .3 Submit templates to required trade to arrange for provisions for accurate setting and fitting of hardware.

.3 Samples:
- .1 Submit 2 samples in accordance with Section 01 33 00 of each item that is different from hardware specified and include manufacturer's parts lists and installation instructions.
- .2 Submit hardware component samples illustrating style, colour and finish. Tag samples identifying applicable Specification article number, brand name and number, finish, building location, date and catalogue number.
- .3 Do not order hardware until samples have been accepted. Submit new samples to replace rejected samples. Supply hardware and finishes identical to each accepted sample.

.4 Closeout submittals:
- .1 Submit the following in accordance with Section 01 78 23 for each Product for incorporation into Operation and Maintenance Manual:
  - .1 Maintenance data.
  - .2 Operating instructions and safety precautions.
  - .3 Parts list with name and address of supplier.
  - .4 Lubrication schedule and type of lubricant recommended.
  - .5 Keys, tools and special devices.

.6 Inspection procedures related to preventive maintenance.

1.4 **QUALITY ASSURANCE**

.1 General:
- .1 Manufacturers: Companies specializing in manufacturing door hardware and registered with BHMA.
- .2 Hardware supplier: Company specializing in supplying commercial door hardware and acceptable to manufacturer.

.2 Certifications:
- .1 Employ an Architectural Hardware Consultant to inspect completed installation and certify that hardware has been installed in accordance with manufacturer's printed instructions, Authorities having Jurisdiction and as specified.
- .2 Submit manufacturer's certificate that finish hardware and fire rated hardware meets specified requirements.

1.5 **DELIVERY, STORAGE, AND HANDLING**

.1 Be responsible for packaging of hardware, on a set by set basis. As material is received from various manufacturers identify it to correspond to Hardware List symbols.

.2 Label packages legibly, indicating manufacturer's number, types, sizes, opening number and Hardware List reference number. Wrap hardware and include in package, screws, bolts and fastening necessary for correct installation. If hardware package is not complete, pay additional charges incurred by installer.

.3 Deliver hardware to Site packaged, labelled and cross-referenced to hardware list for each item and its scheduled installation location.

.4 Accept Products of this Section on Site and ensure that each item is undamaged.

.5 Catalogue and store hardware in secure area.

2 Products

2.1 **GENERAL**

.1 Aluminum door hardware: Supplied and installed under the Work of Section 08 44 00.

.2 Carefully check and verify Hardware List against Contract Drawings to ensure that hardware listed can be used as specified. Inform Consultant of concerns regarding quality, quantity, operation or function of hardware selected:
- .1 Verify hand of doors, examine details on Contract Drawings and at Site to ensure hardware supplied can be correctly installed and is correct for Work as constructed.
- .2 Select hardware in accordance with applicable codes and regulations and to approval of local Fire Marshal.
- .3 Replace and pay for defective hardware including hardware which was incorrectly selected, and remedial and installation costs.

.3 Ensure that hardware selected will function correctly, meets Contract requirements and Ontario Building Code and authorities having jurisdiction.

.4 Ensure that each hardware item is of same type, design and by same manufacturer.

.5 Manufacturer's names or trademarks are not permitted on exposed surfaces of hardware.

.6 Include in packing slip a list of parts, name of supplier and door number in which lock is to be installed.

.7 Hardware for fire rated and labelled door and frame assemblies: ULC listed or as accepted by authorities having jurisdiction.

.8 Fire rated assemblies:
- .1 Hardware: Selected and installed in accordance with applicable codes and regulations, NFPA-80 and to approval of Ontario Fire Marshal.
- .2 Fire rated doors: ULC labelled hardware. Submit written certification of conformance to ULC requirements for each type of hardware prior to delivery.
- .3 Locksets and latchsets on fire rated doors: 19 mm throw minimum.

.9 Permanent Cores shall be provided by Royal Security Solutions, per the Municipality’s Standards. General Contractor shall provide temporary construction cores for use during construction.

2.2 ACCESSORIES

.1 Items to be attached to masonry or concrete with expandable shields, lag screws, bolts or other fastening devices as required. Exposed screws: Stainless steel, Phillips or Robertson heads.

2.3 FINISHES

.1 Metal finishes: Free from defects, clean, unstained and of a uniform colour for each type of finish required. Exposed surfaces and anchors: Specified finish symbol of item.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

3.2 **INSTALLATION**

.1 Install hardware in accordance with reviewed Shop Drawings, manufacturer's installation instructions, and applicable Codes and regulations.

.2 Install hardware in accordance with hardware templates.

.3 Adjust fixed and operable hardware for correct clearances and function.

.4 Mount hardware measured from finished floor to centre of hardware, unless indicated otherwise or required by Code:

.1 Top hinge: 250 mm from head of door to top.
.2 Bottom hinge: 265 mm from finished floor to bottom of hinge.
.3 Intermediate hinge: Equal distance between top and bottom hinge.
.4 Locksets, latchsets: 1000 mm.
.5 Panic device crossbar: 1000 mm.
.6 Push plates: 1100 mm to bottom of plates.
.7 Guard bars: 1100 mm.
.8 Door pulls: 1100 mm to bottom of pulls.
.9 Blank strike: 1450 mm.
.10 Blank fronts: 1450 mm.

.5 Include for supply and installation of wiring for electric strikes from electrical junction box to electric strike hardware.

.6 Locate door stops to contact doors 75 mm from latch edge.

.7 Install hardware and trim square and plumb to doors.

.8 Replace wrappings for hardware provided by manufacturer after installation.

.9 Safeguard keys to keep them out of unauthorized hands, tag them with door number, and deliver them to person designated by Consultant at building completion.

3.3 **FIELD QUALITY CONTROL**

.1 Have hardware inspected after installation by hardware supplier's representative, obtain certification in writing that hardware has been supplied and installed in accordance with Specifications and hardware manufacturer's instructions and is functioning correctly.

.2 Inspect fire rated openings to ensure they are installed in compliance with NFPA 80 requirements and Authorities having Jurisdiction.

.3 Test access control system and electrified hardware devices for proper operation. Verify electric door release hardware operates properly upon activation of fire alarm system.

3.4 **ADJUSTING**

.1 Verify under work of this Section, that installed hardware functions properly.

.2 Adjust hardware so that latches and locks operate smoothly and without binding, and closers act positively with the least possible resistance in use. Lubricate hardware if required by manufacturer's instructions.

.3 Adjust doors with self-closing devices or automatic closing devices for proper operation after the HVAC system is balanced and adjusted. Verify spring power of non-sized door closers is properly adjusted.

3.5 **CLEANING**

.1 Remove wrappings at completion of the Project and clean hardware in accordance with manufacturer's instructions.

3.6 **HARDWARE SCHEDULE**

.1 Hardware groups/schedule: To be prepared with direction from the Client/Municipality and to be paid under the “Cash Allowance”.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Design, labour, Products, tool, equipment and services necessary for automatic door equipment work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 ANSI/BHMA A156.19, Power Assist and Low-Energy Power-Operated Doors.

1.3 **DESIGN REQUIREMENTS**

.1 Design handicap door system comprising of low energy power operator with touchless infrared sensor system as defined in ANSI/BHMA A156.19.

.2 Design system operator to open if touchless infrared sensor system is activated. Actuated door shall open slowly to back check (80º) in 3 to 6 seconds and to full open position in 4 to 7 seconds. Door shall remain open for period set to suit requirements (period of 5 to 30 seconds). After time delay door shall close by spring in door operator from 90º to 10º in 3 to 6 seconds from 10º to fully closed in 1-1/2 to 2 seconds.

1.4 **SUBMITTALS**

.1 Product data: Submit duplicate copies of manufacturer's Product data in accordance with Section 01 33 00 indicating performance criteria, compliance with appropriate reference standard(s), characteristics, limitations, trouble-shooting protocol, transportation, storage, handling and installation requirements.

.2 Shop drawings: Submit shop drawings in accordance with Section 01 33 00 indicating all connections, attachments, reinforcing, anchorage and location of exposed fastenings.

1.5 **EXTENDED WARRANTY**

.1 Submit an extended warranty for automatic door equipment in accordance with General Conditions, except that warranty period is extended to 2 years.
.1 Warrant against failure to meet design criteria and requirements.
.2 Coverage: Complete replacement including affected adjacent Work.

2 Products

2.1 **ACCEPTABLE MANUFACTURER(S) AND SYSTEM(S)**

.1 Heavy Duty Door Operator: Design is based on self-contained, low pressure electro-hydraulic power. Operator to be as manufactured by one of the following:
- .1 PowerSwing by Besam of Canada.
- .2 Magic Force by Stanley Canada Inc.
- .3 Senior/Middle/Astro Swing by Dor-O-Matic.
- .4 ED700 by Dorma Automatics.

.2 Door operating equipment shall be complete with electro mechanical motor gear box. Provide 3 position (off-on) switch. System shall operate between -30 deg C and 50 deg C.

2.2 **REQUIREMENTS**

.1 Functional Requirements:
- .1 Equipment shall be designed to operate swing doors up to weight of 100 kg.
- .2 Opening Speed:
  - .1 Door shall be field adjusted to back check as required in Table 1 of ANSI/BHMA A156.19.
  - .2 Opening speed to fully open shall be 4 seconds or longer.

.2 Hold Open: Door shall be field adjusted to remain fully open for not less then 5 seconds or more than 30 seconds.

.3 Closing Speed:
- .1 Doors shall be field adjusted to close 90º to 10º in 3 seconds or longer as required in Table 1 of ANSI/BHMA A156.19.
- .2 Doors shall close from 10º to fully closed in not less than 1.5 seconds.
- .3 Force required to prevent door from opening or closing shall not exceed 7 kg applied 25 mm from latch edge of door at any point in opening or closing cycle.
- .4 During power failure, doors shall open with manual pressure not exceeding 11.3 kg at point 25 mm from latch edge of door.
- .5 Doors shall be equipped with signs visible from either side, instructing user as to operation and function of door.

.4 Requirements:
- .1 Provide header complete with full housing, finish shall match door frame finish.
- .2 Locations of automatic door operators to conform to requirements of the Ontario Building Code (OBC).
- .3 Operator shall be activated by touchless infrared sensor as indicated.
- .4 Switches shall bear universal handicap logo visible to all types of traffic.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

3.2 **INSTALLATION**

.1 Install automatic door operators, controls and accessories for doors indicated in accordance with reviewed shop drawings and manufacturer written instructions.

.2 Installation of automatic door operators to be in accordance with requirements of the Ontario Building Code (OBC).

.3 Doors shall operate manually as though equipped with manual door closers, without damage to automatic door components, in event of power failure or in event of power termination.

.4 Co-ordinate this work with Section 08 44 00.

.5 Power supply to each door operator and wiring shall be provided by Division 26 - Electrical. Make connections at operators and at control panel and supply and install each electrical work between operators and activating controls. Comply with requirements of Division 26 - Electrical. All wiring shall be concealed and where exposed shall be run in conduit. Location of exposed wiring shall be subject to Consultant's approval.

3.3 **ADJUSTMENT AND CLEANING**

.1 Test and adjust operators and controls smooth and proper operation.

.2 Upon completion of Work of this Section, remove from Site all debris, equipment and excess material resulting from Work of this Section.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Design, labour, Products, equipment, tools, and services necessary for glass and glazing Work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 ASTM C920, Specification for Elastomeric Joint Sealants.

.2 ASTM D2240, Test Method for Rubber Property - Durometer Hardness.

.3 CAN/CGSB-12.1-M, Tempered or Laminated Safety Glass.

.4 CAN/CGSB-12.3-M, Flat, Clear Float Glass.

.5 CAN/CGSB-12.8, Insulating Glass Units.

.6 CAN/CGSB-12.9-M, Glass, Spandrel.

.7 CAN/CGSB-12.11-M, Wired Safety Glass.

.8 CAN/CGSB-12.20-M, Structural Design of Glass for Buildings.

.9 Glass Association of North America (GANA) Glazing Manual.

.10 NFPA 80, Standard for Fire Doors and Other Opening Protectives.

1.3 **DESIGN REQUIREMENTS**

.1 Glass Design:
- .1 Design glass using a probability of breakage of 8 lites per 1000 at the first application of design load.
- .2 Design glass to CAN/CGSB-12.20-M. Perform stress analysis. Design units to accommodate live, dead, lateral, wind, seismic, handling, transportation, and erection loads.
- .3 Perform a thermal stress analysis on each glass unit with Low-E coating and provide heat strengthening and/or tempered units as necessary to prevent thermal breakage.
- .4 Perform a thermal stress analysis on each insulating thermal unit and provide heat strengthening and/or tempered units as necessary to prevent thermal breakage.
- .5 Where required, design glazing units so as not to allow thermal stress fracture due to heat build-up behind insulating units.

.2 Structural Glazing:
.1 Carry out design of structural silicone joints by rational analysis including all movements specified herein. Maximum stress shall not exceed 138 kPa (20 psi) in tension or shear for short term loading. Maximum stress in shear for long term loading due to the dead load of glass shall not exceed 7 kPa (1 psi) or the limit imposed by sealant manufacturer, whichever is less.
.2 The joint shall be essentially rectangular in shape and shall include no internal corners which could precipitate tearing or create high local stresses.
.3 Single Source Responsibility for Sealants, Gaskets and Other Glazing Accessories: In order to ensure consistent quality of performance, provide all glazing sealants and seals from a single manufacturer.
.4 Preconstruction Compatibility and Adhesion Testing: Submit to sealant manufacturer, samples of each glass, gasket, glazing accessory and glass-framing member that will contact or affect glazing sealants for compatibility and adhesion testing. Schedule submission of test samples to provide sufficient time for testing and analysis of results to prevent delay in the progress of work.

.3 Limit glass deflection to flexural limit of glass with full recovery of glazing materials.

.4 Utilize inner light of multiple light sealed units for continuity of air and vapour seal.

1.4 **SUBMITTALS**

.1 Shop drawings: Submit shop drawings in accordance with Section 01 33 00 for fabrication and erection of glazing elements indicating materials, thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.

.2 Samples:
.1 Submit following samples in accordance with Section 01 33 00.
.2 Submit one sample of each type of glass.
.1 300 x 300 mm of each type of insulating glass unit, complete with each different Low-E coating.
.2 300 x 300 mm of each colour of spandrel glass.

.3 Certificates: Submit manufacturer's certification that glass and glazing materials are compatible.

.3 Submit compatibility and adhesion test reports from sealant manufacturer indicating that glazing materials were tested for compatibility and adhesion with glazing sealants. Include sealant manufacturer’s interpretation of test results relative to sealant performance and recommendations for primers and substrate preparation needed for adhesion.

.4 Compatibility test report from manufacturer of insulating glass edge sealant, indicating that glass edge sealants were tested for compatibility with other glazing materials including sealants, setting blocks, edge blocks and any other material that contacts or can affect the edge seal.

.5 IGMA Compliance Audit: Submit in accordance with Section 01 78 23, a written certification of successful completion of a Compliance Audit within the last six months.

1.5 **QUALITY ASSURANCE**

.1 Insulating glass unit fabricators shall be a certified member of the Insulating Glass Manufacturer's Alliance (IGMA). IGMA members must participate in the certification program and shall have successfully passed a Compliance Audit within the last six months.

.2 Installers qualifications: Perform Work of this Section by a company that has a minimum of five years proven experience in the installation of glazing units of a similar size and nature.

1.6 **SITE CONDITIONS**

.1 Glaze with compounds, sealants, or tapes only when glazing surfaces are at temperatures over 4 degrees Celsius, and when positive that no moisture is accumulating on them from rain, mist, or condensation.

.2 When temperature of glazing surfaces is below 4 degrees Celsius, obtain from Consultant approval of glazing methods and protective measures which will be used during glazing operations.

1.7 **EXTENDED WARRANTY**

.1 In accordance with Section 08 44 00.

2 Products

2.1 **ACCEPTABLE MANUFACTURERS**

.1 Glass manufacturers:
- .1 AGC Flat Glass.
- .2 Cardinal Glass Industries.
- .3 Guardian Industries.
- .4 PPG Industries Ltd.
- .5 Viracon Inc.
- .6 Guardian Glass

2.2 **MATERIALS**

.1 All materials under Work of this Section, including but not limited to, primers, coatings, sealers, sealants, adhesives and cleaners are to have low VOC content limits.

.2 Float glass **(FGL)**: CAN/CGSB-12.3-M; clear, glazing quality, minimum 6 mm thick. Clear or tinted as indicated. Heat strengthened as required.

.3 Tempered glass **(TGL)**: CAN/CGSB-12.1-M, Type 2, Class B, Category II, clear or colour as indicated in Low-E coating or opaque, minimum 6 mm thick or 4mm (Solar Blue) / 3mm (clear) thick for apparatus bay door lites.

.4 Fire-lite glass **(FIGL)**: ULC Standard CAN4-S104, S106, NFPA 80, 257, FireLite® as manufactured by Nippon Electric Glass Company, Ltd., 5 mm thick or as otherwise noted on Door Schedule, clear polished glass. 1 Hour Fire Resistance Rating Required

.5 Spandrel glass **(SGL)**: CAN/CGSB-12.9-M, 6 mm thick unless otherwise indicated, with water-based silicone emulsion coating applied to backside, 'Opaci-Coat 300' by ICD High Performance Coatings or approved alternative.
Colour: #3 – 820 Harmony Grey

.5 Tempered Low Iron Glass **(TLIGL):** Clear, glazing quality, minimum thicknesses as indicated, low iron content, colourless: 'Starphire Ultra Clear Glass' by PPG, AGC, or Guardian Industries.

.5 Low Iron Glass **(LIGL):** Clear, glazing quality, minimum thicknesses as indicated, low iron content, colourless: 'Starphire Ultra Clear Glass' by PPG, AGC, or Guardian Industries.

.6 Insulating glass units: To CAN/CGSB-12.8-M and IGMA requirements utilizing approved metallic stainless steel edge spacer. Dual seal with a PIB primary seal and silicone secondary seal.

.7 Argon gas: 100% pure. Argon gas to be used to fill air space at all insulated glass units.

.8 Low-E coating (Soft coat): High performance sputtered low-E coating. Provide insulating glass units with low-E coating edge deletion and low-E coating. Apply low-E coating to second surface unless otherwise indicated. 'Solarban 67' by PPG on Solar Blue substrate. 4mm th. Where used in apparatus bay overhead doors.

.9 Glazing types:

- .1 **Type 1:** (Double glazing): **TLIGL** outside, air space, **LGIL** inside. Standard throughout unless noted otherwise. 25 mm overall thickness. With Low-E Coating
- .2 **Type 2:** (Double glazing): **TGL** outside, air space, **TGL** inside. At exterior doors, thickness to suit alum. door manufacturer glazing width. With Low-E Coating
- .3 **Type 3:** (Double glazing): **TGL** outside, air space, **TGL** inside. 4mm th. Panes. At exterior O/H doors. Thickness to suit O/H doors. With Low-E Coating
- .3 **Type 4: FIGL** used at interior glass lites in fire-rated doors.
- .4 **Type 5: SGL** where indicated.
- .5 **Type 6: TGL** opaque 6mm thick (privacy glass) in Office Room(s) side-lites, or as noted on architectural drawings.

.10 Glazing and rebate primers, sealants, sealers, and cleaners: Compatible with each other. Type as recommended by glass manufacturer.

.11 Glazing sealant: Silicone sealant as recommended by glazing manufacturer. Verify compatibility with insulating glass unit secondary sealant.

.12 Glazing Sealant (Structural Glazing):
- .1 Silicone, One Part in accordance with ASTM C920, Type S or M, Grade NS, Class 25.
- .2 Structural glazing tensile bead: 'Spectrem 2 Sealant' by Tremco or 'Dow 795' by Dow Corning.
- .3 Structural glazing weather bead: 'Spectrem 2 Sealant' by Tremco or 'Dow 795' by Dow Corning.
- .4 Structural glazing (factory glazed): Two-part, neutral cure silicone sealant, 'Proglaze ll' by Tremco or 'Dow 983' by Dow Corning.
- .5 Colour to be selected later by Consultant.

.13 Heel & toe bead: Silicone sealant as recommended by glazing manufacturer.

.14 Glazing gasket: 'Visionstrip' by Tremco Ltd., extruded composite glazing seal, size as recommended by manufacturer.

.15 Glazing tape: 'Polyshim II' glazing tape EPDM shim.

.16 Glazing splines: EPDM or neoprene, extruded shape to suit glazing channel retaining slot, colour as selected.

.17 Setting blocks (regular): EPDM, 80 - 90 Shore A durometer hardness to ASTM D2240, sized to suit glazing method, glass unit weight and area.

.18 Setting Block (Structural Glazing): Silicone setting blocks with Shore, Type A durometer hardness of 85, plus or minus 5 to ASTM D2240, sized to suit glazing method, glass unit weight and area.

.19 Edge blocks: EPDM, 60-70 Shore A Durometer hardness, sized with 3 mm clearance from glass edge and spanning glass thickness(es). Capable of withstanding weight of glass unit, self-adhesive on face.

.20 Glass presence markers: Easily removable, non-residue depositing.

.21 Screws, bolts and fasteners: Type 304 stainless steel.

2.3 FABRICATION

.1 Verify glazing dimensions on Site.

.2 Clearly label each glass lite with maker's name and glass type. Ensure labels are easily removable, non-residue depositing type. Do not remove labels until after Work is accepted by Consultant.

.3 Fabricate glazing not less than 3 mm smaller than rebate size in either dimension; allow for edge spacers, shims, and setting blocks as necessary.

.4 Work shall have smooth finished surfaces free from distortion and defects detrimental to appearance and performance.

.5 Carefully make and fit details. Take special care with exposed finished Work to produce a neat and correct appearance to the Consultant's acceptance.

.6 Fabricate argon filled thermal units with air space filled minimum 90% with argon gas.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

.2 Verify that openings for glazing are correctly sized and within tolerance.

.3 Verify that surfaces of glazing channels or recesses are clean, free of obstructions, and ready to receive glazing.

3.2 **PREPARATION**

.1 Clean contact surfaces with solvent and wipe dry.

.2 Seal porous glazing channels or recesses with substrate compatible primer or sealer.

.3 Prime surfaces scheduled to receive sealant.

3.3 **INSTALLATION**

.1 Provide glazing in accordance with IGMA recommendations. Provide continuous contact between glazing tapes and gasket to the glazing.

.2 Install glazing to the Work of Sections 08 11 13 and 08 44 00.

.3 Provide neat, straight sight lines. Trim excess glazing material flush with top of stops and fixed leg of frames.

.4 Remove protective coatings, glazing stops, clean rebate and glass contact surfaces with solvent, wipe dry.

.5 Apply primer/sealer to contact surfaces, prior to glazing.

.6 Apply glazing tape as per manufacturer's instructions including recommended corner sealant.

.7 Use setting blocks at 1/4 points and spacers to centre glass unit in frame.

.8 Install glazing in accordance with reviewed shop drawings and manufacturer's written instructions. Install glazing with full contact and adhesion at perimeter. Maintain edge clearance recommended by glass manufacturer.

.9 Apply a continuous heel bead of sealant around perimeter of inboard lite of the sealed unit and the metal framing.

.10 Re-install glazing stops ensuring continuous contact and rattle-free installation. Do not distort glass. Trim tape protruding more than 2 mm above stop.

.11 Install glazing gasket in accordance with manufacturer's recommendations.

.12 Do not cut or abrade tempered, heat treated, or coated glass.

.13 Install glass presence markers in two cross stripes extending from diagonal corners. Maintain markers until final clean-up.

.14 Remove, dispose of, and replace broken, cut, abraded glass, and defective glass including but not limited to production dimples, 'tiger-stripping', chips, cracks, etc.

.15 Exterior glass: Glaze units with gasket on exterior side and glazing tape on interior side. Seal gap between glazing and stop with sealant to depth equal to bite of frame. Apply cap head of sealant along void between stop and glazing, to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

.16 Exterior glass (Structural Glazing): Glaze units in accordance with reviewed shop drawings and in accordance with manufacturer's written instructions.

.17 Interior glass: Glaze interior glass using glazing gasket glazing tape.

.18 Wire glass: Install wired glass in fire rated metal doors with 5 mm gap between glazing stops, in accordance with ULC and NFPA 80 requirements. Strike and point exposed joints between metal and glass.

3.4 **CLEANING**

.1 Immediately remove sealant and compound droppings from finished surfaces.

.2 Remove labels, protective material, and glass presence markers from prefinished surfaces.

.3 Clean glass surfaces with cleaning agents and methods in accordance with Manufacturer's written instructions.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Design, labour, Products, equipment and services necessary for gypsum board Work.

1.2 **REFERENCES**

.1 ASTM A653/A653M, Specification for Steel Sheet, Zinc-coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.

.2 ASTM C475, Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.

.3 ASTM C645, Specification for Nonstructural Steel Framing Members.

.4 ASTM C665, Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

.5 ASTM C754, Specification for Steel Framing Members to Receive Screw-Attached Gypsum Board.

.6 ASTM C834, Standard Specification for Latex Sealants.

.7 ASTM C840, Specification for Application and Finishing of Gypsum Board.

.8 ASTM C1002, Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.

.9 ASTM C1177, Specification for Glass Mat Gypsum Substrate for Use as Sheathing.

.10 ASTM C1178, Specification for Glass Mat Water-Resistant Gypsum Backing Board.

.11 ASTM C1278, Specification for Fiber-Reinforced Gypsum Panel.

.12 ASTM C1396, Specification for Gypsum Board.

.13 ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials.

1.3 **DESIGN REQUIREMENTS**

.1 Design ceiling suspension system in accordance with manufacturer's printed directions and ASTM C754.

.2 Design ceiling system for adequate support of electrical fixtures as required by the current bulletin of the Electrical Safety Authority.

.3 Design hanger anchor and entire suspension system static loading not to exceed 25% of their ultimate capacity including lighting fixture dead loads.

.4 Design suspension system to support weight of mechanical and electrical items such as air handling boots and lighting fixtures, and with adequate support to allow rotation/relocation of light fixtures.

.5 Design subframing as necessary to accommodate, and to circumvent, conflicts and interferences where ducts or other equipment prevent the regular spacing of hangers.

.6 Design steel stud framing system for wall assemblies with a height greater than 3000 mm and those assemblies incorporating non-standard gypsum board assemblies including, but not limited to cement board.

1.4 REGULATORY REQUIREMENTS

.1 Provide fire separations and fire protection exactly as specified in test design specification that validates the specified rating. Verify that work specified in other Sections, as a part of the entire assembly, meets applicable validating test design specification.

1.5 SUBMITTALS

.1 Product data:
- .1 Submit copies of manufacturer's Product data in accordance with Section 01 33 00 indicating:
  - .1 Performance criteria, compliance with appropriate reference standard, characteristics, and limitations.
  - .2 Product transportation, storage, handling and installation requirements.

.2 Shop Drawings: Submit Shop Drawings in accordance with Section 01 33 00 indicating wall assemblies, suspension systems, adjacent construction, elevations, sections and details, dimensions, thickness, finishes and relationship to adjacent construction.

.3 Certifications: Submit written certification stating that suspended ceiling system is designed for adequate support of electrical fixtures as required by the current bulletin of the Electrical Safety Authority.

1.6 **QUALITY ASSURANCE**

.1 Qualifications: Execute the Work of this Section by skilled, qualified, and experienced workers trained in the installation of the Work of this Section.

.2 Retain a Professional Engineer, licensed in Province of Ontario, with experience in Work of comparable complexity and scope, to perform following services as part of Work of this Section:
- .1 Design of wall systems with height greater than 3000 mm and at non-standard gypsum board assemblies including, but not limited to, assemblies incorporating cement board.
- .2 Design of suspended gypsum board assemblies.
- .3 Review, stamp, and sign Shop Drawings and design calculations.
- .4 Conduct shop and on-site inspections, prepare and submit written inspection reports verifying that this part of Work is in accordance with Contract Documents and reviewed Shop Drawings.

1.7 **SITE CONDITIONS**

.1 Do not begin Work of this Section until:
- .1 Mechanical and electrical Work above the ceiling is complete.
- .2 Substrate and ambient temperature is above 15 degrees Celsius.
- .3 Relative humidity is below 80 %.
- .4 Ventilation is adequate to remove excess moisture.

.2 Install temporary protection and facilities to maintain Product manufacturer's, and above specification, environmental requirements 24 h before, during, and 24 h after installation.

2 Products

2.1 **MATERIALS**

.1 General: All materials under Work of this Section, including but not limited to, sealants, adhesives, and primers are to have low VOC content limits.

.2 Steel framing: ASTM C754; ASTM A653/A653-M, Z275; cold rolled, galvanized steel sheet.
- .1 Bailey Metal Products Limited.
- .2 Corus Metal Profiles.

.3 Steel studs and track runners: ASTM C645; Galvanized steel studs and runners, 32 mm wide x depth as indicated on Contract Drawings. Formed from galvanized steel sheet, thicknesses as follows:
- .1 Studs less than 3000 mm: Minimum 0.53 mm (25 ga.).

.2 Studs greater than 3000 mm and non-standard assemblies: Minimum 0.91 mm (20 ga.), unless stud thickness of greater thickness is required to accommodate intended condition.

.3 Track runners and ancillary components to match stud thickness.

.4 Main carrying channels: ASTM C645; Formed from galvanized steel sheet, 38 x 19 mm cold rolled, channels.

.5 Resilient channel: ASTM C645; 0.5 mm thick galvanized metal, 57 mm wide x 12 mm deep for walls and ceiling to reduce sound transmission.

.6 Furring channels: ASTM C645; Formed from galvanized steel sheet, 22 mm winged flange type, cold rolled.

.7 Furring channels (hat type): ASTM C645; 0.5 mm base steel thickness, galvanized. 70 mm wide x 22 mm deep hat shaped channel.

.8 Heavy duty furring channels: ASTM C645; 0.9 mm steel thickness, galvanized hat shaped channel with a wider and deeper size as required by manufacturers.

.9 Hanger wires: 4.1 mm minimum diameter galvanized pencil rod.

.10 Tie wire: 1.6 mm thick minimum diameter, soft annealed, galvanized steel wire.

.11 Corner bead, casing bead, and special shapes: Formed from 0.6 mm thick minimum, galvanized steel sheet, designed to be concealed by joint compound.

.12 Control joint strip: Roll formed from galvanized steel sheet, with a tape protected recess, 6 mm wide x 11 mm deep.

.13 Screw fasteners: ASTM C1002 Type S; Corrosion resistant.

.14 Concrete anchors: tie wire sleeve anchors, ‘Redi-Drive Anchors’ by ITW Red Head or approved alternative.

.15 Acoustic/Fire insulation: ASTM C665, Paperless, semi-rigid, spun mineral fibre mats, of thickness as indicated on Contract Drawings, ‘Sustainable Insulation, NoiseReducer’ by CertainTeed, ‘EcoTouch Quiet Zone Pink Fiberglas Acoustic Insulation’ by Owens Corning Inc. or ‘Roxul AFB’ by Roxul Inc.

.16 Acoustical sealant:

.1 Non-rated assemblies: ASTM C834; Acrylic, mould resistant sealant, paintable. ‘Smoke and Acoustic Sealant CP506’ by Hilti or approved alternative. Colour – White.

.2 Fire-rated assemblies: ASTM E84; Acrylic based firestop sealant, colour: red or white as selected by Consultant. ‘Flexible Firestop Sealant CP606’ by Hilti or approved alternative. Colour-Red.

.17 Gypsum board: ASTM C1396; gypsum board 12.7 mm thick of maximum practical lengths to minimize end joints, unless indicated otherwise. Furnish Board by Certainteed Gypsum Canada, CGC Inc., or G-P Products.

.18 Fire rated gypsum board: ASTM C1396; gypsum board 15.9 mm thick of maximum practical lengths to minimize end joints, unless indicated otherwise. Furnish Type X Board by Certainteed Gypsum Canada, CGC Inc., or G-P Products.

.19 Moisture and mould resistant board: 12.7 mm thick of maximum practical lengths to minimize end joints, unless indicated otherwise; 'M2Tech Moisture and Mould Resistant' by Certainteed Gypsum Canada, 'Sheetrock Mold Tough' by CGC Inc. or 'DensArmor Plus High Performance Interior Panel' by G-P Products.

.20 Tile Backer: Water resistant tile backer board meeting ASTM C1178 or ASTM C1278, thickness as indicated. 'Diamondback Tile Backer' by Certainteed Gypsum Canada, 'Fiberock Aqua-Tough Underlayment' by CGC Inc. or 'Dens Shield' by G-P Products.

.21 Primer: Where indicated by board manufacturer, provide primer as required to achieve finishes as defined in ASTM C840.

.22 Joint reinforcing tape:
- .1 Standard gypsum board: ASTM C475; 50 mm wide x 0.25 mm thick, perforated paper, with chamfered edges.
- .2 Moisture resistant and tile backer boards: ASTM C475; fibreglass mat joint tape as recommended by board manufacturer to suit location.

.23 Bonding adhesive: Type for purpose intended and as recommended and approved by manufacturer.

.24 Joint and patching compound: ASTM C475; Asbestos-free, supplied by manufacturer of gypsum board used.

.25 Fast setting patching compound: ASTM C475; Asbestos-free, Sheetrock or Durabond by CGC Inc., 'Moisture and Mold Resistant Setting Compound with M2Tech' by Certainteed Gypsum Canada or approved alternative.

.26 Access doors: Supplied by other Sections for installation as part of the Work of this Section.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

3.2 **SUSPENSION FRAMING**

.1 Install ceiling systems in accordance with reviewed Shop Drawings and manufacturer's written instructions.

.2 Install hanger wires plumb and securely anchored to the building structural framing, independent of walls, pipes, ducts, and metal deck; install additional framing and hangers to bridge interference items.

.3 Install hanger wires at 1200 mm maximum centres along carrying channels, not less than 25 mm, and not more than 150 mm from channel ends.

.4 Install additional hangers at lighting fixture and ductwork locations. Do not attach hanger wires to mechanical or electrical equipment. Do not support mechanical and electrical fixtures and fitting on ceiling without the ceiling manufacturer's written acceptance.

.5 Install main carrying channels transverse to structural framing members. Lap main carrying channels 200 mm minimum at splices and wire each end with two loops and prevent clustering or lining-up of splices.

.6 Install furring channels at 400 mm o.c., not less than 25 mm, and not more than 150 mm from perimeter walls, at openings, at interruptions in ceiling continuity, and at change in plane. Install furring channels to a tolerance of 3 mm maximum in 3600 mm.

.7 Install additional main carrying and furring channels to frame and to reinforce openings such as recessed lighting fixtures, access hatches, ceiling grilles, outlet boxes, ventilating outlets, and similar items.

3.3 **STEEL STUDS AND FURRING**

.1 Install steel studs and furring in accordance with reviewed Shop Drawings and manufacturer's written instructions.

.2 Install steel stud partitions to underside of structure unless indicated otherwise.

.3 Install track runners at floors, ceilings, and underside of structure; align track runners accurately and secure to structure at 600 mm centres maximum.

.4 Install double top track runner assembly to prevent the transmission of structural loads to steel studs.

.5 Install steel studs vertically at 400 mm o.c., unless otherwise indicated, and not more than 50 mm from abutting walls, at openings, and at each side of corners. Install studs securely to track runners.

.6 Schedule and coordinate steel framing installation with mechanical and electrical services installation.

.7 Install full height, double studs at door and service openings, fastened together and stiffened back to the structure to prevent vibration when doors close.

.8 Provide double studs boxed together at all openings, sill, head and jambs and at door jambs, fastened together and stiffened back to the structure to prevent vibration. At each opening exceeding 900 mm in width, double studs shall be 20 ga. extending to structure above, and adequately anchored at each end. Provide steel studs above and below openings spaced at 400 mm oc maximum. All metal stud partitions above doors and screens over 1220 mm wide shall be secured to structure over and reinforced with sway bracing to stabilize walls to prevent lateral movement.

.9 Erect three studs at corner and intermediate intersections of partitions. Space 50 mm apart and brace together with wired 19 mm channels.

.10 Stiffen partitions over 2440 mm high or 3000 mm long, or both, with horizontal bracing extended for full length of partitions. Provide one line of bracing in partitions. Space lines to provide equal unbraced panels. Provide bracing for portions of partitions over door openings in partitions over 3000 mm high, and bracing both above and below openings in partitions located no greater than 150 mm from top and bottom of opening, and extending two stud spaces beyond each edge of opening for both doors and windows. Wire tie or weld bracing to studs.

.11 Frame control joints using back to back double studs at abutting structural elements, at dissimilar backup interface, at dissimilar walls and ceilings, at structural expansion and control joints, at door and other openings, and at 9000 mm maximum spacing in continuous runs. Install control joint strips and secure in place.

.12 Install additional support framing at openings and cutouts for built-in equipment, upper cabinet support, access panels and similar items.

.13 Attach to framing adequate steel reinforcing members or an 18 ga. steel stud mounted horizontally and notched around furring members to support the load of, and to withstand the withdrawal and shear forces imposed by, items installed upon the work of this Section. Such items include, but are not restricted to, coat hooks, washroom accessories, handrail anchors, rub rails, grab bars, guards, wall-hung cabinets and fitments, shelving, curtain and drape tracks; Owner supplied equipment; and minor mechanical and electrical work. Heavy mechanical and electrical equipment shall be self-supporting in Divisions 21, 22, 23 and 26.

.14 Provide for support and incorporation of flush-mounted and recessed mechanical and electrical equipment and fixtures only after consultation and verification of methods with those performing the work of Divisions 21, 22, 23 and 26.

.15 Install cross bracing in accordance with the steel stud manufacturer's recommendations.

3.4 FIRE RATED ASSEMBLIES

.1 Install Products in fire rated assemblies in strict accordance with applicable ULC tested and approved designs.

.2 Stiffen fire rated walls over 3.66 m high, where linear length of wall is greater than 2.44 m between perpendicular wall supports, with diagonal bracing above the ceiling extending perpendicular to wall at a 45-degree angle to structure above. Locate diagonal bracing at maximum 2.44 m o.c.

.3 Where double layers of gypsum board are shown, and required for fire rating, screw first layer to studs and furring and laminate the second layer to the first using joint filler as an adhesive. Stagger joints between first and second layers.

3.5 ACOUSTICAL INSULATION

.1 Install acoustic insulation in partitions, between steel studs, and as indicated on Contract Drawings and in accordance with the manufacturer's instructions. Fill stud cavities to full height of partitions and carefully cut and fit acoustic insulation around services and protrusions.

3.6 ACOUSTICAL SEALANT

.1 Install acoustical sealant to acoustically insulated partitions in accordance with the manufacturer's instructions and Contract Drawings.

.2 Install acoustical sealant under floor runner track, at partition perimeter both sides and at openings, cut-outs, and penetrations, concealed from view in the final installation.

.3 Install firestop fill material behind fire rated acoustical sealant and provide firestop identification tag.

.4 Smooth acoustical sealant with trowel prior to skin forming.

3.7 **GYPSUM BOARD**

.1 Comply with ASTM C840. Install gypsum board in accordance with reviewed Shop Drawings and manufacturer's written instructions.

.2 Install gypsum board vertically or horizontally, whichever results in fewer end joints. Locate end joints over supporting members.

.3 Install gypsum board in lightly butted contact at edges and ends and with 1.6 mm maximum open space between boards; do not force gypsum board into place. Do not install imperfect, damaged, or damp boards.

.4 Install gypsum board butting paired tapered edge joints, and mill-cut or field-cut end joints; do not place tapered edges against cut edges or ends.

.5 Install vertical joints minimum 300 mm from the jamb lines of openings and stagger vertical joints over different studs on opposite sides of partitions.

.6 Do not locate joints within 200 mm of corners or openings, except where control joints occur at jamb lines or where openings occur adjacent to corners. Where necessary, place a single vertical joint over the centre of wide openings.

.7 Install gypsum board over concrete and concrete masonry units with adhesive as recommended by gypsum board manufacturer where indicated on Drawings.

.8 Cut, drill and patch gypsum board as may be necessary to accommodate the Work of other trades.

.9 Fire Separations:

.1 Construct gypsum board assemblies, where located, in accordance with tested assemblies to obtain required or indicated fire rated assemblies. As a minimum fire separations shall consist of metal framing covered on both sides by fire-rated gypsum board.

.2 Install assemblies tightly to enclosing constructions to maintain integrity of the separations. Install casing beads at all perimeter edges.

3.8 CORNER, CASING BEADS AND TRIM

.1 Corner reinforcing bead: Install along all external angles, erect plumb, level and with a minimum of joints. Secure with screws at 225 mm o.c. apply filler over flanges flush with nose of the bead and extending at least 75 mm onto surface of board each side of corner. When filler dries, apply a thin coat of topping cement and blend onto adjoining surfaces.

.2 Casing bead: Install where wallboard butts against a surface having no trim concealing the juncture and where shown on drawings. Erect casing beads plumb or level, with minimum joints, and secure with screws at 300 mm o.c. apply filler over flange flush with bead and extending at least 75 mm onto surface of board. When dry, apply a thin coat of topping cement and blend onto adjoining surfaces.

.3 Recess channels and trim: Install recess channels and special metal trim where shown. Secure to substrate. Provide casing beads full height on wallboard edges at recess channels and metal trim.

3.9 JOINT TAPING AND FINISHING

.1 Install reinforcing tape and a minimum of 3 coats of joint compound over gypsum board joints, metal trim and accessories, and screw fasteners in accordance with the gypsum board manufacturer's instructions.

.2 Fill gaps between, and any imperfections in, gypsum boards with joint compound, allow to dry, and sand smooth ready for painting.

.3 Install finished gypsum board Work smooth, seamless, plumb, true, flush, and with square, plumb, and neat corners.

.4 Finish gypsum board in accordance with ASTM C840 to the following grades:

- .1 Level 0: No taping, finishing, or accessories required. Use above suspended ceilings and within other concealed spaces, unless the assembly is fire rated, sound rated, sound or smoke controlled, or unless the space serves as an air plenum.
- .2 Level 1: At joints and interior angles embed tape in joint compound. Leave surface free of excess joint compound. Tool marks and ridges are acceptable. Use above suspended ceilings and within other concealed spaces if the gypsum board assembly is fire rated, sound rated, sound or smoke controlled, or the space serves as an air plenum.
- .3 Level 2: At joints and interior angles embed tape in joint compound with one separate coat of joint compound applied over joints, angles, fastener heads, and accessories. Use for water resistant gypsum board indicated for use as a substrate for ceramic tile.

.4 Level 3: At joints and interior angles embed tape in joint compound with two separate coats of joint compound applied over all joints, angles, fastener heads, and accessories. Apply joint compound smooth and free of tool marks and ridges. Use where heavy grade wall coverings are the final decoration.

.5 Level 4: At joints and interior angles embed tape in joint compound with three separate coats of joint compound applied over all joints, angles, fastener heads, and accessories. Apply joint compound smooth and free of tool marks and ridges. Use for all locations except those indicated for other finish levels.

.6 Level 5: At joints and interior angles embed tape in joint compound with three separate coats of joint compound applied over all joints, angles, fastener heads, and accessories. Apply a thin skim coat of joint compound, or a material manufactured especially for this purpose, to the entire surface. Leave surface smooth and free of tool marks and ridges. Use where semi-gloss or gloss finish coatings are the final decoration.

3.10 ACCESS DOORS

.1 Install access doors, supplied as part of other parts of the Work, in accordance with manufacturer's written instructions.

3.11 SITE TOLERANCES

.1 Install metal support systems to ensure that, within a tolerance of +3 mm and -1.5 mm for plaster thickness, finish surfaces will be flat within 3 mm under a 3 m straightedge, and with no variation greater than 1.5 mm in any running 300 mm, and that surface planes shall be within 3 mm of dimensioned location.

3.12 REPAIR

.1 Make good cut-outs for services and other work, fill in defective joints, holes and other depressions with joint compound.

.2 Make good defective work, and ensure that surfaces are smooth, evenly textured and within specified tolerances to receive finish treatments.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services necessary for tile Work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 ANSI A108/A118/A136.1, Installation of Ceramic Tile.

.2 ANSI A137.1, Specifications for Ceramic Tile.

.3 ASTM C144, Specification for Aggregate for Masonry Mortar.

.4 CAN/CSA A3000, Cementitious Materials Compendium.

.5 CAN/CGSB 25.20, Surface Sealer for Floors.

.6 TTMAC Specification Guide 09300 Tile Installation Manual.

.7 TTMAC, Maintenance Guide.

1.3 **SUBMITTALS**

.1 Product data:
- .1 Submit copies of manufacturer's Product data in accordance with Section 01 33 00 indicating:
  - .1 Performance criteria, compliance with appropriate reference standard, characteristics, limitations and warranties.
  - .2 Product transportation, storage, handling and installation requirements.

.2 Shop drawings:
- .1 Submit shop drawings in accordance with Section 01 33 00 indicating:
  - .1 Tile layout, patterns, and colour arrangement.
  - .2 Perimeter conditions, junctions with dissimilar materials.
  - .3 Setting details.

.3 Samples:
- .1 Submit following sample panels in accordance with Section 01 33 00.
  - .1 Each colour, texture, size, and pattern of tile.
  - .2 Adhere tile samples to 400 x 400 x 12.5 mm thick cement board complete with selected grout colour in joints.

.4 Certificates: Submit manufacturer's certificates stating that materials supplied are in accordance with this specification.

.5 Closeout submittals: Submit recommended maintenance instructions and listing of recommended maintenance Products for incorporation into Operations and Maintenance Manuals in accordance with Section 01 78 23.

1.4 QUALITY ASSURANCE

.1 Perform Work of this Section by a company that is a member in good standing of the Terrazzo Tile and Marble Association of Canada with proven, acceptable experience on installations of similar complexity and scope.

.2 Shower area system:
- .1 All work related to the shower area system is to be carried out by a single Contractor who is to be responsible for the complete installation of the system from the concrete surface to the completed finished installation.
- .2 This work is not to be divided to multiple contractors.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver materials in adequate crates or containers with manufacturer=s name and product description clearly marked.

.2 Handle and store tiles in a manner to avoid chipping, breakage or the instruction of foreign matter. Take precautions to protect the mortar and grout admixtures from freezing or from excessive heat.

1.6 SITE CONDITIONS

.1 Do not install Work of this Section outside of the following environmental ranges without the Consultant's and Product manufacturer's written acceptance:
- .1 Ambient air and surface temperature: 15^0C to 45^0C.
- .2 Precipitation: None.

.2 Install temporary protection and facilities to maintain the Product manufacturer's, and specified, environmental requirements for 7 Days before, during, and 7 Days after installation.

1.7 MAINTENANCE

.1 Submit extra tile amounting to 5% of gross area covered, allowing proportionately for each pattern and type specified and which are part of the same Production run as installed Products. Store maintenance Products as directed by the Consultant.

1.8 **EXTENDED WARRANTY**

.1 Submit a extended written warranty for shower area system in accordance with the General Conditions, except that warranty period is extended to 10 years.
- .1 Warrant Work against water leakage and failure to perform.
- .2 Coverage: Complete replacement including effected adjacent Work.

2 Products

2.1 **MATERIALS**

.1 General: All materials under Work of this Section, including but not limited to, sealants, adhesives, and sealers are to have low VOC content limits.

.2 Tile:
- .1 To ANSI A137.1.
- .2 Supply coves, caps, inside and outside corners and bullnose tile as required.
- .3 Where unfinished tile edge is exposed, supply cap to Consultant=s selection.
- .4 Refer to Room Finish Schedule for tile types.

.3 Ceramic Tile Base: Cove base tile to match floor tile.

.4 Ceramic Thresholds: Match floor tile, full width of door openings, at junction of ceramic tile and carpet and resilient floor materials.

.5 Floor Divider Strip: Stainless steel edge, continuous at all exposed tile edges, depth as required to suit tile thickness. >Schiene-E= by Schluter Systems or approved alternative.

.6 Wall edge protection and tile cap: Aluminum edge protection with trapezoid-perforated anchoring leg and an anodized finish, continuous at all exposed tile edges, depth as required to suit tile thickness. >Jolly= by Schluter Systems or approved alternative.

2.2 **ACCESSORIES**

.1 Cement: CAN/CSA A3000, Type GU.

.2 Sand: ASTM C144.

.3 Water: Potable and free of minerals and other contaminants which are detrimental to mortar and grout mixes.

.4 Polymer additive: Keralastic by Mapei Inc or approved alternative by Flextile Ltd. or Laticrete International.

.5 Thin-set mortar: 2 component to ANSI A108/A118/A136.1:

.1 'Kerabond with Keralastic Latex Additive' by Mapei Inc. or approved alternative by Flextile Ltd. or Laticrete International unless otherwise recommended by grout manufacturer to suit tile size or application.
.2 White coloured mortar shall be provided at appropriate tile types including, but not limited to; glass tile, light coloured marble, green marble and light coloured granite.

.6 Primer: To meet specified requirements of adhesive manufacturer.

.7 Cleaner: In accordance with TTMAC's requirements and as recommended by tile manufacturer.

.8 Crack-isolation system: Flexible, thin, fabric-reinforced, peel and stick membrane meeting ANSI A118.12 cut into strips to suit joints. 'Mapeguard 2' by Mapei Inc., or approved alternative by Laticrete International Inc. Provide manufacturer approved primer.

.9 Waterproof Membrane: Waterproof Membrane System made from black, cold-applied, self-curing, liquid rubber polymer and an integral reinforcing fabric. '9235 Waterproofing' by Laticrete International Inc. or approved alternative by Mapei Inc.

.10 Shower area system: Provide the following system for use at shower areas as manufactured by Laticrete or Mapei Inc.:
.1 Adhesive: Polymer fortified, thin-set mortar complete with antimicrobials. '254 Platinum' by Laticrete.
.2 Mortar bed: Factory mixed blend of portland cement and aggregates with latex admixture '226 thick bed mortar with 3701 admixture' by Laticrete or approved alternative.
.3 Waterproofing: Single component, self curing liquid rubber polymer. 'Hydro Ban' by Laticrete.
.4 Finish: As indicated on Interior Design drawings or schedule.
.5 Epoxy grout: High performance sanded epoxy grout 'SpectraLOCK Pro Grout' by Laticrete in colour as selected by Consultant.

.11 Grout: Polymer modified cement-based grouts exceeding 10,000 psi compressive strength. Power Grout by TEC or approved alternative. Grout colour: To be selected by the Consultant from the manufacturer's full colour range.

.12 Sealer: CAN/CGSB-25.20, penetrating, type as recommended by tile manufacturer.

.13 Joint backing: Round, closed cell, foam rod, oversized by 30% to 50%, Shore A hardness of 20, tensile strength 140 to 200 kPa.

.14 Tile sealant: In accordance with Section 07 92 00.

2.3 **MIXES**

.1 Levelling bed mix:
- .1 1 part Portland cement.
- .2 4 parts sand.
- .3 1 part water (including polymer additive), adjusted for water content of sand.
- .4 1/10 part polymer additive.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

3.2 **SURFACE PREPARATION**

.1 Clean and dry surfaces thoroughly. Remove oil, wax, grease, dust, dirt, paint, tar, primers, form release agents, curing compound, and other foreign material from substrate surfaces which may prevent or reduce adhesion.

.2 Neutralize any trace of strong acids or alkali from the substrate.

3.3 **CONTROL JOINTS**

.1 Provide control, expansion and isolation joints in accordance with TTMAC specification 301MJ and as indicated on drawings. Install in locations indicated on drawings and specified herein.

.2 Continue control, construction, and cold joints in the structural substrate up through the tile finish, and align with mortar joints where possible. Review joint locations on Site with the Consultant.

.3 Install joint widths to match grout joint widths, except where a minimum width is indicated.

.4 Install control joints in the following typical locations:
- .1 Aligned over changes in type of substrate.
- .2 At the restraining perimeters such as walls and columns.
- .3 Interior areas (not subject to sunlight): 6 mm minimum width, at 7320 mm o.c. maximum.
- .4 Interior areas (subject to sunlight): 6 mm minimum width, at 3660 mm o.c maximum.
- .5 As indicated on the Contract Drawings.

.5 Seal control joints in accordance with Section 07 92 00.

3.4 LEVELLING BED

.1 Install a levelling bed on uneven substrate surfaces, level and plumb substrates in accordance with the following tolerances:
- .1 Vertical surfaces: 3 mm in 2.4 m maximum .
- .2 Horizontal surfaces: 6 mm in 3 m from finished levels of the surface, or better.

.2 Clean structural substrate control joints and blow-clean with compressed air. Grout fill control joints flush to slab with levelling bed.

3.5 SHOWER AREA SYSTEM

.1 Install “226' and ‘3701' by Laticrete mortar bed over ‘254' by Laticrete thin set adhesive on uneven substrate surfaces, level and plumb substrates in accordance with manufacturer=s written instructions and having the following tolerances:
- .1 Vertical surfaces: 3 mm in 2.4 m maximum.
- .2 Horizontal surfaces: 6 mm in 3 m from finished levels of the surface, or better.

.2 Provide slopes to drains as indicated on drawings.

.3 Apply ‘Hydro Ban’ by Laticrete waterproofing with a spray applicator on prepared substrate to a total dry film thickness of 0.8 mm in accordance with manufacturer=s printed directions. Carry up walls to 50 mm high.

.4 Install finish materials after site inspection by manufacturer, ensuring that materials have been installed correctly and in accordance with manufacturers written instructions. Provide written inspection report verifying manufacturers warranty of system.

.5 Apply ‘SpectraLOCK Pro’ by Laticrete grout for shower area system in accordance with epoxy grout manufacturer's directions to produce watertight, filled joints without voids, cracks and excess grout. Thoroughly compact and tool grout. Finish grout flush to edge thickness of tile and remove excess grout with soft burlap or sponge moistened with clean water.

3.6 CRACK ISOLATION

.1 Apply crack-isolation system over shrinkage and non-structural hairline cracks and "spiderwebbing" cracks in structural concrete floor slabs or in concrete topping on structural concrete floor slabs.

.2 Apply liberal coat of primer with brush or roller over cracks, slightly wider than width of membrane. Roll out enough membrane to cover crack; cut and imbed while liquid is wet. Roll membrane to ensure adhesion.

3.7 WATERPROOFING MEMBRANE

.1 Apply with a trowel on prepared substrate to a total dry film thickness of 1.143 mm in accordance with manufacturer's printed directions. Carry up walls to 150 mm high.

3.8 GENERAL INSTALLATION REQUIREMENTS

.1 Install tiles in accordance with manufacturer's instructions and TTMAC Specification Guide 09300 Tile Installation Manual. Manufacturer's installation instructions govern over TTMAC Installation Manual.

.2 Lay out Work to produce a symmetrical pattern with minimum amount of cutting. Ensure cut tile at room perimeter and at joints is not less than 2 full sizes.

.3 Install trim to be placed under tile in locations indicated on Drawings.

.4 Set tiles in place and rap or beat with a beating block as necessary to ensure a proper bond and to level surface. Align tile for uniform joints and allow to set until firm. Clean excess mortar from surface of tile with a wet cloth or sponge while mortar is fresh.

.5 Adjust joints between units uniform, plumb, straight, even, and true, with adjacent tile flush. Align grout joints in both directions unless indicated otherwise.

.6 Align floor, base and wall grout joints.

.7 Install tile accessory fittings for a complete and fully coordinated tile assembly.

.8 Install wall tile full height unless indicated otherwise.

.9 Do not place tile, trim, and accessories over control, expansion, or isolation joints. Stop materials in either side on joints and provide control, expansion and isolation joints as specified.

.10 Cut and fit tile neatly around piping, fittings, joints, projections and around recesses items e.g. washroom accessories. Where surface mounted equipment and accessories are installed on tile surfaces, extend tile over surfaces. Cut edges smooth, even, and free from chipping; chipped and broken edges are not acceptable.

.11 Do not proceed with grouting until minimum 48 hours after tile has set, to prevent displacement of tiles.

.12 Apply grout in accordance with grout manufacturer's directions to produce watertight, filled joints without voids, cracks and excess grout. Thoroughly compact and tool floor grout. Finish grout flush to edge thickness of tile and remove excess grout with soft burlap or sponge moistened with clean water.

3.9 CLEANING

.1 Clean off excess grout with soft burlap or sponge moistened with clean water.

.2 Polish floor and wall tile after grout has cured in accordance with TTMAC recommendations in the Maintenance Guide; do not use acid for cleaning.

.3 Apply 2 coats of sealer to floor tile in accordance with sealer manufacturer’s printed directions.

.4 Re-point joints after cleaning as required to eliminate imperfections, then re-clean as necessary. Avoid scratching tile surfaces.

3.10 JOINT BACKING AND TILE SEALANT

.1 Install joint backing under sealant as necessary.

.2 Install tile sealant around piping and fittings extending through tiled surfaces.

.3 Seal tile control joints.

.4 Seal internal tile to tile junctions. Tool to a smooth, flush surface, free from air bubbles and contamination.

3.11 PROTECTION

.1 Prevent traffic over tiled areas, and protect tiled assemblies from weather, freezing, and water immersion, for 72 hours minimum, after final installation.

.2 Prevent direct impact, vibration and heavy hammering on adjacent and opposite walls for 24 hours minimum, after final installation.

.3 Cover work temporarily with building paper properly lapped and taped at joints until work has been approved by Consultant.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment, and services necessary for detectable/tactile tiles Work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 ASTM C1028, Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method.

.2 ISO 23599, Assistive Products for Blind and Vision-Impaired Persons - Tactile Walking Surface Indicators.

1.3 **DESIGN REQUIREMENTS**

.1 Design detectable tile system conforming to ISO 23599.

1.4 **SUBMITTALS**

.1 Product data:
- .1 Submit copies of manufacturer's Product data in accordance with Section 01 33 00 indicating:
  - .1 Performance criteria, compliance with appropriate reference standard, characteristics, limitations, and warranties.
  - .2 Product transportation, storage, handling, and installation requirements.

.2 Shop drawings:
- .1 Submit shop drawings in accordance with Section 01 33 00 indicating:
  - .1 Perimeter conditions, junctions with dissimilar materials.
  - .2 Setting details.

.3 Samples:
- .1 Submit two 300 x 300 mm samples of each type of detectable/tactile warning surfaces in accordance with Section 01 33 00.

.4 Closeout submittals: Submit recommended maintenance instructions and listing of recommended maintenance Products for incorporation into Operations and Maintenance Manuals in accordance with Section 01 78 23.

1.5 **DELIVERY, STORAGE AND HANDLING**

.1 Deliver materials in adequate crates or containers with manufacturer’s name and product description clearly marked.

.2 Handle and store tiles in a manner to avoid chipping or breakage. Take precautions to protect the adhesives from freezing or from excessive heat.

1.6 **SITE CONDITIONS**

.1 Do not install Work of this Section outside of the following environmental ranges without the Consultant's and Product manufacturer's written acceptance:
.1 Ambient air and surface temperature: Minimum 40^0F.
.2 Precipitation: None.

.2 Install temporary protection and facilities to maintain the Product manufacturers, and specified, environmental requirements for 7 Days before, during, and 7 Days after installation.

1.7 **MAINTENANCE**

.1 Submit extra tile amounting to 5% of gross area covered, allowing proportionately for each pattern and type specified and which are part of the same Production run as installed Products. Store maintenance Products as directed by the Consultant.

2 Products

2.1 **MATERIALS**

.1 All materials under Work of this Section, including but not limited to, sealants and adhesives are to have low VOC content limits.

.2 Vitrified Polymer Composite (VPC) Tile: 5 mm thick epoxy polymer tiles with ultra violet stabilized coating employing aluminum oxide particles in truncated domes providing a slip resistance of not less than 0.80 to ASTM C1028. Tile shall incorporate an in-line pattern of truncated domes measuring nominal 5 mm high x 23 mm base diameter x 11 mm top diameter, spaced 60 mm o.c. diagonally and 42 mm side by side; “VPC Surface Applied Armor-Tile” as manufactured by Engineered Plastics Inc. or approved alternative in colour to be selected.

.3 Fasteners: Colour matched, corrosion resistant, flat head drive anchor as recommended by tile Manufacturer.

.4 Adhesive: Bonding adhesive ‘Armor-Bond’ by Engineered Plastics Inc. or approved alternative.

.5 Sealant: ‘Armor-Seal’ by Engineered Plastics Inc. or approved alternative.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

3.2 **PREPARATION**

.1 Prepare substrate using steel aggregate blast method and vacuum substrate free of debris and dust.

.2 Fill minor cracks and voids and prime surfaces in accordance with manufacturer's recommendations.

.3 Project adjacent surfaces from damage resulting from this Work. Mask and/or cover adjacent surfaces, fixtures, and equipment as necessary.

.4 Clean, prime and seal surfaces as recommended by detectable tile manufacturer.

3.3 **CAST-IN-PLACE INSTALLATION**

.1 Install cast-in-place tile in accordance with manufacturers written instructions and in coordination with Division 3.

.2 Ensure concrete has been poured and finished true and smooth to required dimensions and slope prior to tile placement.

.3 Place tile into fresh concrete and tamp to ensure that top of domes are level to adjacent concrete. Do not step on tiles.

.4 Provide a 9.5 mm radius edge around tile perimeter flush to field level while concrete is still workable.

.5 Do not allow walking, leaning or external forces be placed on tile. Provide two suitable weights of 25 lb each placed on each tile as necessary to ensure solid contact of underside of tile to concrete.

.6 Remove protective plastic wrap from tile following concrete curing stage, using a sharp knife, tight to concrete/tile interface. Concrete bleed under plastic can be removed with a soft brass wire brush without damage to the tile surface.

3.4 CLEANING AND PROTECTION

.1 Clean tiles in accordance with manufacturer's written instructions.

.2 Prevent traffic over new installed detectable tiles, and protect from weather, freezing, and water immersion, for 24 hours minimum, after final installation.

.3 Cover work temporarily with plywood until work has been approved by Consultant.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Design, labour, Products, equipment and services necessary for acoustical ceilings Work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 ASTM A653/A653M, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.2 ASTM C635, Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.

.3 ASTM C636, Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.

.4 ASTM C645, Specification for Non-Load Bearing (Axial) Steel Studs, Runners (Tracks), and Rigid Furring Channels for Screw Application of Gypsum Board.

.5 ASTM E1264, Classification for Acoustical Ceiling Products.

1.3 **DESIGN REQUIREMENTS**

.1 Design ceiling suspension systems in accordance with ASTM C636 and manufacturer's printed directions.

.2 Design tile ceiling system for adequate support of electrical fixtures as required by the current bulletin of the Electrical Safety Authority. Acoustic panel system is not designed to carry the weight of electrical equipment.

.3 Design hanger anchor and entire suspension system static loading not to exceed 25% of their ultimate capacity including lighting fixture dead loads.

.4 Design tile suspension system to support weight of mechanical and electrical items such as air handling boots and lighting fixtures, and with adequate support to allow rotation/relocation of light fixtures. Acoustic panel system is not designed to carry the weight of mechanical and electrical equipment.

.5 Design subframing as necessary to accommodate, to avoid conflicts and interferences where ducts or equipment prevent regular spacing of hangers.

1.4 **SUBMITTALS**

.1 Shop drawings:
  .1 Submit shop drawings in accordance with Section 01 33 00 indicating:
    .1 Suspension system layout including hangers and supports for acoustic tile system.

.2 Acoustic panel system including suspension system, hangers, supports and panel sizes and locations.
.3 Conditions at abutting, intersecting, and penetrating construction.
.4 Dimensioned locations of lighting fixtures, diffusers, sprinkler heads and other items that pierce the ceiling plane.

.2 Samples:
.1 Submit following samples in accordance with Section 01 33 00:
.1 One full-size sample of each type of tile panels to be used.
.2 One of each type of suspension system members.

.3 Certificates: Submit written certification stating that suspended ceiling system is designed for adequate support of electrical fixtures as required by the current bulletin of the Electrical Safety Authority.

1.5 QUALITY ASSURANCE

.1 Mock-up:
.1 Construct one 10 m^2 mock-up for each type of ceiling system incorporating typical light fixture and other typical mechanical and electrical fixtures.
.2 Test the adequacy of the suspension system to support the fixtures without deflection of ceiling or failure of hanging wire anchorage. Supply copy of Test Results to Consultant.
.3 Change materials and installation methods if tests indicate proposed system is inadequate and re-test as necessary until system approved.
.4 Give early notice to Consultant and Mechanical and Electrical Trades and co-operate with them in selecting suitable location for sample ceiling and timing of installation and test.
.5 Do not commence general installation work until sample ceiling approved, then install ceiling to conform with approved samples.
.6 Mock-up may form part of final Work, if acceptable to Consultant. Remove and dispose of mock-ups which do not form part of Work.

1.6 SITE CONDITIONS

.1 Do not install the Work of this Section until:
.1 Mechanical and electrical Work above the ceiling is complete.
.2 Relative humidity is below 80 %.
.3 Ventilation is adequate to remove excess moisture.
.4 Areas are closed and protected against weather, and maintained at no less than 10 degrees C.

.2 Install temporary protection and facilities to maintain Product manufacturer's, and above specification, environmental requirements 24 h before, during, and after installation.

1.7 **MAINTENANCE**

.1 Submit extra acoustic ceilings amounting to 4% of gross ceiling area, allowing proportionately for each pattern and type specified to nearest full carton. Submit Products which are part of same production run as installed Products. Store maintenance Products as directed by consultant.

1.8 **DELIVERY, STORAGE AND HANDLING**

.1 Transport, handle and store material in manner to prevent warp, twist, damage to panel edges and surfaces in accordance with Manufacturer's recommendations.

.2 Any warped and/or damaged panels and trim shall be rejected and be replaced by new, straight, undamaged, and acceptable material at no cost to Owner.

.3 Bent, twisted, or otherwise damaged Tee grid suspension components shall not be used under any circumstances. Replace such damaged items with new undamaged material at no additional cost to Owner.

.4 Store material in warm, dry place away from water and the elements. Protect against undue loading stresses and shock.

.5 All packaged material shall be delivered in original manufacturers wrappers and containers with labels and seals intact. All cartons shall bear U.L. label.

2 Products

2.1 **MATERIALS**

.1 Galvanized steel sheet: ASTM A653/A653-M, Z275; cold rolled, galvanized steel sheet.

.2 Main carrying channels: ASTM C645; Channels formed from galvanized steel sheet, 38 x 19 mm cold rolled.

.3 Subframing: ASTM C645; Channels formed from galvanized steel sheet, dimensions and spans as required.

.4 Hangers: 2.6 mm minimum diameter, galvanized steel wire.

.5 Tie wire: 1.6 mm minimum diameter, soft annealed galvanized steel wire.

.6 Concrete anchors: tie wire sleeve anchors, ‘Redi-Drive Anchors' by ITW Red Head or approved alternative.

.7 Wall mouldings and accessories, including but not limited to, corner caps, edge mouldings, panel hold over clip, metal closures, and trim. Finish and colour: same as main tees.

.8 Exposed main, cross tees, and relocatable cross tees: ASTM C635, 38 mm high steel, bulb tee design double steel web, rectangular single spans without exceeding a deflection of 1/360 of the span. Splices to be integral and reversible; cross tee interlocking into main tee. Colour and finish: Manufacturer's standard white.

.1 Suspension system:

.1 'Prelude XL' 15/16" Exposed Tee by Armstrong World Industries Inc.

.2 'GWDX' 15/16" by CGC Inc.

.3 'EZ Stab Classic' 15/16" by Certainteed Architectural.

.9 Acoustic tile **(ACT-1)**: All Offices, corridors, dormitories, training room, day room & duty watch room.

.1 Basis of Design: Subject to compliance with project requirements, the design is based on the following: USG Interiors, LLC, "Mars High-NRC/High-CAC with plant-based binder".

.2 Classification: Provide ceiling panels complying with ASTM E 1264 for type, form and pattern as follows:

.1 Type: IV, mineral base with membrane faced overlay

.2 Form: 1 & 2, Nodular and water felted

.3 Pattern: E & G, smooth and light texture

.3 Color: **Flat White 050**

.4 LR: Not less than 0.90

.5 NRC: Not less than **0.90**

.6 CAC: Not less than **30**

.7 Edge/Joint Detail: **SQ Square.**

.8 Suspension Grid/Width: **DXT 15/16 inch**

.9 Panel Thickness: **1 inch (25 mm).**

.10 Modular Size: **24 by 48 inches (610 by 1220 mm) & 12 by 48 inches (310 by 1220 mm)**

.11 Recycled Content: **67%.**

.12 High Recycled Content: Classified as containing greater than 50% total recycled content. Total recycled content is based on product composition of post-consumer and pre- consumer post-industrial recycled content per FTC guidelines.

.13 VOC Emissions: Meets CA Specification 01350, GreenGuard Gold certified Low VOC.

.14 ClimaPlus™ 30 year warranty performance: Contains a broad spectrum antimicrobial additive on the face and back of the panel that provides resistance against the growth of mold and mildew. Includes sag resistance performance.

.10 Acoustic tile **(ACT-2)**: Washrooms, Locker Rooms, Fitness room, laundry room, universal washroom and north corridor.

.1 Basis of Design: Subject to compliance with project requirements, the design is based on the following: USG Interiors, LLC, "Mars Healthcare". High NRC Panel 80/40"

.2 Classification: Provide ceiling panels complying with ASTM E 1264 for type, form and pattern as follows:

.1 Type: IV, mineral base with membrane faced overlay

.2 Form: 1 & 2, Nodular and water felted
.3 Pattern: E & G, light texture and smooth
.3 Color: Manufacturers standard Flat White 050.
.4 LR: Not less than 0.90
.5 NRC: Not less than **0.80**
.6 CAC: Not less than **35**
.7 Edge/Joint Detail: **SQ Square.**
.8 Suspension Grid/Width: **DXT 15/16 inch**
.9 Panel Thickness: **1 inch (25 mm).**
.10 Modular Size: **24 by 48 inches (610 by 1220 mm) & 12 by 48 inches (310 by 1220 mm)**
.11 Recycled Content: **69% Minimum.**
.12 High Recycled Content: Classified as containing greater than 50% total recycled content. Total recycled content is based on product composition of post-consumer and pre- consumer post-industrial recycled content per FTC guidelines.
.13 VOC Emissions: Meets CA Specification 01350, GreenGuard Gold certified Low VOC.
.14 ClimaPlus™ 30 year warranty performance: Contains a broad spectrum antimicrobial additive on the face and back of the panel that provides resistance against the growth of mold and mildew. Includes sag resistance performance.

.11 left blank intentionally

.12 Trim:
.1 Trim Channel: Extruded aluminum, alloy 6063.
.2 Hanging Clip: Commercial quality aluminum.
.3 T-Bar Connector Clip: Commercial quality aluminum.
.4 Splice Plate: Galvanized steel.
.5 Finish: Factory-applied baked polyester paint finish.
.6 'Axiom Knife Edge Trim' by Armstrong or approved alternative.

.13 Wall mouldings: To match acoustical ceiling suspension system.

3 Execution

3.1 EXAMINATION

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

3.2 SUSPENSION SYSTEM

.1 Coordinate locations and openings of mechanical and electrical services support, and penetration through the acoustical ceilings. Coordinate field conditions, clearances,

measurements, and mechanical and electrical services testing and commissioning, above the acoustical ceilings.

.2 Install hanger wires plumb and securely anchored to the building structural framing, independent of walls, pipes, ducts, and metal deck; install additional framing and hangers to bridge interference items.

.3 Install acoustical ceiling systems in accordance with manufacturer's written instructions, reviewed shop drawings, and ASTM C636, listed in order of precedence.

.4 Install hanger wires at 1200 mm maximum centres along carrying channels, not less than 25 mm, and not more than 150 mm from channel ends.

.5 Install additional hangers at lighting fixture and air distribution ductwork locations. Do not attach hanger wires to mechanical or electrical equipment. Do not support mechanical and electrical fixtures and fitting on ceiling without the ceiling manufacturer's written acceptance.

.6 Install acoustical ceiling suspension system to a tolerance of 1:1200 of span and 0.4 mm maximum between adjacent metal members. Tolerances are not cumulative. Refer to Electrical Contract Drawings for fixture layout.

.7 Do not bend or twist hangers as a means of levelling. Form double loops tightly and lock to prevent vertical movement or rotation within the loop.

.8 Install edge moulding at intersection of ceiling and vertical surfaces.

.9 Centre acoustical ceiling suspension systems on room axis; install equal border pieces. Install hangers onto the ends of main tee runners at not more than 150 mm from ends of runners, adjacent and perpendicular to walls.

.10 Support the suspension system independently of walls, columns, ducts, pipes and conduits.

.11 Install main runners in maximum available lengths. Layout joints in suspension members to avoid the perimeters of recessed fixtures. Lock grid members to form a rigid assembly. Install additional tee, suspension system framing around recessed fixtures, diffusers, grilles and other items for a complete assembly.

3.3 ACOUSTIC LAY-IN TILES

.1 Install acoustic tile in grid and trim system openings supported by bottom flanges of members. Provide special shapes and sizes to provide a complete installation by cutting tile to fit into openings. Fit tile moderately tight between upright legs of members.

.2 Carefully cut and trim acoustic tiles to accommodate items piercing the finished ceiling plane.

.3 Remove and replace acoustic tiles with broken edges, or damaged, marked, discoloured, soiled, or stained faces.

3.4 ADJUSTMENTS AND CLEANING

.1 Clean soiled or discoloured surfaces of exposed work on completion of work.

.2 Replace components which are visibly damaged, marred or uncleanable.

END OF SECTION

1 GENERAL

1.1 GENERAL PROVISIONS

.1 Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

.1 **Work Included:** Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

i. Rubber Tile Flooring

ii. Substrate Preparation

.2 **Related Work:** The following items are not included in this Section and are specified under the designated Sections:

iii. Section 03 30 00 CAST-IN-PLACE CONCRETE for concrete substrate; slab surface tolerances

iv. Section 06 10 00 ROUGH CARPENTRY for plywood substrate and surface tolerances

v. Section 09 69 00 ACCESS FLOORING for resilient floor covering for access panels

.3 **References (Industry Standards):**

vi. ASTM International (ASTM):

a. ASTM D2047, Standard Test Method for Static Coefficient of Friction as Measured by the James Machine

b. ASTM E648, Standard Test Method for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source ASTM D2240, Standard Test Method for Rubber Property – Durometer Hardness

c. ASTM F970, Standard Test Method for Static Load Limit

d. ASTM F970 (Modified), Modified Test Method for Max weight Limit

e. ASTM F1515, Standard Test Method for Measuring Light Stability of Resilient Flooring by Color Change

f. ASTM E90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

g. ASTM E492, Standard Test Method for Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using the Tapping Machine

h. ASTM E2179, Standard Test Method for Laboratory Measurement of the Effectiveness of Floor Coverings in Reducing Impact Sound Transmission Through Concrete Floors

i. ASTM F710, Standard Practice for Preparing Concrete to Receive Resilient Flooring

j. ASTM F1482, Standard Guide to Wood Underlayments products Available for Use Under Resilient Flooring

k. ASTM F1869, Standard Test Method for Measuring Moisture Vapor Emissions Rate of Concrete Subfloor using Anhydrous Calcium Chloride

l. ASTM F2170, Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs using in situ Probes.

vii. National Fire Protection Association (NFPA):

a. NFPA 253, Test Method for Critical Radiant Flux of Floor Covering Systems Using a Radiant Energy Source

1.3 SUBMITTALS

.1 **General:** Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures.

.2 **Product Data:** Submit manufacturer's technical data sheet, care & maintenance document, submittal and/or warranty for each material and accessory proposed for use (available at www.roppe.com).

.3 **Samples:** Submit representative samples of each product specified for verification, in manufacturer’s standard size samples of each resilient product color, texture and pattern required.

1.4 QUALITY ASSURANCE

.1 **Manufacturer Qualifications:** Provide resilient flooring materials manufactured in the United States of America by a firm with a minimum of 10 years’ experience with resilient flooring materials of type equivalent to those specified.

i. Provide resilient flooring products, including wall base, accessories, and subfloor preparation products from one manufacturer to ensure color matching and compatibility.

ii. Manufacturer shall be capable of providing technical training and technical field service representation.

.2 **Installer Qualifications:** Installer must be professional, licensed, insured, and familiar with the resilient flooring material to be installed. Project Managers or Field Supervisors must be INSTALL (International Standards & Training Alliance) certified CFI (Certified Floorcovering Installers) Certified and/or an FCICA (The Flooring Contractors Association) CIM (Certified Installation Manager) for the requirements of the project.

.3 **Sustainable Design Requirements:**

iii. Rubber Tile that has a published EPD.

iv. Rubber Tile that has a published HPD.

v. Rubber Tile and accessories that are easily cleaned and do not require coatings and stripping, or use chemicals that may be hazardous to human health.

vi. Rubber Tile is SCS FloorScore® Certified and meets California Specifications Section 01350.

vii. Rubber Tile manufactured in a Facility that is ISO 14001 Certified.

viii. Rubber Tile free of materials known to be teratogenic, mutagenic or carcinogenic including halogens, asbestos and chlorines.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Deliver materials in labeled packages. Store and handle in strict compliance with manufacturer's recommendations. Protect from damage due to weather, excessive temperatures, and construction operations.

.2 Deliver materials sufficiently in advance of installation to condition materials to the required temperature for 48-hours prior to installation.

1.6 PROJECT CONDITIONS

.1 Install Rubber Tile after other finishing operations, including painting, have been completed.

.2 Maintain temperature at service levels and/or the ambient temperature must remain steady (± 10° F) between 65° F and 85° F for at least 48-hours prior to, during and until substantial completion.

.3 Maintain relative humidity at service levels, or between 40% and 65% RH.

.4 Avoid conditions in which dew point causes condensation on the installation surface.

1.7 WARRANTY

.5 Provide manufacturer’s standard limited commercial warranty to cover manufacturing defects

2 PRODUCTS

2.1 MANUFACTURER

.1 Basis-of-Design: Roppe Corporation | 1602 N Union St. | Fostoria, OH 44830 | P: (800) 537-9527

.2 Substitutions: No substitutions permitted.

2.2 PRODUCTS

.1 TUFLEX RUBBER TILE FLOORING

i. Roppe Tuflex Spartus Rubber Tile Flooring can be used in interior or exterior applications.

ii. Roppe ***Tuflex Spartus*** Rubber Tile Flooring colour: 936 Dusk

iii. Roppe Tuflex Rubber Tile Flooring, Specify Dimensions: Interlocking: 25 ¾" x 25 ¾" x 3/8" (9mm)

iv. Thickness: 3/8" (9 mm)

v. Surface Finish: Smooth

vi. ASTM D2047, Static Coefficient of Friction; > 0.8

vii. ASTM F648/NFPA 253, Critical Radiant Flux; Class 1, > 0.45 W/cm^2

viii. ASTM F970, Static Load Limit; Passes 250 PSI

ix. ASTM F970, Modified Static Load Limit; Passes 1,000 PSI

x. ASTM F1515, Light Stability: Passes $\Delta E < 8$

xi. ASTM E492, Acoustical (Impact Insulation Class) Impact; IIC 52 (6" concrete, no drop ceiling), 67 IIC (6" concrete, with drop ceiling).

xii. ASTM E90, Acoustical (Sound Transmission Class) STC 52 (6" concrete, no drop ceiling), STC 63 (6" concrete, with drop ceiling)

xiii. ASTM E2179, Effectiveness of Floor Covering; ΔIIC 22

xiv. Tuflex Spartus Rubber Tile is free of PVC.

xv. Tuflex Spartus Rubber Tile is Phthalate-free.

xvi. Tuflex Spartus Rubber Tile has a documented EPD (Environmental Product Declaration).

xvii. Tuflex Spartus Rubber Tile has a documented HPD (Health Product Declaration v2.1).

xviii. Tuflex Spartus Rubber Tile can be viewed on mindfulMaterials website.

xix. Tuflex Spartus Rubber Tile is manufactured in a facility that is ISO 14001:2015 Compliant.

xx. Tuflex Spartus Rubber Tile is FloorScore Certified.

xxi. Tuflex Spartus Rubber Tile contains no crumb rubber.

xxii. Tuflex Spartus Rubber Tile is Red List Chemical free.

xxiii. Tuflex Spartus Rubber Tile is made in the USA.

xxiv. Tuflex Rubber Tile is 100% Recyclable using the Roppe Impact Program.

xxv. Tuflex Spartus Rubber Tile is designed for a 'Circular Economy'.

xxvi. Tuflex Spartus Rubber Tile carries a 10 year Limited Warranty when installed following the manufacturer's installation instructions and adhesive recommendations.

2.3 INSTALLATION AND MAINTENANCE MATERIALS

.1 Moisture Mitigation: Moisture testing is required for all Tuflex Rubber Tile installations. Mitigation should be performed if results indicate high levels of moisture. Recommended Moisture Mitigation Product:

i. Excelsior MM-100, Moisture Mitigation provided by Roppe

a. Unit Size: 2.5 Gallons

b. Coverage: 1000 square feet per unit with one coat

c. MM-100 is a water, solvent and VOC free, polyurethane-based moisture mitigation product used to treat concrete slabs with excessive moisture levels beyond what flooring adhesives allow.

d. MM-100 can block moisture up to 20 lbs. MVER or 99% RH.

e. MM-100 is a single component product, eliminating extensive mix times and concerns regarding pot life.

f. MM-100 does not require aggressive concrete preparation, such as shotblasting or diamond grinding.

g. MM-100 is not recommended as a moisture mitigation system over a non-porous substrate. The substrate should be porous as per ASTM F3191 with 90% of the original substrate exposed.

h. MM-100 is a two coat system that is incredibly easy to apply and does not require any specialized equipment, its excellent coverage rates also make it incredibly cost effective.

i. Despite being a two coat system, MM-100 is incredibly fast drying.

j. Flooring or subsequent coatings can be installed in less than two hours.

k. Backed by a 10 year material and labor warranty, MM-100 is a fast and easy solution for the moisture issues that commonly plague flooring installations.

.2 Substrate Preparation Products: Substrates should be prepared to properly receive the resilient flooring products being specified. Trowelable leveling and patching compounds that are latex-modified, Portland cement based or blended hydraulic cement based formulation. Recommended Substrate Preparation Products:

ii. Excelsior NP-230, Non-Porous Substrate Primer provided by Roppe
   a. Unit Size: 2.5 Gallons
   b. Coverage: 1000 Square Feet per unit with one coat
   c. Used over MM-100 to promote adhesion of cementitious materials
   d. Single component and fast drying to allow for quick and easy installation
   e. Contains an aggregate to provide mechanical bond for cementitious materials

iii. Excelsior CP-300, Cementitious Patch provided by Roppe
   a. Unit Size: 10 lb. Unit
   b. Coverage: 33 Square Feet per unit @ 1/8”
   c. Doesn’t require primer over porous substrates
   d. Install flooring in as little as 30 minutes

iv. Excelsior SU-310, Self-Leveling Underlayment provided by Roppe
   a. Unit Size: 50 lb. Bag
   b. 5500 PSI Compressive Strength after 28 days
   c. Install flooring within 12 hours
   d. Pumpable

.3 Adhesives: Adhesives should be selected based on the site conditions and use of the space being installed. Recommended Adhesive Products:

v. Excelsior MS-700, Modified Silane Wet-Set Adhesive provided by Roppe
   a. Unit Size: 3 Gallon
   b. Coverage: 480-705 Square Feet per unit
   c. Standard installations over porous and non-porous substrates
   d. Excellent green grab
   e. Hard set adhesive adding to dimensionally stable materials
   f. Excellent sheer strength
   g. Approved for Hill-Rom Beds
   h. Superior bond strength

i. Great for environments with topical moisture
j. Great for exterior applications

k. Installation Limits, Indoor Installations only
(1) 95% RH, ASTM F2170
(2) 10 lbs. MVER, ASTM F1869

vi. Excelsior EW-710, Epoxy Wet-Set Adhesive provided by Roppe
a. Unit Size: 1 Gallon
b. Coverage: 120 – 135 Square Feet per unit
c. Standard installations over porous and non-porous substrates
d. Excellent green grab
e. Hard set adhesive adding to dimensionally stable materials
f. Excellent sheer strength
g. Approved for Hill-Rom Beds
h. Superior bond strength
i. Great for environments with topical moisture
j. Great for exterior applications
k. Installation Limits, Indoor Installations only
(1) 90% RH, ASTM F2170
(2) 6 lbs. MVER, ASTM F1869
(3) 7-10 pH

.4 **Maintenance Materials:** Proper maintenance of the installation is critical to the long term performance of the flooring products being specified. Using the appropriate chemicals to maintain the product according to the environment in which it is specified is critical. Recommend maintenance products:

vii. Excelsior NC-900, All Purpose Neutral Cleaner
a. For initial maintenance

viii. Excelsior CM-910, Cleaner Maintainer
a. For initial and routine maintenance

ix. Excelsior PF-960, Performance Finish provided by Roppe
a. For initial maintenance

x. Excelsior PR-930, Performance Remover
a. For heavy cleaning and restorative maintenance

3 EXECUTION

3.1 GENERAL

.1 General Contractor Responsibilities:

i. Supply a safe, climate controlled building and subfloor as detailed in Roppe Technical Data Sheets.

ii. Ensure substrate meets the requirements of ASTM F710, Roppe Technical Data Sheets and Excelsior Technical Data Sheets.

iii. Provide a secure storage area that is maintained permanently or temporarily at normal operating temperature and humidity conditions between 65° F and 85° F and between 40% and 65% relative humidity, for at least 48-hours prior to and during the application of the flooring, so the flooring contractor can acclimate the flooring materials per manufacturer's instructions.

iv. Provide an installation area that is weather tight and maintained either permanently or temporarily at ambient service temperature and humidity. Normal operating temperature and humidity conditions are between 65° F and 85° F and between 40% and 65% relative humidity, for at least 48-hours prior to and during the application of the flooring per the manufacturer's instructions.

v. Ensure areas with direct prolonged exposure to sunlight are protected with protective UVA/UVB restrictive coatings or films.

vi. Areas of the flooring that are subject to direct sunlight through doors or windows should have them covered using blinds, curtains, cardboard or similar for the time of the installation and 72-hours after the installation to allow the adhesive to cure. Note: These areas should be installed using wet adhesives only.

vii. Conduct initial maintenance prior to final usage per the Roppe Care & Maintenance Documents. Do not conduct initial maintenance until adhesive has cured per the adhesive technical data.

.2 Flooring Contractor Responsibilities:

viii. Provide trained installers that are professional, licensed, insured and familiar with the resilient flooring material to be installed.

ix. Ensure installers or installation teams meet one of the following requirements:

a. Have completed INSTALL (International Standards & Training Alliance) or CFI (Certified Floorcovering Installers) training programs and/or are certified by INSTALL or CFI.

b. Are being supervised by Project Managers or Field Supervisors that are INSTALL (International Standards & Training Alliance) certified.

c. CFI (Certified Floorcovering Installers) Certified and/or an FCICA (The Flooring Contractors Association) CIM (Certified Installation Manager).

x. Follow all requirements in the appropriate Roppe and/or Excelsior Technical Data Sheets, Care & Maintenance Documents, Warranties and other technical documents or instructions.

xi.

3.2 EXAMINATION

.1 **General**: Follow guidelines laid out in Division 01, Section 01 71 00 – Examination and Preparation, as well as Section 01 43 00 – Quality Assurance.

.2 **Verification of Conditions:** Inspect all substrates to ensure they are clean, smooth, permanently dry, flat, and structurally sound. Confirm all areas are properly sealed and acclimated per manufacturer's requirements.

.3 **Verification of Products:** In accordance with manufacturer's installation requirements, visually inspect material for size, color or visual defects prior to installing. Any material that is incorrect or visually defective shall not be installed.

3.3 SUBSTRATE PREPARATION

.1 **General**: Follow guidelines laid out in Division 01, Section 01 71 00 – Examination and preparation. All work required, ensuring substrate or subfloor meets manufacturers' guidelines are the responsibility of the general contractor.

.1 **Preparation**: Ensure substrate meets the requirements of ASTM F710 for concrete substrates and ASTM F1482 for wood substrates and/or Roppe Technical Data Sheets and Excelsior Technical Data Sheets.

i. Substrates must be free of visible water or moisture, dust, sealers, paint, sweeping compounds, curing compounds, residual adhesives and adhesive removers, concrete hardeners or densifiers, solvents, wax, oil, grease, asphalt, visible alkaline salts or excessive efflorescence, mold, mildew and any other extraneous coating, film, material or foreign matter.

ii. It is recommended that all substrates have a floor flatness of FF32 and/or flatness tolerance of 1/8" in 6' or 3/16" in 10'.

iii. Acclimate all products to be used during the installation and the installation environment prior to installation according to the manufacturers written instructions

.2 Concrete Substrates:

iv. **Moisture Testing:** Perform moisture testing per the manufacturer's recommendations to determine conditions, it is recommended to treat new and existing slabs a little bit different to ensure adequate conditions exist for installation.

a. New Slabs on all grade levels: it is recommended to perform ASTM F2170 Relative Humidity testing no more than a week prior to installation too determine the levels present and when to proceed with the installation.

b. Existing Slabs on all grade levels: in addition to ASTM F2170 testing, existing slabs that have previously had floor covering installed, must be tested to ASTM F1869 Calcium Chloride test kits to determine the MVER of the concrete.

v. Mechanically remove contamination on the substrate that may cause damage to the flooring material, this includes paint, permanent and non-permanent markers, pens, crayons, etc. Leaving these on the substrate or marking with them on the back of the material could cause bleed through and damage the flooring.

vi. Fill cracks, holes, depressions and irregularities in the substrate to prevent transferring through to the surface of the resilient flooring. Use a high-quality Portland cement based product such as Excelsior installation products provided by Roppe.

vii. Do not install material over expansion joints.

3.4 INSTALLATION

.1 General: Follow all relevant guidelines detailed in Division 01, as well as flooring and adhesive manufacturer's technical data sheets.

.2 Rubber Tile: Install material in accordance with manufacturer's recommendations:

i. Select the appropriate adhesive for the application and job site conditions.

ii. Install material according to directional arrows on the back of the material and do not reverse tiles.

iii. Ensure material is rolled appropriately into the adhesive using a 100 lb. three section roller.

3.5 CLEANING & MAINTENANCE

.1 **General**: Clean up installation area and sweep, dust or wipe material to remove any dirt, dust or debris.

.2 **Initial Maintenance**: Conduct initial maintenance per the manufacturer's recommended procedures stated in the Maintenance Documents. All documentation is available upon request or from the Roppe website: www.roppe.com Excelsior Cleaning and Maintenance products are the recommended products for use. All can be found linked to the product on the Roppe website or at www.excelsiorproducts.net.

.3 **Regular Maintenance**: Advise & train Owner on proper regular maintenance to be performed on regular intervals as needed. Insufficient cleaning will reduce the wear life of the flooring. The amount of maintenance depends directly upon the amount of dirt and particulates the floor is subjected to.

3.6 CLOSEOUT ACTIVITIES

.1 **General**: Follow all federal, state and local requirements and Division 01 Section 01 76 00 – Protecting Installed Construction and Section 01 78 00 – Closeout Submittal requirements for these activities.

.2 **Protection**: Protect newly installed material with construction grade paper or protective boards, such as Masonite or Ram Board, to protect material from damage by other trades. Be sure all construction debris is swept up and removed prior to the protective material being installed and does not get trapped underneath. Limit usage and foot traffic according to the adhesive's requirements. When moving appliances or heavy furniture, protect wall base from scuffing and tearing using temporary floor protection as well.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment, and services necessary for epoxy flooring Work in accordance with the Contract Drawings.

1.2 **SUBMITTALS**

.1 Product data: Submit manufacturer's Product data in accordance with Section 01 33 00 indicating:
- .1 Two copies of manufacturer's Product data on characteristics, performance criteria, and limitations.
- .2 Preparation, installation requirements and techniques, Product storage, and handling criteria.

.2 Samples: Submit duplicate samples of each type and colour of epoxy flooring mounted on 250 x 200 mm hardboard in accordance with Section 01 33 00.

.3 Reports: Submit manufacturer's acceptance of substrate prior to installation in writing. Submit verification of moisture content of floor prior to installation.

.4 Close-out submittals: Submit maintenance data for incorporation into Operations and Maintenance manuals.

1.3 **QUALITY ASSURANCE**

.1 Perform Work of this Section by a company that has a minimum of five years proven experience in installations of a similar size and nature and that is approved by manufacturer. Submit to Consultant, applicator’s current certificate of approval by the material manufacturer as proof of compliance.

.2 Mock-up:
- .1 Construct one 1 m^2 mock-up of each type and colour of epoxy flooring in location acceptable to Consultant.
- .2 Arrange for Consultant's review and acceptance, allow 48 hours after acceptance before proceeding with Work.
- .3 Mock-up may remain as part of Work if accepted by Consultant. Remove and dispose of mock-ups which do not form part of Work.
- .4 Upon acceptance, mock-up shall serve as a minimum standard of quality for the balance of the work of this Section.

.3 Pre-installation meetings: Arrange with manufacturer's representative and Consultant to inspect substrates, and to review installation procedures 48 hours in advance of installation.

1.4 **SITE CONDITIONS**

.1 Do not install the Work of this Section outside of the following environmental ranges without Product manufacturer's written acceptance:
- .1 Ambient air and surface temperature: 15^0C to 30^0C.
- .2 Relative Humidity: In accordance with manufacturers' requirements.
- .3 When no dust is being raised.
- .4 In well-ventilated and broom clean areas.

.2 Do not apply epoxy flooring over materials that contain over 4% moisture.

.3 Install temporary protection and facilities to maintain the Product manufacturers, and the above specification, environmental requirements for 24 hours before, during, and 24 h after installation.

.4 Post do not enter and appropriate warning signs at conspicuous locations.

1.5 **DELIVERY, STORAGE, AND HANDLING**

.1 Package, seal and label each epoxy flooring material to show manufacturers and product name, and colour.

.2 Store materials at site in an area specifically set aside for purpose that is locked, ventilated, and maintained at a minimum temperature of 16^oC.

.3 Ensure that health and fire regulations are complied with in storage area, and during handling and application.

1.6 **EXTENDED WARRANTY**

.1 At completion of this work, provide a signed Sealant and Waterproofing Association warranty to the Owner covering defects of workmanship and materials for a period of 2 years commencing from Contract Completion. Agree to make good promptly any defects which occur or become apparent within the warranty period in conjunction with the membrane manufacturer’s warranty. Defects shall include but not be limited to leakage, deformation, and failure to stay in place. Coverage includes complete replacement including affected adjacent Work at no cost to Owner.

2 Products

2.1 **MATERIALS**

.1 General:
- .1 All materials under Work of this Section, including but not limited to, primers and epoxy flooring are to have low VOC content limits.

.2 Each material used in the application of each flooring system shall be as recommended or manufactured by the supplier of the flooring system.

.2 Epoxy flooring: Apply to manufacturers recommended thickness.

Colours and finishes: As noted below;

Apparatus Bay Area and all other rooms: 'Stonclad GS' with Stonkote GS4 Topcoat and texture 3 as manufactured by Stonhard or approved alternative by BASF or Sika Construction. Colour: 'Silver Grey' field, with 'Yellow' vehicle guidelines and safety lines as noted on plans. Cover entire floor area for all rooms noted as EP-1 floor finish on the contract documents.

.3 Primer: As recommended by manufacturer.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

.2 Verify that concrete floor has cured 28 days minimum, and that substrate is acceptable to epoxy manufacturer.

.3 Test surfaces for moisture content to ensure that they are suitable for application.

3.2 **PREPARATION**

.1 Prepare substrate using steel aggregate blast method and vacuum substrate free of debris and dust.

.2 Fill minor cracks and voids and prime surfaces in accordance with manufacturer's recommendations.

.3 Project adjacent surfaces from damage resulting from this Work. Mask and/or cover adjacent surfaces, fixtures, and equipment as necessary.

.4 Fill open control joints, and other cracks and voids with material compatible with epoxy materials.

.5 Clean prime and seal surfaces as recommended by epoxy manufacturer.

3.3 APPLICATION

.1 Apply epoxy flooring in accordance with manufacturer's printed instructions. epoxy manufacturer shall supervise application.

.2 Stop epoxy in a straight line on each side of control joints; fill space over expansion joint with a self-levelling, non-sag polyurethane sealant.

.3 Apply epoxy with care to ensure that no laps, voids, or other marks or irregularities are visible, and with an appearance of uniform colour, sheen, and texture, all within limitations of materials and areas concerned.

.4 Match colours and textures of approved samples.

.5 Make clean true junctions with no visible overlap between adjoining applications of epoxy.

.6 Chase edge of adjacent floor systems so that epoxy finishes flush with adjacent floor systems.

.7 Provide 100 mm coved base at room perimeter and at built-in fitment locations. Form cove with 25 mm radius.

3.4 SITE TOLERANCES

.1 Finish surfaces shall be level, or straight where sloped to drains, within a tolerance of 1.5 mm in 3 m, and shall not vary more than 0.8 mm in any running 300 mm.

3.5 REPAIR

.1 Touch-up and refinish minor defective work. Refinish entire coated surface areas where finish is damaged or otherwise unacceptable.

3.6 CLEANING

.1 Remove promptly as work progresses spilled or spattered materials from surfaces of work performed under other Sections. Clean floors on completion of work. Do not mark surfaces while removing.

.2 Leave storage and mixing areas in same condition as equivalent spaces in project.

3.7 PROTECTION

.1 Erect barriers to prevent the entry and presence of personnel not performing work of this Section during application of epoxy flooring, and for 48 hours following completion of application.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services necessary for carpet Work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 Canadian Carpet Institute (CCI), Contract Carpet Manual, No. 001.

.2 CGSB 4-GP-36M, Carpet Underlay, Fiber Type.

.3 CAN/CGSB 4.155-M, Flammability of Soft Floor Covering.

1.3 **SUBMITTALS**

.1 Product data:
- .1 Submit two copies of manufacturer's Product data for each product specified in accordance with Section 01 33 00 indicating:
  - .1 Performance criteria, characteristics, and limitations.
  - .2 Product transportation, storage, handling, and installation requirements.

.2 Shop drawings:
- .1 Submit shop drawings in accordance with Section 01 33 00 indicating:
  - .1 Carpeted floor areas, carpet selection, pile direction, location and direction of seams, cross joints, and other details required by Consultant to clarify work.

.3 Samples:
- .1 Submit following samples in accordance with Section 01 33 00.
  - .1 Submit duplicate 300 mm square pieces of underpad, and carpet specified, 300 mm long pieces of carpet base and cap strip, 150 mm lengths of carpet gripper and binder bars and moulding.

.4 Certification:
- .1 Submit certification that carpet has been tested and passed the Indoor Air Quality (IAQ) Carpet Testing Program requirements of the Canadian Carpet Institute.
- .2 Four weeks after Notification of Award, submit certification from carpet manufacturer that carpet has been ordered.
- .3 Submit program parameters for recycling.

.5 Closeout submittals: Submit maintenance and cleaning data for incorporation into Operations and Maintenance Manuals in accordance with Section 01 78 23.

1.4 **SITE CONDITIONS**

.1 Do not install Work of this Section when the ambient air and surface temperature is below 18^0C or above 40^0C without Consultant's and Product manufacturer's written acceptance.

.2 Supply and install temporary protection and facilities to maintain Product manufacturer's, and above specified environmental requirements for 24 hours before, during, and 24 hours after installation.

1.5 **MAINTENANCE**

.1 Submit extra 3% each colour, pattern and type of flooring material required for maintenance use. Extra materials to be from same production run as installed materials and clearly labelled. Provide in one continuous full width roll. Store where directed.

.2 Upon completion of the work of this Section, bundle and wrap all large remnant pieces of carpet remaining and store where directed by Consultant.

2 Products

2.1 **MATERIALS**

.1 General: All materials under Work of this Section, including but not limited to, adhesives are to have low VOC content limits.

.2 Carpet tile: Refer to Room Finish Schedule for carpet tile types (CP1 & CP2).

.3 Undercushion: CGSB 4-GP-36M, open cellular rubber reinforced with solid rubber particles bonded to fibreglass/cellulose backing forming a cushion of 6 mm thickness. Undercushion shall meet CAN/CGSB 4.155-M for flame spread and smoke density ratings. Undercushion shall be ‘Duracushion’ manufactured by Dura Undercushions Ltd. or approved alternative.

.4 Seaming tape: Types recommended by carpet manufacturer for purpose intended.

.5 Adhesive connectors (carpet tile): Pressure sensitive adhesive squares/circles for glue-free installation. ‘Tac-Tile’ by interface, ‘Lok Dots’ by Shaw Contract Group or approved alternative.

.6 Binder bars: Anodized aluminum finish, self-gripping bar of type recommended by carpet manufacturer, in colour to match carpet selection.

.7 Reducing edge strips, thresholds: Nitrile rubber plasticized vinyl, 80-95 Shore A Durometer, adhesive as recommended by manufacturer.

.8 Carpet cap strip: extruded vinyl, No. 703 manufactured by Finercraft Plastic Products Inc., or approved alternative. Standard colour as selected by Consultant.

.9 Carpet protection: Non-staining heavy duty kraft paper.

.10 Concrete skim coat compound: High-performance, rapid-setting cement based skim coating compound. 'Ultra SkimCoat' by Mapei or approved alternative for filling minor voids and leveling existing substrate.

3 Execution

3.1 EXAMINATION

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

3.2 PREPARATION

.1 Verify substrate surfaces are solid, free from surface water, dust, oil, grease, scaling or laitance, projections and other foreign matter detrimental to performance.

.2 Repair depressions and cracks with latex base compound or water putty crack filler. Sweep and vacuum surfaces before laying carpet.

.3 Pre-condition carpeting following manufacturer's printed instructions.

.4 Install vinyl carpet cap strip for carpet base before proceeding with carpeting.

3.3 CARPET GRIPPERS AND BINDER BARS

.1 Install carpet grippers to conform to high and low spots in floor, using carpet gripper cement, concrete nails or other approved fastening device.

.2 Use carpet grippers at walls and vertical surfaces; metal binder bars and mouldings at exposed carpet edges.

3.4 UNDERCUSHION INSTALLATION

.1 Lay undercushion using minimum number of pieces. Secure undercushion to prevent shifting.

.2 Butt edges firmly together. Lay up to edge of gripper and tape joints. Remove bubbles and slightly stretch.

.3 Anchor undercusion at projections and where cut to contours.

.4 Offset undercusion seams minimum 300mm from carpet seams.

.5 Omit undercusion behind carpet on vertical surfaces.

.6 Where undercusion is to be installed on or below grade slabs, lay polyethylene film over entire area. Lap joints minimum 150mm and tape to prevent shifting.

3.5 **CARPET TILE INSTALLATION**

.1 Install floor carpet in accordance with pattern layout and reviewed shop drawings, manufacturer's printed instructions and in accordance with Contract Carpet Manual, Standard for Installation of Textile Floor covering Materials No. 001.

.2 Cut and install carpet to fit tightly and neatly around perimeter of carpeted areas, around permanent fixtures and around projections through the floor.

.3 Adhesive connector method:
- .1 Perimeter tiles shall be cut net to wall, where perimeter tile does not extend to a surface for butting, perimeter tile shall be installed using adhesive.
- .2 Lay anchor rows, placing adhesive connector at every joint.
- .3 Install remaining carpet using step method and placing a adhesive connector at every corner.

.4 Butt all carpet tiles to tight contact to make all joints as inconspicuous as possible.

.5 Finish installation to present smooth wearing surface free from mis-alignment, lifting, burring and other faults.

.6 Use material from same dye lot. Ensure colour, pattern, and texture match within any one visual area. Maintain constant pile direction.

.7 Continue carpeting through passageways and extend carpet into recesses, such as closets, and under movable casework, equipment, and other movable items.

.8 Terminate carpeting at centerline of door, in closed position, in openings where adjacent floor finish or colour is dissimilar.

3.6 CLEANING AND PROTECTION

.1 Vacuum carpets clean immediately after completion of installation. Protect traffic areas.

.2 Prohibit traffic on carpet until adhesive is cured.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services necessary for painting Work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 CAN/CGSB 85.10, Protective Coatings for Metals.

.2 CAN/CGSB-85.100, Painting.

.3 Master Painters Institute (MPI), Painting Specification Manual.

.4 SSPC Steel Structures Painting Council, Standards.

1.3 **SUBMITTALS**

.1 Product data:
- .1 Submit copies of manufacturer's Product data in accordance with Section 01 33 00 indicating:
  - .1 Performance criteria, compliance with appropriate reference standard, characteristics, limitations.
  - .2 Product transportation, storage, handling and installation requirements.
- .2 Submit listing of manufacturer's Product types, Product codes, and Product names, number of coats, and dry film thicknesses, corresponding to each Painting Schedule code; submit listing minimum of 8 weeks before materials are required.

.2 Samples:
- .1 Submit following samples in accordance with Section 01 33 00.
  - .1 Three 300 x 150 mm drawdowns of each colour minimum 4 weeks before paints are required.
  - .2 Identify each sample with Contract number and title, colour reference, sheen, date, and name of applicator.

.3 Certificates:
- .1 Submit certification from paint manufacturer, on company letterhead, indicating each product proposed for use is Manufacture's premium grade, first line Product.
- .2 Submit certified documentation to confirm each airless spray painter has minimum of 5 years' experience on applications of similar complexity and scope.
- .3 Submit certified documentation to confirm each worker has Provincial Tradesman Qualification certificate of proficiency.

.4 Reports:
- .1 Submit written field inspection and test report results after each inspection.
- .2 Submit Field Quality Control test result reports for alkali content, substrate moisture, and dry film thickness.
- .3 Submit electronic moisture meter manufacturer's specifications including tolerances. Submit record of latest meter calibration to meet manufacturer's recommendations.

1.4 QUALITY ASSURANCE

.1 Finishing Work: Perform work to MPI requirements for premium grade.

.2 Supervision: Have Work supervised by a full-time qualified foreperson who has 10 years minimum experience on Contracts of similar complexity and scope.

.3 Mock-up:
- .1 Construct three 4 m^2 mock-ups of different Paint Schedule code systems, selected by Consultant, in locations acceptable to Consultant to demonstrate installation workmanship, colour, and hiding power of Products.
- .2 Obtain Consultant's acceptance in writing before proceeding with the Work of this Section.
- .3 Mock-ups may remain as part of the Work if acceptable to Consultant and will serve as a standard for similar code systems.
- .4 Repaint over mock-ups which do not form part of the Work.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Install correct, safe temporary storage for paint, thinner, solvents, and other volatile, corrosive, hazardous, and explosive materials in accordance with requirements of authorities having jurisdiction.

.2 Post hazard warning signage in areas of storage and mixing. Install and maintain sufficient CO_2 fire extinguishers of minimum 9 kg capacity, accessible in each storage mixing and storage areas.

.3 Maintain storage enclosures at minimum 10°C ambient temperature and to manufacturer's instructions.

1.6 SITE CONDITIONS

.1 Apply coatings under the following conditions:
- .1 Exterior coatings (except Latex): 5° C minimum.
- .2 Exterior latex coatings: 10°C minimum.
- .3 24 hours minimum after rain, frost, condensation, or dew.
- .4 When no condensation is possible (unless specifically formulated against condensation).
- .5 Interior coatings: 7°C minimum.

.6 Relative humidity: 85% maximum.
.7 Not in direct exposure to sun light.

.2 Maintain temperature conditions indicated above for 24 hours before, during and 24 hours after painting.

.3 Install clean plywood sheets to protect floors and walls in storage and mixing areas, from paint drips, spatters, and spills.

.4 Apply sufficient masking, clean drop cloths, and protective coverings for full protection of Work not being painted including, but not limited to, the following:
.1 Light fixtures, fire and smoke detectors.
.2 Sprinkler heads.
.3 Prepainted diffusers and registers.
.4 Prepainted equipment.
.5 Fire rating labels and equipment specification plates.
.6 Finished surfaces.

1.7 ENVIRONMENTAL PERFORMANCE REQUIREMENTS

.1 Provide paint products meeting MPI "Green Performance Standard GPS-1-05".

1.8 MAINTENANCE

.1 Deliver to Owner's place of storage on completion of work, sealed containers of each finish painting material applied, and in each colour. Label each container as for original, including mixing formula. Provide the following:
.1 1 L of extra materials when less than 50 L are used for Project;
.2 3.78 L of extra stock when 50 to 200 L are used;
.3 7.57 L of extra stock when over 200 L are used.

2 Products

2.1 MATERIALS

.1 Paint:
.1 All materials under Work of this Section, including but not limited to, primers, stains, and paints are to have low VOC content limits.
.2 Products in accordance with the MPI Painting Specification Manual, Exterior and Interior Systems;
.1 For each MPI paint code, manufacture's premium grade, first line Products is to be use.
.2 Uniform dispersion of pigment in a homogeneous mixture.
.3 Ready-mixed and tinted whenever possible.
.3 Products within each MPI paint system code: From single manufacturer.
.4 Acceptable manufacturers:
.1 Benjamin Moore.

.2 Dulux Paints/PPG.
.3 Para Painting & Coatings.
.4 Sherwin Williams.

.2 Epoxy floor coating: In accordance with Section 09 67 23.

.3 Epoxy wall coating: In accordance with Section 09 96 56.

2.2 **COLOUR SCHEDULE**

.1 Consultant will select choice of colours and gloss when compiling a Colour Schedule after award of Contract; allow for colour selection beyond paint manufacturer's standard colour range.

.2 Refer to Colour Schedule for selected colour references.

.3 Conform to gloss reflectance definitions listed in MPI Specification Manual.

2.3 **PAINTING AND FINISHING SCHEDULE**

.1 Refer to Table 1, MPI Painting and Finishing Schedule coded systems, comply with MPI Painting Specification Manual.

Table 1: Painting and Finishing Schedule

EXTERIOR SUBSTRATES	Typical substrates (Including but not limited to)	MPI Manual Ref.	MPI Finish System Code	Topcoat
Structural steel and metal fabrications		EXT 5.1	EXT 5.1D	Alkyd
Galvanized steel	HM doors & frames	EXT 5.3	EXT 5.3B	Alkyd
INTERIOR SUBSTRATES	Typical substrates (Including but not limited to)	MPI Manual Ref.	MPI Finish System Code	Topcoat
Concrete floors		INT 3.2	INT 3.2C	Epoxy
Concrete block masonry		INT 4.2	INT 4.2A	Latex

Table 1: Painting and Finishing Schedule				
Structural steel (Factory primed)		INT 5.1	INT 5.1R	High performance latex
Steel (High heat)	Boilers, pipes, flues, heat exchangers	INT 5.2	INT 5.2A	Heat resistant enamel
Galvanized steel	Ducts, pipes, metal deck	INT 5.3	INT 5.3A	Latex
Galvanized metal	HM doors & door frames	INT 5.3	INT 5.3B	WB light industrial coating
Dressed lumber	Doors and frames requiring paint finish	INT 6.3	INT 6.3A	High performance latex
Wood paneling & casework	Millwork	INT 6.4	INT 6.4C	Semi-transparent stain
Wood paneling & casework	Millwork	INT 6.4	INT 6.4E	Poly-urethane
Gypsum board,	Drywall, walls, ceilings	INT 9.2	INT 9.2A	Latex
Gypsum board,	Wet areas	INT 9.2	INT 9.2F	Epoxy-modified latex

3 Execution

3.1 **EXAMINATION**

.1 Verify condition of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

3.2 **PREPARATION**

.1 General:
- .1 Clean substrate surfaces free from, dust, grease, soiling, or extraneous matter, which are detrimental to finish.
- .2 Patch, repair, and smoothen minor substrate defects and deficiencies e.g. machine, tool and sand paper marks, shallow gouges, marks, and nibs.
- .3 Clean, sweep, and vacuum floors and surfaces to be painted, debris and dust-free prior to painting.
- .4 Refer to MPI Painting Specification Manual for surface preparation requirements of substrates not listed here.

.2 Where finish hardware has been installed remove, store, re-install finish hardware, to accommodate painting. Do not clean hardware with solvent that will remove permanent lacquer finishes.

.3 Alkali Content tests and neutralization:
- .1 Test for ph level using litmus paper on dampened substrate.
- .2 Neutralize surfaces over 8.5 ph with 4% solution of Zinc Sulphate for solvent based systems and tetrapotassium pyrophosphate for latex based systems, to below 8.0 ph, and allow to dry.
- .3 Brush-off any residual Zinc Sulphate crystals.
- .4 Coordinate paint system primer / sealer to be alkali-resistant.

.4 Substrate moisture tests:
- .1 Test for moisture content over entire surface to be painted, minimum one test/ 2 m^2 in field areas and one test/600 mm along inside corners including at ceiling to wall juncture.
- .2 If any test registers above 10% allow entire substrate surfaces, within the plane, to dry further before paint system application. Install temporary drying fans if necessary.
- .3 Re-test employing same criteria.

.5 Mildew removal: Scrub with solution of trisodium phosphate and sodium hypochlorite (Javex) bleach, rinse with water, and allow to dry completely.

.6 Cementitious and masonry (Concrete, block):
- .1 Allow 28 days cure before painting.
- .2 Coordinate repair of protrusion-chipping and grinding, and honeycomb filling with responsible trades.
- .3 Remove dirt, loose mortar, scale, powder, efflorescence, and other foreign matter.
- .4 Remove form oil and grease with trisodium phosphate, rinse, and allow to dry thoroughly.
- .5 Prepare surfaces in accordance with CAN/CGSB-85.100.
- .6 Remove rust stains with solution of sodium metasilicate after thorough wetting; allow to dry thoroughly.

.7 Concrete floors:
- .1 Allow 28 days cure before painting.
- .2 Remove contamination, acid etch, rinse with water, and allow to dry completely. Test and adjust for neutral ph.
- .3 Prepare surfaces in accordance with CAN/CGSB-85.100 acid etch.

.8 Galvanized steel sheet:
- .1 Z275 (Satin & Spangled Sheet): SSPC SP7 brush blast.
- .2 ZF075 (Wiped Coat): Remove contamination, wash with Xylene solvent.
- .3 Touch-up damaged galvanized areas with organic zinc rich primer.

.9 Galvanized iron and steel: Prepare galvanized and ungalvanized metal surfaces according to CAN/CGSB-85.10.
- .1 Unpassivated, unweathered and weathered: Remove contamination, wash with Xylene or Toluol solvent, allow to dry thoroughly. Make paint system primer/sealer an etching type primer.
- .2 Manufacturer pre-treated (including passivated): SSPC SP7.
- .3 Touch-up damaged galvanized areas with organic zinc rich primer.

.10 Structural steel and miscellaneous metal fabrications:
- .1 Coordinate the following with the responsible trades:
  - .1 Rust, mars, mill scale, and weld-burn touch-ups.
  - .2 Oil, grease, weld flux and other residue removal.
- .2 Prime paint items, not otherwise indicated to be primed as part of another Section.
- .3 Touch-up damaged galvanized areas with organic zinc rich primer.

.11 Wood and Millwork:
- .1 Wood surfaces to be clean and dry with a moisture content of less than 15%.
- .2 Remove foreign matter prior to prime coat; spot coat knots, pitch streaks and sappy sections with sealer.
- .3 Fill nail holes and fine cracks after primer has dried.
- .4 Backprime interior and exterior woodwork.

.12 Factory primed surfaces:
- .1 Touch up damaged areas.
- .2 Clean as required for top coat.

.13 Gypsum board:
- .1 Apply primer/sealer paint to reveal defects and deficiencies and to equalize absorption areas.
- .2 Coordinate repairs and touch-ups with the responsible trade.
- .3 Re-prime repairs.

.14 Coordinate with other trades to prevent:
- .1 Damage, and inadvertent activation of fire and smoke detectors.

.2 Odour and dust distribution by permanent HVAC systems including fouling of ducts and filters.

.15 Field-mix Products in accordance with manufacturer's written instructions.

3.3 **APPLICATION**

.1 Apply painting systems in accordance with the MPI Painting Specification Manual. Apply each Product to manufacturer's recommended dry film thickness.

.2 Painting systems listed are required minima, apply additional coats if necessary to obtain substrate hiding acceptable to the Consultant.

.3 Tint intermediate coats lighter than final top coats for identification of each succeeding coat and to facilitate inspections. Include only manufacturer's recommended reducing and tinting accessories. Do not add adulterants.

.4 Primer to be specialized primer coating system as required by manufacturer for selected colour. Standard primer being tinted shall be tinted to a maximum of 1.5% by volume.

.5 Sand lightly between coats to achieve a tooth or anchor for subsequent coats.

.6 Apply paint uniformly in thickness, colour, texture, and gloss, as determined by the Consultant under adequate illumination and viewed at a distance of 1500 mm. Apply finishes free of defects in materials and application which, in the opinion of the Consultant, affect appearance and performance. Defects include, but are not limited to:
.1 Improper cleaning and preparation of surfaces.
.2 Entrapped dust, dirt, rust.
.3 Alligatoring, blisters, peeling.
.4 Scratches, blemishes.
.5 Uneven coverage, misses, drips, runs, and poor cutting in.

.7 Do not apply coatings on substrates which are not sufficiently dry. Unless indicated otherwise, allow each painting system coat to cure dry and hard before following coats are applied.

.8 Repaint entire areas of damaged or incompletely covered surfaces, to the nearest inside or outside corner; patching will not be permitted.

.9 Miscellaneous painting requirements:
.1 Paint projecting ledges, and tops, bottoms and sides of doors both above and below sight lines to match adjacent surfaces.
.2 Paint door frames, access doors and frames, door grilles, prime coated butts, and prime coated door closers to match surface in which they occur.
.3 Finish closets and alcoves as specified for adjoining rooms.

.4 Paint light coves white whether a light lense is installed or not, unless otherwise indicated.
.5 Paint interior columns to match walls of room.
.6 Allow for:
.1 2 wall colours per room, one ceiling colour per room.
.2 Different door colours in each functionally different area.
.3 Different colours on both sides of same door.

.10 Mechanical, electrical, and other painting coordination:
.1 Paint mechanical services in accordance with Mechanical Identification Division 21, 22 and 23.
.2 Coordinate painting of pipes, ducts, and coverings with the Work of Division 21, 22 and 23 to precede pipe colour banding, flow arrows, and other pipe identification labeling installation.
.3 Paint exposed conduit, pipes, hangers, ductwork, grilles, gratings, louvres, access panels, fire hose cabinets, registers, convector and radiator covers, enclosures, and other mechanical and electrical equipment including services concealed inside cupboard and cabinet Work; apply colour and sheen to match adjacent surfaces, except as noted otherwise.
.4 Paint portions of surfaces such as duct interiors, piping, ductwork, hangers, insulation, walls, and similar items, visible through grilles, louvres, convector covers etc., matte black in colour.
.5 Remove the following to accommodate painting, carefully store, clean, then re-install on completion of each area and when dry:
.1 Switch and receptacle plates, fittings and fastenings, grilles, gratings, louvres, access panels, convector covers, and enclosures.

3.4 FIELD QUALITY CONTROL

.1 Dry film thickness tests:
.1 Test for film thickness over entire surface to be painted, minimum one test/2 m^2 in field areas and one test/600 mm along inside corners including at ceiling to wall juncture.
.2 If any test registers below specified thickness, re-apply paint to entire surface to nearest inside and outside corners.
.3 If test registers more than 50% above specified thickness, consult with paint manufacturer, determine if problem exists, offer solutions to Consultant, and repair as directed.
.4 Re-test employing same criteria after repair.

3.5 CLEANING

.1 Remove spilled, splashed, and spattered paint promptly as Work proceeds and on completion of Work. Clean surfaces soiled by paint spillage and paint spatters. Repair or replace damaged Work, as directed by Consultant.

3.6 **PROTECTION**

.1 Post Wet Paint signs during drying and restrict or prevent traffic where necessary.

.2 Post sign, after Consultant's inspection and acceptance of each room, reading: PAINTING COMPLETE - NO ADMITTANCE WITHOUT CONTRACTOR'S PERMISSION.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment, and services necessary for compartments and cubicles Work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 ANSI/NEMA LD3, High-Pressure Decorative Laminates.

.2 ASTM A167, Specification for Stainless Steel and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

.3 ASTM A653, Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.4 CAN/CSA B651-M, Barrier Free Design.

1.3 **SUBMITTALS**

.1 Shop drawings: Submit shop drawings in accordance with Section 01 33 00 indicating fabrication and erection details, plans, elevations, hardware, and installation details.

.2 Samples:
.1 Submit samples in accordance with Section 01 33 00.
.1 Submit 300 x 300 mm samples for each colour.
.2 Submit samples of each hardware item, including brackets, fastenings, and trim.

1.4 **MAINTENANCE DATA**

.1 Provide maintenance data for maintenance of finished work for incorporation into Maintenance Manual specified in Section 01 78 23.

1.5 **PROTECTION**

.1 Cover finished surfaces with heavy Kraft paper or put in cartons during shipment. Protect installed surfaces by approved means. Do not remove until immediately prior to final inspection.

2 Products

2.1 **ACCEPTABLE MANUFACTURERS**

.1 Floor Mounted Overhead Braced;
- .1 Solid Phenolic Core by Bradley Corporation.
- .2 Duraline Solid Phenolic by Bobrick Washroom Equipment of Canada Ltd.
- .3 Shanahan's Model O.B. Overhead Braced by W.G. Wood Sales Company Limited.
- .4 Phenolic Partitions by Global Partitions/Watrous.

2.2 **MATERIALS**

.1 All materials under Work of this Section, including but not limited to, adhesives are to have low VOC content limits.

.2 Phenolic partitions: 19 mm thick consisting of multiple resin-impregnated kraft paper core with colour and clear melamine surface sheets, fused at high temperature. No brown core permitted.
Colour/finish to match Panolam's W163 'Looks Likatre' or Pionite's WP110N 'Looks Likatre'.

.3 Hardware:
- .1 Hinges: concealed, heavy-duty aluminum or stainless steel casting, self-lubricating inward swing.
- .2 Slide bolt and keeper: aluminum or stainless-steel casting or extrusion, equipped for emergency access.
- .3 Doorstop: aluminum or stainless steel casting or extrusion with rubber insert.
- .4 Connecting brackets: channel shaped, stainless steel extrusion or casting, continuous.
- .5 Coat hook: combination hook and door bumper, aluminum or stainless-steel casting.

.4 Stainless steel sheet metal: ASTM A167, Type 304 with No. 4 satin finish.

.5 Fasteners: Stainless steel tamperproof type screws and bolts.

2.3 **FABRICATION**

.1 Toilet partitions shall be floor mounted, overhead braced.

.2 Fabricate stiles and doors of 19 mm thick solid phenolic core and panels and benches of 13 mm thick solid phenolic core with decorative plastic laminate facing. Multiple resin-impregnated kraft and surface sheets shall be fused at high temperature and pressure with all edges finished and polished.

.3 Unless otherwise indicated or required, doors shall be nominal 610 mm wide, except doors to compartments for the handicapped shall be 810 mm wide.

.4 Fabricate headrail of brake formed anti-grip 1.5 mm thick clear anodized aluminum.

.5 Fabricate pilaster boot assembly for bottom, of 1.5 mm thick die formed stainless steel. Fabricate assembly in size to suit pilaster.

.6 Fabricate wall hung screen panel same as toilet partitions, except size shall be 19 mm thick, 760 mm deep by 1067 mm high unless indicated otherwise.

3 Execution

3.1 EXAMINATION

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

3.2 INSTALLATION

.1 Install compartments and cubicles in accordance with manufacturer's details and reviewed shop drawings, for a secure, plumb, square, and rigid installation.

.2 Provide connecting brackets and secure to building structure and to pilasters. Insert edge of panels and closure pilasters into brackets and secure with through type sleeve bolt and nut.

.3 Install doors with 6 mm to 10 mm maximum space between door panel and pilasters.

.4 Install panels with 6 mm maximum space between panels and walls.

.5 Install hardware in accordance with manufacturers' instructions and CAN/CSA B651-M.

.6 Make compartments adjustable with screw jack through steel saddles made integral with pilaster. Conceal fixings with stainless steel shoes.

.7 Provide for adjustment of floor variations with screw jack through steel saddles made integral with pilaster. Conceal floor fixings with stainless steel boot assemblies.

.8 Install door tops edges aligned parallel with top edges of side partitions; determine alignment when doors are in closed position.

.9 Brace through top of pilasters with rectangular shaped anti-grip headrail and fasten with stainless steel sheet metal screws.

.10 Set panels and doors level and in line, raised approximately 300 mm above finished floor.

.11 Hang doors to remain stationary at open position.

.12 Equip each door with hardware. Adjust and align hardware for easy, proper function.

.13 Provide closure pilasters, as required, at end units of compartment bank.

.14 Remove and replace damaged components not acceptable to Consultant.

3.3 SCREEN ERECTION

.1 Provide urinal stall screens consisting of panel and framing/supports as specified for toilet compartments.

.2 Anchor screen panels to walls with wall hung urinal screen brackets at height as indicated.

3.4 CUBICLE BENCH

.1 Provide in each compartment 25 mm thick solid phenolic core high pressure plastic laminate bench secured to stainless steel brackets at 406 mm on centre, wall mounted. Ensure brackets are secured to reinforcing in wall.

3.5 ADJUSTING

.1 Adjust operating hardware to work smoothly and without force. Adjust hinges of compartment doors so that all doors remain open to the same degree when unlatched, except doors at handicapped cubicles shall close automatically.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services for washroom accessories Work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 ASTM A167, Specification for Stainless Steel and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

.2 ASTM A312, Specification for Seamless and Welded Austenitic Stainless-Steel Pipes.

.3 ASTM A653/A653M, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.

.4 CAN/CSA B651-M, Barrier Free Design.

1.3 **SUBMITTALS**

.1 Product data: Submit Product data to requirements of Section 01 33 00 indicating each washroom accessory describing size, finish, details of function, attachment methods, hardware and locks, description of rough-in frame, and building-in details of anchors for grab bars.

.2 Closeout submittals:
.1 Submit for each Product operation and maintenance instructions for incorporating into the Operations and Maintenance Manuals in accordance with Section 01 78 23.
.1 Supply 2 keys for each lockable washroom accessory.
.2 Master key washroom accessories which are keyed.

1.4 **DELIVERY, STORAGE AND HANDLING**

.1 Deliver materials in sealed cartons and containers with manufacturer’s name and product description clearly marked.

1.5 **EXTENDED WARRANTY**

.1 Submit an extended warranty for washroom accessories Work in accordance with the General Conditions, except that the warranty period is extended to 10 years.
.1 Against cracked or scratched mirrors, spoiling or deterioration of silvering or backing, loosening of fastenings or adhesive
.2 Coverage: complete replacement including effected adjacent Work.

1.6 **MAINTENANCE**

.1 Maintenance Tools: Provide special tools necessary for accessing, assembly/disassembly or removal of toilet, bath, and cleaning accessories in accordance with requirements specified in Section 01 78 23.

2 Products

2.1 **MATERIALS**

.1 Stainless steel:
.1 Sheet metal: ASTM A167, Type 304.
.2 Tubing: ASTM A312, Type 304.

.2 Sheet steel: ASTM A653M, Z275; Cold rolled, commercial quality, surface preparation and pretreatment as required for applied finish.

.3 Fasteners, screws and bolts: ASTM A167, Type 304 stainless steel, tamper-proof.

2.2 **ACCESSORIES**

.1 Refer to drawings for quantity and location of washroom accessories.

.2 Shower Base **(SB-1):** As manufactured by Avonite, Size 36” x 60” c/w front linear integral trench drain, shower base shall be recessed into floor to ensure level roll in/out for wheelchair access. No thresholds or tapers permitted. Model “SKC9010ADA3660FT” Colour: “Sand Castle 9031”

.3 Shampoo and Soap Holder **(RSH-1)**: Double Shampoo and Soap Holder by Avonite Surfaces; Recessed mounted 12” x 18” x 3.75”, colour “White 8017”, Model “SKC8016RSH1218”

.4 Shower Wall & Ceiling Wet Wall Panel **(SWP-1)** system as manufactured by Avonite, all walls from T/O wall cove base to U/S ceiling, inc. on U/S of Gyp. Ceilings within shower areas. Colour “Dove Shimmer 7856”

.5 Shower Rod & Curtain **(SCR-1):** ‘Bobrick’ Shower Curtain Rod concealed mounting Model ‘B-6107’ x 36” c/w ‘Bobrick’ Shower Curtain ‘204-2’ 42” width w/ ‘204-1’ Shower Curtain Hooks. Rod, curtain & hooks installed such that bottom of curtain is 50mm above the finished floor.

.6 Shower Rod & Curtain **(SCR-2):** ‘Bobrick’ Shower Curtain Rod concealed mounting Model ‘B-6047’ x 60” c/w ‘Bobrick’ Shower Curtain ‘204-3’ 70” width w/ ‘204-1’ Shower Curtain Hooks. Rod, curtain & hooks installed such that bottom of curtain is 50mm above the finished floor.

.7 L-shaped grab bar **(GB-1)**:
- .1 3800-P Series by ASI Group Canada or approved alternative by Bobrick series B-5854.99 ; 38 mm diameter, 1.2 mm thick, 'L' shaped configuration concealed mounting with snap flange, complete with escutcheons.
- .2 Dimensions: 1016 mm x 762 mm.
- .3 Finish: Type 304 stainless steel with a satin finish and peened grip.

.8 Grab bar **(GB-2)**:
- .1 Series B-6806-99 by Bobrick or #3800-P Series by ASI Group Canada; 38 mm diameter, 1.2 mm thick, concealed mounting with snap flange, complete with escutcheons.
- .2 Dimensions: 610 mm long.
- .3 Finish: Type 304 stainless steel with a satin finish and peened grip.

.9 Mirror **(MIR-1)**: 6 mm thick, mirror quality float glass
- .1 #B-293 2436 by Bobrick or #20655 series by ASI Group Canada; mitred corners welded, and polished smooth. 24" Wide x 36" High
- .2 Shelf: 1.2 mm thick stainless steel with 19 mm return edge on front. Corners are welded, ground and polished smooth.
- .3 Dimensions: Sizes and locations as indicated on the Contract Drawings.
- .4 Frame finish: Type 304 stainless steel satin finish.

.10 Mirror with shelf **(MIR-2)**: 6 mm thick, mirror quality float glass.
- .1 #B-166 Series by Bobrick 24" Wide x 36" High, corners welded, and polished smooth.
- .2 Dimensions: Sizes and locations as indicated on the Contract Drawings.
- .3 Frame finish: Type 304 stainless steel satin finish.

.11 Folding Shower seat **(FDS-1)**:
- .1 #B-5191 by Bobrick or #8203 Series by ASI Group Canada; surface wall mounted seat with 8 mm thick water-resistant, ivory coloured solid phenolic.
- .2 Dimensions: 405 mm deep x 460 mm wide.
- .3 Finish: Type 304 stainless steel frame.

.12 Adult changing station **(ADCT-1)**:
- .1 Horizontal, Surface mounted, fold down, adult changing station with stainless steel exterior finish and plastic interior with a smooth finish, capable of withstanding 181 kg (400 lbs) and conforming to ASTM.
  - .2 Door to be 1.6 mm (16 gauge) and the flange and cabinet to be 1.3 mm (18 gauge).
- .3 Changing table to be equipped with a rounded contoured pull handle and gas spring to assist user in opening and closing unit with one hand. Bed liner to be light grey, high impact plastic with smooth fish.
- .4 Liner to be equipped with an adjustable two-part adult protection safety strap and cam buckle adjustable with one hand.
- .5 Unit to provide graphic instructions.
- .6 Finish: Type 304 stainless steel with satin finish.

.7 Surface mounted model: #100iSSE-SM by ASI Group Canada or approved alternative.

.13 Backrest assembly **(BS-1)**:
.1 Provide barrier-free backrest assemblies for floor mounted water closets.
.2 Backrest assembly to be fabricated from 32 mm o.d. stainless steel tubing with a satin finish, concealed mounting with snap on flanges complete with two white solid phenolic component panels.
.3 'Model W-1401-T2-8' by ASI Group Canada or approved alternative.

.14 Coat Hook **(CH-1):**
.1 Provide Coat hooks in all washrooms with showers, and on back of door to barrier free washroom & all private offices, mount at 1830mm A.F.F.
.2 Polished Satin 304 stainless steel Model "B-6827" by 'Bobrick' or approved equivalent.

.15 Recessed Convertible Paper Towel Dispenser and waste Receptacle **(PTD-1)**:
.1 #B-3944 by Bobrick; mitred corners welded, and polished smooth. 17-3/16"" Wide x 56" High
.2 Locations: Locations as indicated on the Contract Drawings.
.3 Frame finish: Type 304 stainless steel satin-finish.

.16 Surface-Mounted Multi-roll Toilet Tissue Dispenser **(TPH)**:
.1 #B-2888 by Bobrick; welded construction, and satin finish.
.2 Locations: Locations as indicated on the Contract Drawings.
.3 Frame finish: Type 304 stainless steel satin finish.

.17 Solid Phenolic Folding Shower/Dressing Area Seat (SPFS):
.1 #B-5191 by Bobrick;
.2 Locations: Locations as indicated on the Contract Drawings.
.3 Frame finish: Type 304 stainless steel satin finish

3 Execution

3.1 EXAMINATION

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to consultant. Commencement of Work means acceptance of existing conditions.

3.2 INSTALLATION

.1 Verify and coordinate templates, inserts, and rough-in frames and verify exact location of washroom accessories for installation.

.2 Verify there is adequate supports and/or blocking in gypsum wall assemblies prior to installation of washroom accessories.

.3 Provide fastening and mounting kits for washroom accessories.

.4 Locate washroom accessories where indicated on Drawings and where directed by Consultant.

.5 Install washroom accessory fixtures, accessories, and items in accordance with manufacturer's instructions and CAN/CSA B651-M. Provide exposed tamper-proof screws of stainless steel to match units.

.6 Install washroom accessories plumb, level, and securely and rigidly anchored to substrate surfaces and framing. Adjust accessories for proper operation and verify mechanisms function smoothly.

.7 Install grab bars to withstand minimum 408 kg downward pull. Provide necessary reinforcements as required.

.8 Clean and polish exposed surfaces and fill accessories with necessary supplies prior to acceptance by consultant.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Phenolic Locker work includes the following:
.1 Locker Compartments (various sizes, styles, and tier configurations)
.2 Component Accessories
.1 Slope Tops
.2 Filler Kits
.3 Trim Kits for recessed installations
.4 Locking Device Options
.5 Hooks, Coat Rod Hooks, Coat Rods
.6 Number Plates

.2 Phenolic Bench work includes the following:
.1 Solid Phenolic Benches 12” or 18” Width free standing moveable pedestals.
.2 Solid Phenolic Benches 12” Width – wall mounted with powder coated brackets & associated mounting hardware.

.3 Furnish all labour and materials necessary for completion of work in this section as shown on the contract drawings and specified herein.

.4 Work in this section shall include but is not limited to:
.1 Locker Compartments.
.2 Hardware for Locker compartments.
.3 Shop drawings and working drawings
.4 Manufacturer’s guarantee
.5 Related Work specified elsewhere shall include accessories and anchorage/ blocking for attachment of compartments.

1.2 **SUBMITTALS**

.1 Shop drawings: Submit shop drawings in accordance with Section 01 33 00 indicating fabrication and erection details, plans, elevations, hardware, and installation details.

.2 Submittal of shop drawings and details for architect’s approval.
.1 Colors (Doors and End-Cover Panels only) shall be selected from the manufacturer’s premium (and/or Designer Black core colours) range of colors.
.2 Color samples 300mm x 300mm shall be submitted for approval to the architect
.3 Hardware samples shall be submitted for approval to the architect upon request

1.3 **ACCEPTABLE MANUFACTURERS**

.1 Solid Phenolic Lockers:
.1 ASI Storage Solutions
.2 Spectrum
.3 PSISC

1.4 **PRODUCTS**

.1 **LCKR-1** Single Tier Solid Phenolic Lockers, each locker shall be 18”W x 24”D x 72”H and shall be the premium or top-line model of the respective manufacturer and shall allow for selection from the premium or top line colours & finishes in addition to all standard colour & finishes and shall include:
.1 Surface mount numbered hasp pad for standard Dudley or padlock.
.2 Colour & finish selection to be made by Architect.
.3 Internal Shelf & Coat Hook in each locker.
.4 Sloping tops & finished end gables for all exposed ends.

.2 **SPB-1** Free standing solid phenolic top bench moveable 18” depth 48” length with 4 legs.
.1 Colour & finish selection to be made by Architect.

.3 **SPB-2** Free standing solid phenolic top bench moveable 12” depth, 30” length with 4 legs.
.1 Colour & finish selection to be made by Architect.

.4 **SPB-3** Wall mounted solid phenolic top bench 12” depth, 48” length plus 2 legs.
.1 Colour & finish selection to be made by Architect.

1.5 **MAINTENANCE DATA**

.1 Provide maintenance data for maintenance of finished work for incorporation into Maintenance Manual specified in Section 01 78 23.

1.6 **PROTECTION**

.1 Cover finished surfaces with heavy Kraft paper or put in cartons during shipment. Protect installed surfaces by approved means. Do not remove until immediately prior to final inspection.

2.0 **EXECUTION**

.1 Installation:
- .1 Assemble and Install lockers in accordance with reviewed shop drawings and manufacturer's written instructions.
- .2 Securely fasten lockers to bases and grounds and nailing strips and to each other when in locker banks.
- .3 Install trim and closures where indicated and where obstructions occur.
- .4 Install locker numbers.

.5 Upon completion, test doors and adjust for ease of operation.

.2 Cleaning:

.1 Touch up scratches and abrasions to match the original finish. Clean and polish lockers prior to final acceptance by consultant

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services necessary for miscellaneous specialties Work in accordance with the Contract Documents.

1.2 **SUBMITTALS**

.1 Product data:
.1 Submit duplicate copies of manufacturer's Product data for each Product specified in accordance with Section 01 33 00 indicating:
.1 Performance criteria, compliance with appropriate reference standard(s), characteristics, and limitations.
.2 Product transportation, storage, handling and installation requirements.

.2 Shop drawings: Submit shop drawings in accordance with Section 01 33 00 indicating elevations, sections, details, dimensions, materials, gauges, and finishes.

.3 Closeout submittals: Submit cleaning and maintenance instructions for miscellaneous specialties for incorporation into Operations and Maintenance Manuals in accordance with Section 01 78 23.

1.3 **DELIVERY, STORAGE, AND HANDLING**

.1 Package or crate, and brace products to prevent distortion in shipment and handling. Label packages and crates and protect finish surfaces by sturdy wrappings.

2 Products

2.1 **MANUFACTURED UNITS**

.1 **Janitor’s shelf with mop and broom holders and hooks (MHLDR-1)**:
.1 #B-239 x 34 by Bobrick Washroom Equipment of Canada or approved alternative.
.2 330 mm H by 205 mm deep. Shelf constructed of minimum 1.2 mm stainless steel, mop, and broom holders to have spring loaded rubber cam to grip handles up to 30 mm in diameter, and stainless-steel hooks positioned below shelf.
.3 Finish: Type 304 stainless steel with satin finish.

.2 **Gear storage (BGR-1)**: Wall mounted 610 mm deep x 1830 mm high tubular steel wire shelves with 610 mm wide compartments with full length dividers (quantity of 22). Free standing 610 mm deep x 1830 mm high tubular steel wire shelves with 610 mm wide compartments with full length dividers (quantity of 18)

. Complete with adjustable boot and helmet shelves, adjustable apparel hooks and label holder for each compartment. 'Red Rack Wall Mounted & Free Standing 24" Compartments' by Ready Rack inc. or approved alternative by GearGrid Corp.

.3 **Murphy bed:** 'Sico Mobile Sleeper' (Standard-Twin XL in colour-black) or approved alternative.

.1 MFBD-1: Murphy bed Twin XL length complete with frame and hinge assembly and required hardware. Provide Shop Drawings.

.4 **Flagpole:** Tapered aluminum 6063 T-6 flag poles with heights of (one) 30 ft & (two) 25 ft to be coordinated on site with foundation depths for each pole. Wall thickness between 4.8 to 9.5 mm, designed to withstand 110 Mph winds. 14-gauge clear anodized aluminum ball with flush seams. Supply all trucks, internal halyards, cleats, collar, anchor base and accessories. 'Ground set architectural cone tapered aluminum' as manufactured by Ewing or approved alternative by Hollard Supply Inc. Provide a total of 3 flag poles where indicated on Site Plan drawings.

.5 **Fire Extinguisher Cabinet:** Model SS2409-5R by Larsen Manufacturing. Semi recessed S.S. Trim. Complete w/ 5LB Extinguisher. Total of 8 separate cabinets for the whole building, locations of each unit to be coordinated with Architect and Building Department staff for final occupancy.

.6 **Window Blinds (WB-1):** Single Manual Roller Shades by 'Elite in all locations where shown on FF&E plan.
Roller Shades: Blackout, Cassettes: V-90 with Exposed Bottom Rails. Provide shop drawings to consultant for review prior to fabrication.

.7 **Window Film (WF-1):** 'Apex Classic Sand Blasted Window Film by 'Apex Window Films' or approved equivalent during shop drawing process.
Installed to interior window face only (no exterior window applications) where noted on architectural drawing A-901.

.8 **Prefabricated Shower Base (SB-1):** 'ADA Roll in Shower Pan: seamless 63" x 37" wide with front trench drain. Supplied by Barrier Free Architectural Inc. or approved equivalent. Model: P26337A1FTT.V2
Provide shop drawings for review.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

3.2 **PREPARATION**

.1 Verify substrate surfaces are solid, free from surface water, dust, oil, grease, projections and other foreign matter detrimental to performance.

.2 Items to be built-in: Provide information and templates required for installation of work of this Section, and assist or supervise, or both, the setting of anchorage devices, and construction of other work incorporated with products specified in this Section in order that they function as intended.

.3 Verify there is adequate supports and/or blocking in gypsum wall assemblies prior to installation of miscellaneous specialty items as required.

3.3 **INSTALLATION**

.1 Install miscellaneous specialties level and securely and rigidly anchored to substrate in accordance with authorities having jurisdiction, reviewed shop drawings, and manufacturer's written instructions.

.2 After installation, adjust miscellaneous specialties in accordance with manufacturer’s written instructions.

3.4 **CLEANING**

.1 Clean and polish exposed surfaces prior to acceptance by consultant.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Division 00, General Requirements is part of this Section and shall apply as if repeated here.

.2 Unless specified otherwise, this Section shall apply to all Sections of Electrical Divisions, 26, & 27. The Electrical Contractor’s scope shall include Divisions 26, & 27.

.3 Conform to the conditions stated in the Contract Documents.

.4 This Section of the Specifications is an integral part of the Contract Documents and shall be read accordingly.

1.2 INTENT AND SCOPE OF WORK

.1 The Work shall include all labour, materials, tools, equipment, services, and incidentals, etc., necessary to provide the complete systems.

.2 The intent of these specifications is to provide complete systems that are ready for operation, and while no attempt has been made to detail or list each individual part required.

.3 Sections of these Specifications are not intended to delegate functions nor to delegate Work and supply to any specific trade.

.4 The Specifications are integral with the Drawings which accompany them. Neither is to be used alone. Any item or subject omitted from one, but included in the other is properly specified.

.5 Wherever differences occur in the Contract Documents, the maximum conditions and higher standards will govern and be allowed for in the Contract Price. The item to be incorporated will be at the option of the Consultant.

1.3 DEFINITIONS

.1 Where used, words "Electrical" or "Electrical Work", “Electrical Divisions”, “Electrical Systems” shall include all Work in Divisions of 26, & 27.

.2 Where used, words "Section" and "Division" shall also include other Subcontractors engaged on Site to perform work to make the building and Site complete in all respects.

.3 Where used, the word “Product” shall mean the material, equipment, component, machinery, or fixture forming the completed Work.

.4 Where used, the word “connect” shall mean to supply and install all wiring and raceways and make all power connections to Products.

.5 Where used, the word "supply" shall mean to include all labour, materials and services to furnish to the Site in the location required or directed complete with accessory parts, but is not intended to include installation.

.6 Where used, the word "install" shall mean to include all labour, materials, and services to secure in place Products, including receiving, unloading, transporting, storage, uncrating, installing, connecting and performance of such testing and finish Work as is compatible with the degree of installation specified complete ready for use.

.7 Where used, the word "provide" shall mean to supply and install as each is described above.

.8 Where used, the word "commission" shall mean to start-up and initial operation of Products as required to demonstrate satisfactory operation of Products and the entire system including calibration of any instrumentation.

.9 Where used, the word "Work" shall mean the total construction required by the Contract Documents and includes all labour, Products and services.

.10 Where used, wordings such as "approved, to approval, as directed, permitted, permission, accepted, acceptance, report to", shall mean "approved, directed, permitted, accepted, report to", by the Consultant.

1.4 STANDARDS AND REGULATIONS

.1 Conform to latest version of the applicable standards and regulations, including Federal, Provincial and Municipal laws, By-laws, regulations, Codes and Standards and the requirements of other authorities having jurisdiction in the area where the Work is to be performed. Minor changes required by an authority having jurisdiction shall be carried out without change to the Contract Price. Standards established by the Drawings and Specifications shall not be reduced by applicable codes or regulations.

.2 Comply with the latest editions and all amendments of the following standards and regulations. Where conflicts in requirements occur, the higher standards shall apply.

.1 Canadian Standards Association (CSA) Standards
.2 Underwriter's Laboratories of Canada (ULC) Standards
.3 Canadian Underwriters Association (CUA) Standards
.4 Ontario Building Code (OBC)
.5 Ontario Fire Code (OFC)
.6 National Building Code of Canada (NBCC)
.7 National Fire Code of Canada (NFCC)
.8 National Fire Protection Association (NFPA) Standards
.9 Ontario Electrical Safety Code (OESC) and Bulletins
.10 Electrical Safety Authority (ESA) Requirements
.11 National Electrical Manufacturers Association (NEMA) Standards
.12 Electrical and Electronic Manufacturers Association of Canada (EEMAC) Standards

.13 All standards and regulations mentioned in other Sections of this Division

1.5 TENDERS AND FORMS

.1 State separate prices in the Bid Form for the Work indicated in the Contract Documents. Prices shall include the complete cost of the Work, i.e. all equipment, wiring, material, labour, incidentals, profit, overhead, etc, excluding taxes. It shall be the Owner's option to delete from the Contract any of the Work indicated at the prices stated.

.2 Cash allowances shall be carried in the Contract for the Work indicated, including all equipment, wiring, material, labour, incidentals, profit, overhead, etc, excluding taxes. If the actual cost is less than the Cash Allowance, the remainder shall be reverted to the Owner. If the actual cost exceeds the Cash Allowances, the Owner will reimburse the extra amount.

1.6 PERMITS AND FEES

.1 Apply for, obtain, and pay for permits, licenses, certificates, connection charges and inspections required by authorities having jurisdiction. Include any premiums applicable due to requirements for after office hour inspections.

.2 Submit all required documentation to the authorities for their approval and comments before starting any Work. Provide all additional drawings, details or information as may be required. Comply with any changes requested by Authorities as part of the Contract, but notify the Consultant immediately of such changes.

1.7 EXAMINATION OF SITE AND CONDITIONS

.1 Examine the Site and local conditions prior to tender submission.

.2 Examine carefully all Drawings and complete Specifications to ensure that Work and equipment will satisfy Site conditions and performance requirements as shown. The Drawings do not show all Site conditions and existing equipment. The Contract Price shall cover all existing Site conditions.

.3 No allowance will be made later for any expense incurred through failure to make these examinations or to report any such discrepancies and omissions in writing, five Working Days prior to tender closing.

.4 Examine the work of Other Contractors and report at once any defect or interference affecting the work, its completion or warranty.

.5 Submission of a tender confirms that the Contract Documents and Site conditions are completely understood and accepted without qualifications unless exceptions are specifically indicated in the Bid Form.

1.8 CONTRACT DOCUMENTS

.1 The Contract Drawings of this Division are performance drawings and indicate the scope and general arrangement of the Work. They are diagrammatic except where specific details are given.

.2 They shall be read in conjunction with Architectural, Structural, Mechanical and all other Division Drawings of the Contract.

.3 The Drawings do not show all conduits and/or wiring or all structural, mechanical and architectural details.

.4 Obtain accurate dimensions from the architectural and structural Drawings, or by Site measurement. Locations and elevations of services are approximate and must be verified before construction is undertaken.

.5 Make changes required to accommodate structural conditions, (beams, columns caps, etc.). Obtain the Consultant's approval before proceeding.

.6 Adjust the location of materials and/or equipment up to 3 meters in any direction as instructed without adjustment to Contract Price, provided that the instructions are given before installation and rough-in.

.7 Plan and install conduit runs respecting all applicable conditions including structural, mechanical and architectural details.

1.9 SHOP DRAWINGS

.1 Prepare and submit shop drawings of all Products in accordance with Division 1-General Requirements as specified herein and in each Section of this Division.

.2 Submit three (3) copies of shop drawings unless otherwise noted in the Contract Documents. PDF files are acceptable.

.3 Shop drawings shall have a minimum 210 mm x 285 mm (8-1/2" x 11") clear space on the front sheet, suitable for stamping. The cover sheet shall include the project name, Contractor's name and Product description. Where multiple Products are submitted in one binding, include an index of all equipment as the front sheet.

.4 Assume full responsibility for submission of shop drawings. Allow a minimum of 10 Working Days for the Consultant review.

.5 The Consultant will only review shop drawings bearing the Electrical Division and Contractor's stamps of approval.

.6 Submit shop drawings showing the following:

.1 Contract name
.2 Contract number
.3 Manufacturer's name and model number
.4 Supplier's name
.5 Approval agencies
.6 Shipping and working weight
.7 Performance characteristics
.8 Dimensions, including required clearances
.9 Electrical characteristics

.10 Bill of materials and finishes
.11 Time required to fabricate and deliver
.12 All variations from Contract Documents
.13 Construction and field connection details
.14 Installation requirements

.7 The review shall not relieve the Contractor of its responsibility to provide Products in accordance with the design intent and Contract Documents.

.8 Manufacturer's printed data sheets for standard items are acceptable providing pertinent characteristics are identified and relate to specified items.

.9 Each shop drawing shall be checked and stamped as being correct, by trade purchasing item, and by the Contractor, before drawing is submitted.

.10 Where applicable, provide wiring details, schematics, single line drawings, and wiring diagrams showing interconnection with the Work of other Divisions.

.11 Verify and check dimensions to ensure proper installation of equipment in available space and without interference to the Work of other Divisions. Ensure that electrical and all other coordination is complete prior to submission of shop drawings.

.12 Provide data sheets and samples for all wiring devices and wall plates prior to installation. Device and plate colours/finishes to be confirmed prior to ordering.

.13 Where requested, submit samples of Products for review and approval.

.14 Do not have equipment delivered to the Site until a shop drawing for the item has been reviewed.

1.10 INTERFERENCE AND DETAIL DRAWINGS

.1 Prepare Interference and Details Drawings in conjunction with all parties and trades concerned showing sleeves and openings and passage of piping and conduits through building structure. Drawings shall also show inserts, curbs, equipment bases, anchors, special hangers, and weights on all load points.

.2 Prepare fully dimensioned detail drawings of Products and services in electrical rooms, service and ceiling spaces, and all other critical locations. Coordinate the Work with all other Divisions. Base drawings on reviewed shop drawings and indicate all details pertaining to access, clearances, sleeves, electrical connections, and elevations of pipes, ducts, and conduits. Include location of access doors provided under this Division.

.3 Ensure that clearances required by jurisdictional authorities are indicated on the interference drawings.

.4 The Owner will not consider any extra cost as a result of the Contractor’s failure to prepare proper drawings. Submit drawings two (2) weeks after receipt of the Notice to Commence the Work.

1.11 RECORD DRAWINGS

.1 Conform to the General Requirements. Maintain at least 2 sets of documents and clearly mark on same as the Work progresses, changes and deviations from Work shown so that on completion the Owner will have records of the exact location of ducts and equipment and a record of material and equipment changes.

.2 The Contractor shall obtain a clean set of prints at the start of Contract Work and shall keep these prints up-to-date at the Site, accurately recording all changes made on the project and locating all services, equipment, etc. which may have been shown only diagrammatically on the Contract Documents.

.3 The Contractor shall ensure that as-built information is accurately recorded and shall check same. As-Built drawings shall be reviewed at each Site meeting.

.4 Prepare record drawings showing the following:

- .1 All buried conduit runs are to be shown complete with dimension from building lines.
- .2 Inverts of all services entering and leaving the building and at property lines
- .3 Dimensions of underground services in relation to property lines at key points of every run
- .4 Elevations of underground services in relation to ground floor level of the building
- .5 Location of all services embedding in the structure, utilizing grid line references
- .6 Dimensioned locations of all services left for future work
- .7 All changes to the Work due to Change Orders and Site Instructions
- .8 All changes to the Work during construction
- .9 All changes to structural and architectural elements that affect the backgrounds of this record set
- .10 Location and designation of all electrically supervised valves, flow switches and pressure switches
- .11 Location and designation of all items requiring access or service in a hidden location
- .12 Location of all access doors provided under Electrical Division
- .13 All changes and revisions to Specifications, details and equipment schedules
- .14 All homerun conduits, junction boxes for complete electrical systems

.5 Upon completion of the Work, prior to the Substantial Performance inspection and after final review with, the Contractor shall neatly transfer recorded information and make a final As-Built submission for review in the following form:

- .1 One (1) copy of clean, legible prints
- .2 One (1) copy of ACAD2024 format drawings, files shall retain all setting (layers, line types, scales colors, etc) used in the Contract drawing

.6 After Record Drawings have been reviewed, revise if necessary. Deliver drawings in the form of AutoCAD disk and three (3) sets of prints taken from those disks to the Owner. Where original design ACAD files to be obtained from the Consultant, a cost of $300.00 plus HST will apply.

1.12 OPERATION AND MAINTENANCE MANUAL

.1 The Contractor will be responsible for collecting and organizing three (3) copies of all data, operating instructions, maintenance and trouble-shooting instructions, parts lists, parts diagrams, evidence of all tests and certifications, complete reviewed shop drawings, etc. and assembling them in neat manuals in hard cover. Identify cover “Operation and Maintenance Manual for NAME OF THE PROJECT”. Manuals shall be separated with dividers in logical sections and volumes.

.2 The Contractor shall also collect from Subcontractors and Suppliers all Guarantees/Warranties specified in the Contract Documents. Check that starting date (date of Total Performance of the Work) and extent of each guarantee/warranty are clearly indicated. Check also that all guarantees/warranties indicate the Supplier’s Name or Subcontractor’s Name as appropriate together with contact phone number. Assemble neatly in labelled section of each manual.

.3 Prior to requesting the Substantial Performing inspection, submit one (1) copy for review. Make all corrections as requested and forward the corrected two (2) copies to the Owner.

1.13 SCHEDULING

.1 Comply with the construction schedule. Conform to phasing of Work if applicable. Conform to interim and final completion dates.

.2 Coordinate the Electrical schedule with general construction schedule.

.3 Submit a bar chart schedule showing the start and completion dates for each activity based on a critical path analysis of the Work.

.4 Include in the schedule for Electrical Work done by others, e.g. Power Supply Authority connection.

1.14 ALTERNATES AND SUBSTITUTIONS

.1 Substitute Products will only be considered when tendered Products become unobtainable. State in the tender the proposed substitute and amount added or deducted.

.2 It is the responsibility of the Contractor to ensure "Substitute Products" fit the space allotted and provides the performance specified in the Contract Documents.

.3 If Products manufactured and/or specified by a manufacturer named as equivalent are used in lieu of the manufacturer specified, the Contractor shall be responsible for ensuring that the substituted Product is equivalent in performance

and operating characteristics to the specified Product, and, it shall be understood that all costs for additional space, larger power feeders and changes to associated or adjacent Work will be borne by the Contractor offering the substitution. In addition, in Equipment Rooms where Products named as equivalent is used in lieu of specified Products and the dimensions of such Products differs from the specified Products, prepare and submit for approval, accurately dimensioned layouts of rooms affected.

1.15 VALUATION OF CHANGES

.1 For each change submit a complete itemized breakdown of labour and material.

.2 Only the net difference between an extra and a credit will be subject to overhead and profit mark up.

.3 Material shall be valued at current trade prices incorporating all discounts and labour rates. Overhead and profit shall be as shown in the Tender Form.

1.16 WORKMANSHIP

.1 Workmanship and method of installation shall conform to best standards and practice and be performed to approval. Work shall be done by tradesmen skilled in the type of work to be performed. Where required by local or other By-laws and Regulations, tradesmen shall be licensed in their trade. Install all Work and equipment according to the manufacturer's printed directions.

1.17 INSTALLATION REQUIREMENTS

.1 Coordinate the Work of this Division with the Work of all other Divisions. Inform the Subcontractors for the Work of other Divisions of the locations of openings, chases, sleeves, supports, services, connections, etc., to be incorporated into the Work.

.2 Check the locations of all expansion/building joints and ensure that all electrical installations, are at or crossing these locations, are as detailed and as required to compensate for the possible movement at the joint.

.3 Confirm the exact location of outlets, fixtures, and connections. Check architectural details and elevations for more requirements. Confirm location of connection points for equipment supplied under other Divisions or by the Owner.

.4 Install neatly all equipment and apparatus to allow free access for maintenance, adjustment and eventual replacement.

.5 Install metering and/or sensing devices to provide accurate and reliable sampling of quantities being measured. Install instruments to permit easy observation.

.6 Provide suitable shielding and physical protection for devices.

.7 Install all Products and services in accordance with the manufacturer's requirements and/or recommendations.

.8 Provide all supports, hangers, and fasteners. Secure all Products and services so as not to impose undue stresses on the structure and systems.

.9 Ensure that the load onto structures does not exceed the maximum loading per square meter (foot) as shown on structural Drawings or as directed.

.10 Do not use explosive activated tools.

1.18 FIELD REVIEW

.1 The Owner and Consultant shall have access to the Site at all times for review of the Work during construction.

.2 Arrange for review of Products during manufacturing.

.3 Provide all gauges, instruments and other necessary measuring equipment required for review of the Work.

.4 Maintain a complete set of Contract Documents at all times for field reference.

.5 Correct any deficiencies as they are reported during the performance of the Work.

1.19 TEMPORARY SERVICES

.1 Provide temporary office, workshop and tools and material storage space for the Work and assume responsibility for any loss or damage thereto. Buildings erected for this purpose shall conform in appearance to those erected for similar purposes under other Divisions of the Specifications.

.2 Provide temporary lighting for whole construction area.

.3 Provide scaffolding and shoring necessary for the Work of this Division. Scaffolding and shoring shall be adequate to protect the workmen according to Provincial and Local Regulations.

.4 Provide rigging and mill-righting, labour and equipment necessary for the Work of this Division. Employ only workmen well experienced and skilled in such trades for this portion of the Work.

.5 Provide hoisting machinery, operators, labour and materials necessary to lift and place equipment supplied under this Division.

.6 The permanent systems or any part thereof shall not be used during construction for construction purposes, unless so permitted in advance by the Owner, in writing.

1.20 PROTECTION AND CLEANING

.1 Securely plug or cap open ends of electrical raceways or equipment to prevent entry of dirt, dust, debris, water, snow, or ice.

.2 Equipment stored on Site shall be protected from weather and kept dry and clean at all times. Take care to avoid corrosion of metal parts.

.3 Protect all finished and unfinished Work of this and other Divisions from damage due to carrying out of this Work.

.4 Make good any damage caused directly or indirectly to walls, floors, ceilings, woodwork, brickwork, finishes, etc.

.5 Before energizing any systems, inspect and clean the inside of all panel boards, switchgear and cabinets to ensure that they are completely free from dust and debris.

.6 Clean all polished, painted and plated Work. Clean all lighting fixtures. Remove all debris, surplus material and tools.

.7 Carry out additional cleaning operations of systems as specified in other Sections of this Division and as Division 1 requires.

1.21 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials.

.2 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling.

.3 Divert unused wiring and metal materials to a metal recycling facility, or place in appropriate on-site bins for recycling.

1.22 MOCK-UPS AND TRIAL USAGE

.1 Provide mock-ups in accordance with the conditions stated in the Contract Documents and Division 1 of the Specifications.

.2 Trial usage of any equipment or materials shall not be construed as evidence of acceptance of same and no claim for damage shall be made for injury to, or breaking of, any part of such Work which may be so used.

1.23 COMMISSIONING

.1 Be responsible for commissioning of all Work provided under this Division. The total commissioning requirements of this Division involve:

.1 Complete activation of all systems

.2 Re-torquing of all bolted connections in all distribution equipment

.3 Calibration, testing and verification of all systems.

.2 Commissioning shall commence with activation and verification of all systems in accordance with requirements of the Specifications. This will include, but not be limited to, the following items to be tested, adjusted and verified:

.1 Secondary switchgears

.2 Emergency power system

.3 Lighting and power distribution

.4 Emergency lighting system

.5 Electric heating equipment/system

1.24 TESTING

.1 Carry out all tests specified in the Contract Documents and tests required by authorities having jurisdiction. The testing and adjusting is the responsibility of the Contractor.

.2 Provide all equipment, labour, instruments, expenses of the manufacturer's representative, and incidentals, and pay for all power and fuel required to carry out the tests.

.3 Submit the record of all tests signed by the Contractor's Superintendent and, where applicable the manufacturer's representative. Show in schedule form a record of the systems or parts of systems tested, the date of the test, the circumstances such as current, temperatures, etc., the duration of the test and any special remarks pertaining to events during the test. Note the test has been witnessed by authorities having jurisdiction.

.4 Submit certification letters from the manufacturers of all equipment certifying that their technical representatives have inspected and tested their equipment and are satisfied with the methods of installation and operation. Where existing systems are extended, provide letters covering both new and existing equipment and connections. These letters shall state the names of persons present at testing, methods used and a list of functions performed with location and room numbers where applicable.

.5 Conduct the following tests, at a minimum:

.1 Emergency lighting system test

.2 Power distribution, including control and switching, polarity tests, voltage-drop tests and phase balancing measurement

.3 General operations: energize and operate electrical circuit and item

.4 Circuits originating from branch distribution panels

.5 Lighting and lighting control

.6 Motors, heaters and associated control equipment, including sequenced operation

.7 Di-electric tests, hi-pot tests, insulation resistance tests and ground continuity tests as required by nature of various systems and equipment

.8 Demonstrate systems operation

.9 Repair, alter, replace, test and adjust as necessary for a complete and operating electrical system

1.25 INSPECTION

.1 Arrange for inspection of all Work by the authorities having jurisdiction. Upon completion of the Work furnish final unconditional certificates of approval by the inspection authorities.

.2 Application for final review will be considered when the Work has been completed and written declarations submitted that all commissioning, testing adjustment, set up and documentation is complete. Final review shall be done when:

.1 All reported deficiencies have been corrected.

.2 All systems have been balanced, tested, commissioned and are operational.

.3 The Owner has been instructed in the operation and maintenance of all equipment.

.4 All reports have been submitted and reviewed.

.5 All maintenance manuals have been submitted and reviewed.

.6 All tags and nameplates are in place and all data submitted and reviewed.

.7 Cleaning up is finished in all respects.

.8 All certificates are furnished.

.9 All spare parts and replacement parts specified have been provided.

.10 All record drawings have been submitted and reviewed.

1.26 DEMONSTRATION AND INSTRUCTION

.1 Provide personnel, equipment and tools to demonstrate and instruct the Owner's designated personnel in the operation, controlling, adjusting, troubleshooting and servicing of all systems and equipment to satisfaction of the Owner. This Work shall take place during the Owner's regular business hours prior to acceptance.

.2 Where specified elsewhere in this Division, manufacturers shall provide demonstration and instructions.

.3 Where deemed necessary, the Owner's agent may record these demonstrations via video tape or other means for future reference.

1.27 WARRANTY

.1 Provide a written guarantee stating that systems, equipment, components, etc. have been installed to manufacturer's instructions, that systems meet the Contract requirements and that all deficiencies in material and labour occurring within two (2) years after Substantial Performance of the work, will be corrected at no charge to the Owner.

.2 Obtain Product warranties in excess of two (2) years from the manufacturer on behalf of the Owner. These Product warranties shall be issued by the manufacturer to the benefit of the Owner.

.3 Instruct all manufacturers and suppliers that warranties on Products will commence upon the date of Total Performance of the Work and not from the date the Products are put into operation.

.4 All corrections to deficiencies listed in field review reports and other correspondence, as well as but not limited to those indicated in testing, adjusting, balancing, and commissioning, shall be completed prior to turn over.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 This Section of the Specifications is an integral part of the Contract Documents and shall be read accordingly.

.2 Comply with Section of Electrical General Requirements.

.3 Unless specified otherwise, this Section shall apply to all Sections of Electrical Divisions, 26 & 27

.4 Work to be done under this Section shall include furnishings of labour, materials, and equipment required for installation, testing and putting into proper operation complete electrical systems as specified in the Contract Documents, as shown on the Drawings and as otherwise required. Complete systems shall be left ready for continuous and efficient satisfactory operation.

1.2 SUBMITTALS

.1 Submit shop drawings and Product data for Products specified in this Section in accordance with Section of Electrical General Requirements.

1.3 QUALITY ASSURANCE

.1 Electrical Work shall be carried out by qualified, licensed electricians.

Part 2 Products

2.1 PRODUCTS

.1 Products shall be new, of Canadian manufacture where available, first quality and uniform throughout. The Contractor shall submit in tender based on the use of Products specified in the Contract Documents, or on the listed acceptable alternate Products as further noted.

.2 Electrical Products shall be CSA or ULC approved and be so labelled. Products not CSA/ULC approved shall receive acceptance by the Owner for installation, and modifications and charges required for such acceptance shall be included in the Work of this Section.

.3 Products shall not be installed or connected to the source of electrical power until approval is obtained.

.4 Where a manufacturer is not specified, provide Products of high commercial standard and quality consistent with the standards of these Specifications. Provide Products of the same manufacture for like applications unless noted otherwise in the Contract Documents.

.5 Products shall be designed and manufactured in accordance with latest issue of applicable Standards or authorities when such are either mentioned herein, or

have jurisdiction over such materials or items of equipment. Confirm capacity, ratings and characteristics of Products being provided to supply power to equipment provided under other Sections of the Work. Resolve discrepancies before such items are purchased.

.6 Acceptance of Products installed presumes that Products have not been damaged or exposed to conditions that would adversely affect performance and life expectancy. If in the opinion of the consultant, Products have sustained damage, or have been exposed to abnormal conditions it shall be the responsibility of the Contractor to have such tests performed as are deemed necessary by the Consultant to establish the condition and therefore, acceptability of installed Products.

2.2 ELECTRICAL IDENTIFICATION

.1 Cable and conduit

.1 Identify conduits and cables for the various systems by the use of the following distinctive coloured labels. The labels shall comprise pressure sensitive plastic tape with printing labels indicating the system. Apply a small area of paint to the inside of each outlet box, pull box and panel as it is being installed. Identify junction boxes in suspended ceiling areas with colour on both inside and outside.

.1 Power system - yellow

.2 Emergency power - orange

.3 Cable TV systems – purple

.4 Telephone systems – blue

.5 Security/Intercom/CCTV systems – black

.6 Other telecommunication systems - grey

.2 Locate identification labels as follows:

.1 Behind each access

.2 At each change of direction, at junction boxes, and at both ends of each run

.3 Not more than 15m apart in straight runs

.4 Where passing through a wall, partition, and floor; one on each side of the wall, partition, and floor

.2 Cable and conduit labels

.1 For power and lighting system feeders, install labels at either end of the conductors where terminated inside of equipment to match wiring diagram conductor identification or panelboard circuit numbers. Typical identification Panel AA circuit - 21; use "AA-21". For a three phase circuit provide identification on phase A conductor only. For a single phase circuit provide identification on the phase conductor.

.2 For lighting branch circuits identify circuit at panel and in outlet box connection to lighting fixture. Install label on phase conductor tap-off. Typical identification if fixture connected to Panel A, circuit 5; marker identification A-5.

.3 For branch circuits supplying single phase and three phase devices such as receptacles and connections to equipment identify conductors at panel

and in device outlet box. Install label on phase conductor inside outlet box. Typical identification if device is connected to Panel B - circuit 14, marker identification "B-14".

.4 For switchboards identify all control conductors at terminal strips inside equipment and where terminated at all remote devices. Identification shall match the numbering system on the Drawings and "Reviewed" shop drawings.

.5 For fire alarm systems, identify all conductors at terminal strips located in:

.1 Control panels.

.2 Annunciators.

.3 Printers.

.4 Local terminal cabinets.

.5 All remote devices.

.6 All connections in the system.

.7 Provide identification in accordance with the numbering system on the "Reviewed" shop drawings.

.6 For miscellaneous systems identify all conductors at terminal strips located in:

.1 Control and/or monitoring panels.

.2 Control and/or monitoring stations.

.3 Local terminal cabinets.

.4 All remote devices.

.5 All connections in the system.

.6 Provide identification in accordance with the numbering system on the "Reviewed" shop drawings.

.3 Equipment nameplates

.1 Provide lamacoid name plates, white background with black engraved letters 0.4" (10 mm) high, for electrical equipment but not limited to panels, switchboards, transformers, disconnect switches, breakers, contactors, relay panels, starters, TVSS, FACP and miscellaneous panels.

.2 Nameplates shall indicate voltage, capacity, upstream, and downstream equipment. Typical identification for panel: "Lighting Panel C, 230/415V, 3 phase, 4 W. Supplied from Panel BB".

.3 Switchboards - Plates to be mounted on face of switchboards. Typical identification for switchboard: "Switchboard AAA - 230/415V, 3 phase, 4 W". Typical identification for branch feeders: "Power Panel BB".

.4 Install plates after all painting has been completed. Secure with mechanical fastening devices except on the inside of panel doors where gluing will be acceptable.

.4 Power system colour code

.1 Power system phase colour code:

.1 Red - Phase A

.2 Black - Phase B

.3 Blue - Phase C

.4 Neutral - White

.5 Ground - Green

.2 Identify incoming utility service lines with enamel paint conforming to the above colour code.

.3 Band buses in switch board and panels shall conform to the above colour code.

.4 Provide branch conductor conforming to the above colour code.

.5 Manufacturer’s nameplates

.1 Have the manufacturer's nameplates affixed to each item of all equipment showing the size, name of equipment, serial number and all information usually provided, including voltage, cycle, phase, horsepower, etc., and the name of the manufacturer and its address. Ensure that all stamped, etched or engraved lettering on plates is perfectly legible. Ensure that nameplates are not painted over. Where apparatus is to be concealed, attach the nameplate in an approved location on the equipment support or frame.

.2 Ensure that panels and other apparatus which have exposed faces in finished areas do not have any visible trade marks or other identifying symbols. Mount nameplates behind doors.

.6 Signage

.1 Provide signage to the local inspection authority on all equipment and electrical rooms.

.2 The suitable warning signs must be installed as per the Electrical Safety Code.

.3 Where applicable, provide warning signs for ground fault protection circuit as required by ESC.

.4 Where applicable, provide warning signs and marking for the power disconnect switches for fire pumps as per NFPA-20, section 9.3.

.7 Single line distribution drawings

.1 Provide a clear acrylic covered framed, as-built single line distribution system drawing of the entire project in the main electrical room. Distribution system shall be CAD generated. Size shall be minimum 305 mm x 460 mm with all text legible. Provide interim drawings until such time that permanent as-built drawings are available for permanent installation.

2.3 WIRES AND CABLES

.1 Comply with the requirements of the latest editions of the followings:

.1 CSA C22.2 No. 0.3, Test Methods for Electrical Wires and Cables

.2 CAN/CSA-C22.2 No.131 – Type TECK 90 Cable

.3 CSA C22.2 No. 38, Thermoset Insulated Wires and Cables

.4 CSA C22.2 No. 75, Thermoplastic-Insulated Wires and Cables

.5 CSA C22.2 No. 65, Wire Connectors

.2 Use copper conductors RW90XLPE and/or RWU90XLPE, 90ºC rated insulation unless otherwise noted in the Contract Documents.

.3 All wire and cable voltage rating shall be 600V. All outdoor wire and cable shall be -40 Deg. C rated.

.4 Direct burial cable is **not** acceptable. All wire and cable shall be run in conduit.

.5 Solid conductors of #12AWG and smaller. Stranded conductors for #10 AWG and larger

.6 Except as indicated hereinafter, wire for lighting and receptacle branch circuits to be #12 AWG except that #10 minimum to be used where the home run exceeds 27m (90').

.7 Wire for control circuits to be #12AWG minimum, and for 24 volt control circuits to be #16 AWG minimum.

.8 Wire to ceiling outlet boxes on which a lighting fixture is or may be mounted, with conductors having insulation suitable for 90°C.

.9 Cables located in plenum, ceiling or floor spaces shall be totally enclosed in non-combustible conduit or raceway or be armoured cable where permitted by the Ontario Building Code.

.10 Unless specified otherwise in the Contract Documents, wire for branch circuits shall be 2#12 + Ground in 16mm conduit.

.11 Wires and cables for outdoor locations shall be rated accordingly.

.12 Armoured cables shall be complete with interlocked aluminum armour, approved fastening and connectors and meet the requirements of Vertical Flame Test-Cables in Cable Tray of CSA C22.2 No. 0.3. The PVC jacket cables (TECK 90 and ACWU90) shall be FT6 rated.

.13 Install all wiring in raceways, unless indicated as armoured. Route wire and cable to meet project conditions. Use suitable cable fittings and connectors.

.14 Use an approved lubricant to assist in pulling conductors through conduit. Neatly train and lace wiring inside boxes, equipment and panelboards.

.15 Balance the loading on feeders so that unbalanced load is less than 10%.

.16 Limit the voltage drop at the end of feeders and branch circuits to 2% at the rated load of the circuit.

.17 Lighting fixture wiring in accessible ceiling spaces shall be run in conduit from the lighting panel to ceiling outlet boxes with armoured cable drops no longer than 2m permissible from the boxes to fixtures.

.18 Protect all exposed non-armoured cables in manholes, pull pits and trenches with an approved fire protective fibreglass tape of '3M' manufacture or approved equal. Extend the protective wrapping on the cables where they leave pull pits or

trenches below switchgear to the circuit breaker or fused switch terminals. Rack cables in manholes and pull pits to provide clear access for maintenance and servicing.

.19 Splice wire, up to and including No. 6 gauge, with nylon insulated expandable spring pressure type connectors. Splice large conductors using compression type connections insulated with heat shrink sleeves.

.20 **No surface wires and/or cables are allowed in indoor space on wall, floor or drop ceiling.**

2.4 RACEWAYS AND FITTING

.1 Drawings do not show all raceways. Those shown are generally in diagrammatic form only.

.2 Comply with the requirements of the latest editions of the following:

- .1 CAN/CSA C22.2 No. 18, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware
- .2 CSA C22.2 No. 45, Rigid Metal Conduit
- .3 CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit
- .4 CSA C22.2 No. 62, Surface Raceways and Lighting Fixture Raceways and Fittings
- .5 CSA C22.2 No. 83, Electrical Metallic Tubing
- .6 CSA C22.2 No. 126, Cable Tray System
- .7 CSA C22.2 No. 211.2, Rigid PVC (Unplasticized) Conduit
- .8 CAN/CSA C22.2 No. 227.3, Flexible Non-metallic Tubing
- .9 CSA C22 No. 18, Outlet Boxes, Conduits Boxes, Fittings and Associated Hardware

.3 Conduits

- .1 Steel galvanized electrical metallic tubing (EMT) installed:
  - .1 In partitions;
  - .2 In ceiling spaces;
  - .3 In service spaces.
  - .4 In masonry walls.
- .2 Rigid steel conduit hot dip galvanized inside and outside installed:
  - .1 On the exterior of building;
  - .2 Where exposed to mechanical damage;
  - .3 Where conduits turn up or turn down out of concrete slab;
  - .4 Damp and wet locations.
- .3 Rigid PVC (unplasticized) conduit except for exit light, emergency lighting, and fire alarm system installed:
  - .1 In slabs with rigid steel galvanized turn-up;
  - .2 Underground with rigid steel galvanized turn-up;
  - .3 In concrete walls;

.4 Damp and wet locations.

.4 Flexible armoured conduit:

.1 In partitions;

.2 For lighting fixture drops;

.3 From ceiling junction boxes into wall outlets;

.4 Flexible armoured conduits shall be limited to 10'-0" lengths where run horizontally from take-off junction boxes.

.5 Liquid tight flexible conduit:

.1 Final connection to motors.

.2 Any equipment which vibrates or generates noise.

.6 Provide green ground/bond wire in all conduits.

.7 Provide bushings on the ends of all conduits in enclosure, boxes, panels and cabinets, to protect the conductor installation. Except where grounding bushings are specified, use all plastic insulated bushings with a temperature rating of 150°C with double locknuts.

.8 For EMT use steel concrete tight set screw fittings as manufactured by T & B or equal. Die cast or pressure cast fittings are not acceptable.

.9 For rigid steel conduit use only insulated throat set screw type fittings. Threadless, die cast or pressure cast fittings are not acceptable.

.10 Use PVC conduit for all landscaping locations where conduit comes in contact with soil. Refer to the Landscape Drawings for the final elevation of planting soil. Co-ordinate and adjust electrical devices accordingly. Use epoxy glue coupling, and formed offsets. Approved manufacturers are Scepter Mfg. Co. Ltd and CGE “Cobocon”.

.11 Conceal all conduits except in ceiling spaces. Surface conduit on wall, column, and under drop ceilings are prohibited.

.12 Install all locknuts and bushings to ensure a secure mechanical and electrical bond. Use Erickson couplings in lieu of running threads.

.13 Where conduit joints occur in concrete, use silicone sealing compound to make water tight.

.14 Lay out conduit to drain free of all moisture.

.15 Securely hold conduits in place in concrete or masonry during pouring and construction operations; provide templates, forms and spacers as necessary.

.16 Support multiple runs of conduit on channel or angle iron with rod hangers.

.17 Secure all conduits in place with conduit clamps T & B or equal. Perforated pipe straps, wire lashings, wood screws or nails are not acceptable.

.18 Provide conduit expansion joints where conduits cross building expansion joints, also in straight runs of conduit 30 m (100') or longer. Conduit expansion joints shall be telescoping sleeve type, with insulated bushings and ground jumper.

.19 Make field bends and offsets uniform and symmetrical without flattening conduit. Minimum bending radius shall be ten (10) times the conduit diameter.

.20 Ream conduit ends to remove burrs and sharp edges. Fit conduit stubs with waterproof plastic caps during installation to protect threads and to prevent entrance of moisture into conduit.

.21 Test all conduits for clear bore using ball mandrel, brushes and snake. Clear any conduit which rejects the ball mandrel. Replace if necessary. Bear all costs involved in making all Work good, restoring all surfaces to their original pre-construction condition.

.22 Install a continuous nylon cord 180 kg (400 lb) test in each conduit left empty.

.23 Install a correctly sized green copper ground wire within each conduit.

.24 Provide conduit seals in conduits which pass to the outside.

.25 Provide pull boxes, fittings or junction boxes in conduit runs, on the basis of not more than two (2) right angle bends or their equivalent or not more than 30 m (100'), in straight runs between boxes. For outdoor direct buried conduit, up to 50m.

.26 Size conduits to code requirements, provide larger sizes where noted in the Contract Documents.

.27 Size conduits for low voltage wiring in accordance with the manufacturer's recommendations.

.28 Provide conduit sealing fittings and correspond for hazardous application to Electrical Safety Code requirements.

.29 Maximum conduit size permitted in a concrete slab shall be 35 mm. In any case verify with Structural Consultant for acceptability.

.30 Where multi-conduits parallel run and/or crossover in concrete slab/wall, verify with Structural Consultant for acceptability.

.4 Install raceways system complete with appropriate fittings such as connectors, bushings, elbows, couplings, locknuts, expansion fittings, fasteners and supports and accessories supplied as integral parts of assembly, as specified in the Contract Documents. Installation shall comply with Regulatory Authorities requirements.

.5 Keep raceway ends parallel and on proper spacing to suit knockouts or raceway openings in equipment or enclosure.

.6 Keep raceways at least 150 mm clear of heating pipes, flues and hot item surfaces. Where the required clearance cannot be provided, obtain written approval alter the layout or to reduce clearance.

.7 Provide expansion couplings, with bonding jumper and ground clamps where raceways cross building control joints.

.8 Use only metallic, enclosed raceway on installation that require shielding of electrical cables or where installed in ceiling used as return air plenum, as specified or indicated on Drawings.

.9 Raceways shall have established positive low resistance paths to ground and effectively isolate conductors so that any short-circuit arc is confined.

.10 Select appropriate fittings, such as grounding bushings, bonding and grounding straps, to maintain continuity and effectiveness of grounding of raceway system.

.11 Provide necessary fasteners and supports acceptable for type and size of raceways, to ensure a rigid, complete assembly.

.12 Provide suitable inserts or expansion type machine bolts for fastening raceways, fittings, boxes and equipment to concrete surfaces.

.13 Do not use wood screws, lag screws, expansion shields, raw plugs and nylon inserts.

.14 Secure raceway and other associated Work to structure members. Raceway shall not be supported from the ceiling suspension system.

.15 Thoroughly clean raceway and dry clear obstructions before pulling cable or wire.

.16 Minimum raceway size: 16mm (1/2”) conduit equivalent system.

2.5 OUTLET AND CONDUIT BOXES

.1 Comply with the requirements of latest edition of the followings:

- .1 CSA Standard C22.2 No.18, Outlet Boxes, Conduit Boxes and Fittings
- .2 CSA Standard C22.2 No. 85, Rigid PVC Boxes and Fittings

.2 Outlet and conduit boxes - general

- .1 Size boxes in accordance with CSA C22.1.
- .2 102mm square or larger outlet boxes as required for special devices.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 Combination ganged boxes with appropriate steel removable barriers where outlets for more than one system are grouped.
- .6 Where standard make boxes are not suitable, provide boxes of special design to fit space and other requirements.
- .7 Where vapour proof lighting is specified, provide matching vapour proof ceiling or wall junction boxes and fittings as required.

.3 Sheet steel outlet boxes

- .1 Electro-galvanized steel single and multi gang flush device boxes for flush installation, minimum size 76mm x 50mm x 38mm or as indicated in the Contract Documents. 102mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .2 Electro-galvanized steel utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102mm x 54mm x 48mm.
- .3 102mm square or octagonal outlet boxes complete with steel fixture studs where supporting lighting fixtures. Die cast fittings are not permitted.
- .4 102mm square outlet boxes with extension and plaster rings for lush mounting devices in finished plaster or tile walls.

.4 Masonry boxes

.1 Electro-galvanized stamped steel masonry single and multi gang boxes for devices flush mounted in exposed block walls, minimum size 95mm x 50mm x 64mm standard.

.5 Concrete boxes

.1 Electro-galvanized stamped steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

.6 Recessed floor boxes and outlets

.1 For concrete and wood floor:

.1 Concrete tight electro-galvanized sheet steel floor boxes with adjustable finishing rings to suit floor finish with brushed aluminum cover plate. Confirm exact cover finish to suit floor finish prior to ordering devices during the shop drawings review.

.2 Minimum 2 compartments for both power and communication and 4-gang capability

.3 Device mounting plates (brackets) to accommodate power receptacles and communication outlets.

.4 Complete with minimum 2 duplex power receptacles and one communication single gang plate for 2 communication outlets.

.5 Minimum size: 254mm x 204mm x 76mm (deep)

.6 Wiremold Resource #RFB series or equal

.2 Poke-thru type boxes for floor with access from below:

.1 UL fire rated of 2hr, water tight, suitable for plenum space.

.2 Die-cast aluminum cover, confirm exact cover finish to suit floor finish prior to ordering devices during the shop drawings review.

.3 Minimum 2 compartments for both power and communication and 2 1/2-gang capability

.4 Device mounting plates (brackets) to accommodate power receptacles and communication outlets.

.5 Complete with minimum 2 duplex power receptacles and one communication single gang plate for 2 communication outlets.

.6 Wiremold Evolution #6AT series or equal

.3 Raised Access Floor Boxes and outlets

.1 Die-cast aluminum housing with 2 compartments for both power and communication, 3-gang capability

.2 Flush in raised floor tile complete with lift-up cast aluminum recessed cover and cable lid. Confirm exact cover finish to suit floor finish prior to ordering devices during the shop drawings review.

.3 Device mounting plates (brackets) to accommodate power receptacles and communication outlets.

.4 Complete with 2 duplex power receptacles and one communication single gang plate for 2 communication outlets.

.5 Minimum: 203mm x 152mm x 114mm.

.6 Wiremold #AF series or equal

.7 Conduit boxes

.1 Cast FS or FD aluminum, or feraloy boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacles.

.2 PVC FS or FD boxes or PVC conduit where required in special corrosive areas as indicated on the Drawings.

.8 Fittings - general

.1 Bushing and connectors with nylon insulated throats.

.2 Knock-out fillers to prevent entry of debris.

.3 Conduit outlet bodies for conduit up to 35mm and pull boxes for larger conduits

.4 Double locknuts and insulated bushings on sheet metal boxes

.9 Installation

.1 Support boxes independently of connecting conduits. Install all boxes vertically plumb and securely fastened so associated trades will not cause the box to be misaligned.

.2 Where interior recessed boxes on exterior wall, a good vapour barrier continuity technique shall be employed such as Iberville or Mold Processors 1004-VB plastic backboxes.

.3 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of the Work.

.4 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.

.5 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washer is not allowed.

.6 Size and install appropriate boxes and enclosures in accordance with applicable section(s) of Ontario Hydro Electrical Safety Code and the manufacturer’s recommended procedures.

.7 Co-ordinate the location and installation of boxes so as to be accessible and clear from the building system equipment.

.8 Install pull boxes in inconspicuous but accessible locations.

.9 Use pull boxes for conduits larger than 35mm. Use conduit outlet bodies for conduit 35mm.

.10 Provide approved hole plugs in unused conduit knockouts and openings.

.11 Furnish boxes and enclosures with corrosion resistant machine screws.

.12 Boxes and enclosures embedded in concrete for flush-mounted, shall be secured properly with connecting conduits and related Works set in place before concrete is poured. Forms, when used, shall be able to be removed without disturbing installed boxes or enclosures.

.13 Ensure junction and outlet boxes mounted in ceiling cavities do not interfere with removal of ceiling tiles.

.14 Use masonry boxes for flush mounting in exposed block walls, concrete boxes for flush mounting in concrete wall.

.15 Furnish conduit boxes with neoprene gaskets for outdoor area or hazardous area application.

.16 Install all wall boxes for door security access devices, fire alarm devices, etc., adjacent to lock side of door openings unless otherwise shown on the Drawings. Check door swing before installing any switch.

.17 Install all boxes in walls so that tapped holes for mounting wiring devices or fixtures will be aligned vertically or horizontally, as required. Where boxes are grouped at one location with common and varying mounting heights, align boxes horizontally and vertically from centre line unless otherwise indicated in the Contract Documents.

.18 Offset outlet boxes in sound attenuating partitions to avoid undue transmission of sound between the partition elements. Use flexible conduit connections where wiring is required between outlet boxes on opposite sides of partition.

.19 Offset outlet boxes where installed on either side of a fire separation.

.20 Where steel supports are required for outlet boxes, wood supports are not acceptable.

.21 Maintain integrity of vapour barriers along building perimeter wall where flush outlet boxes are required.

2.6 ACCESS PANELS AND DOORS

.1 All access panels and doors shall be Milcor or Bel, 12 gauge with concealed hinges.

.2 In glazed tile walls provide #304 alloy stainless steel with #4 finish recessed frame and secured with stainless steel countersunk flush head screws.

.3 In plaster surfaces provide dished steel door for plaster finish with welded metal lath and plastic grommet for keyhole.

.4 In other finishes use plain steel door with lock and anchor straps, complete with factory prime coat.

.5 In lay-in ceilings, tiles properly marked may serve as access panels.

.6 Provide the appropriate Subcontractors for other Divisions of the Work with panels and doors, complete with frames and all pertinent information for installation. Ensure that all panels and doors are flush mounted and properly aligned with building modules and grids. Indicate locations on record drawings.

.7 Select all access panels and doors to provide adequate access, and to suit appropriate architectural finish, minimum size 150 mm x 150 mm (6" x 6"). Where necessary for persons to enter, provide minimum 600 mm x 450 mm (24" x 18") size doors.

2.7 BACKBOARDS

.1 Provide backboards for all surface mounted power distribution equipment.

.2 Provide backboards for telecommunication systems.

.3 Backboards shall be minimum 0.76” (19mm) thick, good one (1) side fire retardant plywood backboards, pressure impregnated with fire retardant chemicals, and stamp. Conform to CSA 080.

.4 Construct each backboard in a rectangular shape of the size as indicated in the Contract Documents. Where no size is indicated, provide a backboard a minimum 4” (100mm) higher than the equipment. Where more than one (1) piece of equipment is installed on the backboard, construct the backboard of a size to suit the maximum vertical and horizontal dimensions of the equipment. Backboards for the telecommunication system shall be a minimum of 4” wide x 8” high.

.5 Finish each backboard with one (1) coat of primer followed by a minimum of one (1) finish coat of ANSI 61 grey paint prior to installing any equipment.

.6 Fastenings:

.1 Fasten each backboard to a wall or to a support structure using cadmium plated hardware. Provide a flat washer under the head of each fastener. Recess the head of the mounting bolt where equipment, including future equipment, is to be installed.

.2 Use expansion shields, toggle bolts or other types of wall fastenings to suit the wall type. Align the mounting bolts with the wall studs for stud type walls.

.3 Install fastenings a maximum 20” (500mm) apart in both the vertical and horizontal directions.

.4 When installing equipment heavier than 50kg, fasten the equipment through the backboard directly to the wall or support structure.

2.8 METALS

.1 Provide all other electrical Work such as, but not limited to, equipment bases, supports, catwalks, framework to support checker plates and electrical equipment above trenches and cable pits, ladders, pit and trench covers, etc. Have such Work carried out in accordance with the requirements of Division of Metals.

2.9 SLEEVES AND CURBS

.1 Provide conduit sleeves of galvanized steel for conduit and cable runs passing through concrete walls, beams, slabs and floor. Cut flush with finished surface.

.2 Extend galvanized conduit sleeves for conduit rising through slabs a minimum of 4" above finished floors.

.3 Through exterior walls below grade waterproofed floors, and other waterproof walls use heavy weight cast iron pipes machine cut. Extend sleeves 100 mm (4") above finished floors and cut flush with underside of floor.

.4 For rectangular duct openings for bus ducts and cable tray use minimum 18-gauge galvanized steel sleeves or provide a removable wood box-out of the required size. Brace sleeves to retain their position and shape during the pouring of concrete and other work.

.5 Seal sleeves and openings to maintain fire rating. Use Dow-Corning #3-6548 `Silicone RTV' foam, Thomas & Betts `Flamesafe' firestop system, installed in accordance with the manufacturer's specifications and recommendations.

.6 Seal all openings and sleeves after installation of equipment:

.1 With an approved material to maintain fire rating where sleeves and openings pass through fire separations and floors.

.2 With an approved material to maintain fire rating for sleeves and openings provided for future equipment.

.7 Size sleeves to provide 13 mm (1/2") clearance all around.

.8 Provide all flashing and waterproofing for sleeves through the roof and exterior walls in accordance with the requirements of Division of Thermal and Moisture Protection.

.9 Except where furred in, provide watertight concrete curbs, 100 mm (4") high by 100 mm (4") wide with 19 mm (3/4") chamfered edges around all sleeves and openings passing through waterproof floors.

2.10 SUPPORTS AND BASES

.1 Submit the proposed method of attachment of hangers and beam clamps, to cellular steel deck for approval before proceeding with Work.

.2 Supply and erect special structural Work required for the installation of electrical equipment. Provide anchor bolts and other fastenings unless noted otherwise in the Contract Documents. Mount equipment required to be suspended above floor level, where details are not shown, on a frame or platform bracketed from the wall or suspended from the ceiling. Carry supports to either the ceiling or the floor, or both as required, at locations where, because wall thickness is inadequate, it is not permitted to use such brackets.

.3 Electrical panels, switches or other electrical equipment shall be complete with suitable bases or mounting brackets.

.4 Provide channel or other metal supports where necessary, to adequately support lighting fixtures. Do not use wood unless wood forms part of the building structure.

.5 Secure supports, in general to structure, from inserts in concrete construction or from building structural steel beams, using beam clamps. Provide additional angle or channel steel members, required between beams for supporting conduits and cables.

.6 Provide any additional supports required from existing concrete construction for any piping or equipment, by drilling same and installing expansion bolt cinch anchors.

.7 Do not use explosive drive pins in any section of Work without obtaining prior approval.

.8 Hangers for electrical conduit shall be galvanized after fabrication. Conduit hangers shall be as manufactured by:

.1 Burndy Canada Ltd.
.2 Canadian Strut Products Ltd.
.3 E. Myatt & Co. Ltd.
.4 Steel City Electric Co.
.5 Pilgrim
.6 Thomas & Betts
.7 B-line

.9 Do not use, perforated strapping (grappler bars).

.10 Steel supports in wet or dry locations shall be galvanized after fabrication.

.11 Provide concrete housekeeping pads or bases for all floor mounted equipment 100 mm (4") high with 19 mm (3/4") chamfered edges, keyed to the floor slab and extending at least 100 mm (4") on all sides of the equipment. Where draw-out truck type circuit breakers are provided extend pad to accommodate complete withdrawal of breaker. Provide and set all anchor bolts.

.12 Use only factory made threaded or toggle type insert.

.13 Place inserts only in structural members and not in the finishing material.

.14 Provide bus ducts, cable trays, and wireways with fire barriers at each floor level and fire separation.

.15 Provide locations and dimensions for all pads and curbs and provide and set all anchor bolts for all concrete Work provided under Division of Concrete.

2.11 SPARE PARTS

.1 Furnish spare parts and maintenance materials as recommended by the equipment manufacturer for the warranty period.

2.12 EMERGENCY CALL SYSTEM

.1 Provide emergency call system in barrier-free washrooms, and as noted. The system shall consist of dome lights, emergency call switches, relays transferring signal to security system, power wiring in conduit and signal wiring in conduit to security central control station.

.2 Activating an emergency call switch (pushing the button) shall automatically result in the following:

.1 Indication light in push button shall be illuminated at the switch.
.2 Dome lights shall be flashed.

.3 The emergency call switch shall include:

.1 Combination push button and lamp indicators, red color. Latching switch (push-on/push-off) rated at 1A/ 125VAC. Normally-open, single pole

.2 Relay (normally-open dry contact) transferring single to security system

.3 White flame retardant plastic faceplate

.4 Mount in recessed single gang box at 1100mm AFF

.5 Heritage Medcall #HM series or equal

.4 Strobe light/Horns

.1 Rounded dome shape, clear lexan lens, white plate 5” square, 15/75cd strobe rating, 90dB rating

.2 Rating: 0.03A at 120VAC

.3 Wall mounted in recessed box 100mm above the door or at 2300mm AFF

.4 Tork#TA55210D-UAD or equal

2.13 DOOR BELLS

.1 Provide door bell systems including weatherproof push buttons and indoor bells, 120V AC operation. Install bells on wall at 200 mm below ceiling. Run wiring in concealed conduits. Tork #TAC 212 WL

2.14 SMOKE ALARMS AND CARBON MONOXIDE DETECTORS

.1 Smoke alarms, carbon monoxide detectors and their combinations in suites shall not be connected to the fire alarm system.

.2 Ceiling mounted ionization type smoke alarms shall be activated by the presence of combustion products. The unit shall contain dual ionization chambers (one for fire detection, one for reference), solid state “Power On” indicator, sensitivity test button, electronic for providing 85 dB at 3 meters output, and the unit shall operate from 120 volt ac power circuit. Where more than one (1) smoke alarm is provided in a suite, the operation of one smoke alarm shall operate the alarm of all other smoke alarms within the suite. Each smoke alarm shall be complete with additional signal contact and wired to monitoring panel as required.

.3 Ceiling mounted carbon monoxide detectors shall operate from a hard-wired 120 volt AC source. The detector’s chemical sensor to respond to CO concentrations and when dangerous levels are reached, trigger an internal alarm rated at a minimum of 85 dB at 3 meters. Detector shall be complete with LED light to indicate unit is receiving power and test button. Where more than one detector is provided in a suite, the operation of one detector shall operate the alarm of all other CO detectors within the suite. Each detector shall be complete with additional signal contact and wired to monitoring panel as required.

.4 Ceiling mounted combination smoke alarm and carbon monoxide detectors shall be activated by the presence of combustion products and the dangerous levels of CO concentration. The unit shall contain ionization chamber and chemical CO sensor, two visual alarm icons, alarm sound level of minimum 85 dB at 3 meters, “POWER ON” indicator, test/reset button, and the unit shall operate from 120 VAC power circuit. Where more than one unit is provided in a suite, the operation of one unit shall operate the alarm of all other units within the suite. Each detector shall be complete with additional signal contact and wired to monitoring panel as required.

Part 3 Execution

3.1 NEUTRALS AND PHASING

.1 Provide one (1) identified grounded neutral conductor for each set of branch circuits connected to different mains of each panel.

.2 For circuits identified as computer dedicated (D) or isolated ground (IG), provide individual neutral per identified circuit.

.3 Install a separate neutral for each GFCI circuit when the GFCI is located at the panelboard.

.4 Connect two or three (2 or 3) circuits sharing a common neutral to different mains or phases.

.5 Balance the connected loads across the mains of each panel to within 15%.

.6 Circuit numbers on the panels must correspond to the numbers on the Drawings.

.7 Connections in all equipment to be Phase A, B and C from left to right, and front to back when viewing from the front or accessible direction.

3.2 MOUNTING HEIGHTS

.1 Mounting heights are from floor level to centre line of device outlet, unless noted otherwise in the Contract Documents. Confirm all locations before installation. In all areas accessible to persons in wheelchairs, the mounting heights of all switches, thermostats, intercom switches, pull stations, etc., shall comply with the Ontario Building Code “Barrier Free” requirements.

.2 The mounting heights of all power and lighting devices shall comply with Ontario Electrical Safety Code requirements. The mounting heights of all fire alarm devices shall comply with CSA requirements.

.3 If mounting height of equipment is not specified or indicated in the Contract Documents, verify before proceeding with installation.

.4 Install electrical equipment at the following heights (centre of device) unless indicated otherwise in the Contract Documents.

- .1 Wall switches, dimmers, timers, speed controllers, speaker volume controllers, thermostats and hand dryers: 1100 mm.
- .2 Wall receptacles:
  - .1 General: 350 mm.
  - .2 Above top of continuous baseboard heater: 250 mm.
  - .3 Above top of counters or counter splash backs: 250 mm.
  - .4 In mechanical rooms: 1100 mm. (gang with switch)
- .3 Panelboards: as required by Code or as indicated in the Contract Documents.
- .4 Telephone, TV and data outlets: 350 mm.
- .5 Wall mounted Interphone outlets: 1100mm.

.6 Wall mounted speakers: 150 mm below ceiling.

.7 Door bell pushbuttons and door open push buttons: 1100 mm.

.8 Security key switches, card readers and intercom switches: 1100mm.

.9 Security wall-mounted motion sensor: 2300mm, or 150mm below ceiling.

.10 Service receptacle for roof mounted equipment: 750mm above finished roof.

3.3 WIRING OF MECHANICAL EQUIPMENT

.1 The locations of starters, motors and associated equipment indicated on the Drawings are approximate and diagrammatic only. Coordinate with the Work of the Mechanical Division to ensure the proper location of all the equipment. The exact locations of conduit terminations at mechanical units shall be determined from the equipment manufactures' approved shop drawings. Conduits must be installed to enter only in the locations designated by equipment manufactures.

.2 All electric baseboard heaters, cabinet heaters, force flow unit heaters and heating cables shall be provided under Electrical Division. Electric duct heaters shall be provided under Mechanical Division.

.3 Electrical Division shall provide safety disconnect switches required at motors by CESC whether shown on the Drawings or not. Provide power wires and connections to all mechanical equipment.

.4 All the motor starters/controllers, and/or line voltage thermostats shall be supplied under Mechanical Division and installed under Electrical Division.

.5 All control wiring, control devices and low voltage thermostats shall be provided under Mechanical Division.

.6 Where motor starters, switches and the like, are grouped together, provide suitable plywood backboard to which all such equipment shall be secured.

.7 Where the single-phase exhaust fan shall be controlled by manual switch, power connections to the fan, heavy-duty toggle control switch and the safety disconnect means shall be provided under Electrical Division.

3.4 SERVICES TO EQUIPMENT SUPPLIED BY OWNER / OTHER DIVISIONS

.1 Provide all necessary connections required for equipment supplied by the Owner and under other Divisions. Examine all Drawings and Specifications and identify all requirements.

.2 Verify the type, rating and location of all outlets and/or connections required for all equipment provided by the Owner and under other Divisions.

.3 Provide isolation devices as required to the equipment for all services.

3.5 PROVISION FOR FUTURE EQUIPMENT AND CONSTRUCTION

.1 Spaces designated for future equipment or building expansion shall be left clear.

.2 Provide services for future extensions complete with Products necessary for present termination and to permit future extension.

.3 Identify each service by a permanent marker at its termination point.

3.6 CUTTING AND PATCHING

.1 Provide all cutting and patching required for the Work of Electrical Division. Work shall be carried out in conformance with the requirements of Concrete Division. Include any radiography required to locate concealed services before penetrating into inaccessible locations.

.2 Any modifications to building shall be done so as not to diminish structural, fire resistance, or smoke barrier integrity.

.3 Proposed modifications to the structure shall require acceptance by the Structural Engineer.

.4 The Consultant shall be afforded the opportunity to review the intent prior to any major cutting.

3.7 PAINTING

.1 Provide all exposed ferrous metal Work, and Products, except conduit, with at least one (1) factory prime coat or paint one prime coat on Site. Clean up or wire brush all equipment before painting. The primer shall be rust inhibiting primer in accordance with CGSB-GB-40d.

.2 Unless otherwise noted in the Contract Documents, finish painting will be done under Division 9 of these Specifications.

.3 Do not paint galvanized supports and hangers.

.4 Repaint or refinish all damaged factory applied finishes.

3.8 VIBRATION AND NOISE CONTROL

.1 Spring type vibration isolations shall be complete with horizontal spring constant (kH) to vertical (kV) ratio between one and two to assure stability. Select springs to operate no greater than 2/3 solid deflection. For indoor mounting use springs with one (1) coat of zinc chromate primer and two (2) coats of paint. For outdoor mounting use springs of neoprene coated steel or stainless steel. All spring housings to be hot dipped galvanized. Where the spring assembly is bolted to the floor provide vibration isolation washers and pads to reduce transmission of vibration.

.2 Pad type isolators shall be rubber for indoor application, neoprene for oil filled devices and for outdoor use. Use 30 durometer rubber and 50 durometer neoprene. Select pad type isolators which do not exceed the mid-point of their recommended operating rate with maximum deflection of 20% of thickness. Use minimum 6 mm (1/4") thick pads under spring assemblies.

.3 Provide spring type vibration isolators for IC engine driven equipment. Raise equipment to operating height, levelled with blocks and shims so that connections can be made to a rigid system at operating level before isolator adjustments.

.4 For power class transformers provide spring or pad type isolators in accordance with the manufacturer's recommendations. Where dry type transformers are contained within unit substation enclosures mount the core and coils to the structural framing of the unit substation. Locate isolators between core and coil frame and unit substation structural frame.

.5 Provide pad type isolators for all floor mounted dry type distribution transformers. Locate isolators between transformer enclosure and floor.

.6 Where transformers are platform mounted from structure above provide spring hangers with levelling devices and sound pads in all supports.

.7 Make connections to rotating, vibrating, magnetic or other noise producing equipment such as motors, transformers, and between independent structure by means of loop flexible conduits.

.8 If objectionable noise or vibration should be transmitted to occupied portions of the building by any part of the electrical Work, make necessary changes and/or additions, to the Commissioner’s approval, at no increase to the Contract Price.

3.9 CONCRETE

.1 Concrete Work shown on the structural Drawings will be done as part of Division 3of these Specifications.

.2 Provide all other concrete Work necessary for the Work of this Division. Have such Work carried out in accordance with the Concrete Division 3 of these Specifications.

3.10 EXCAVATION AND BACKFILLING

.1 Before commencement of excavation of the Work, determine with the Consultant, the municipalities and utilities, the presence of existing underground services at the site and verify satisfactory condition. Locate such services and mark out same. Ensure that all trades concerned are aware of their presence.

.2 Do all excavation and backfilling up to grade required for the electrical work inside and outside of building. Check available soil test reports. Obtain instructions of the Consultant regarding the type of soils and their extent.

.3 Carry out all trench excavation in strict conformity with all applicable acts and bylaws.

.4 Excavate to the required depth and width. Backfill excess excavation.

.5 For direct buried cable in all soil conditions excavate to 150 mm (6") below and a minimum of 200 mm (8") to either side of the cable run. Fill back with a bedding of granular 'A' gravel or sand.

.6 Provide ducts under roads and paved areas.

.7 Refer to details and to Utility Company requirements for concrete encased duct installations.

.8 Where excavation is necessary in proximity to and below the level of any footing, provide a sleeve at the proximity and backfill with 14,000 kPa (2,000 psi) concrete to the level of the highest adjacent footing. Proximity is determined by the angle of repose as established by the Consultant.

.9 Protect the bottom of excavations against flooding and freezing. Use pumping or other means to keep bottom dry. Do not open more than weather will permit. Have excavations inspected at least once a week by authorities. Break up rocks and boulders and remove these by drilling and wedging. Do not use blasting unless approved in writing by the Consultant.

.10 Compact all backfill to a density of 95% Modified Proctor. Before backfilling, obtain approval. Remove all shoring during backfilling. Obtain approval for all compaction machines used.

.11 Backfill trenches within building, with clean sharp sand in individual layers of maximum 150 mm (6") thickness. Manually compact the first layers up to a compacted level of 300 mm (12”). Machine compact the balance up to grade, using approved equipment.

.12 Backfill trenches outside buildings, not under roads, parking lots, or traffic areas, manually compact up to a compacted level of 450 mm (18") above the cable or duct bank with individual layers of material up to 150 mm (6") thick, using sand or granular 'A' gravel. Machine compact the balance up to grade with 150 mm (6") layers of approved excavated material.

.13 Backfill all other trenches outside buildings with granular 'A' gravel in layers not exceeding 150 mm (6") thickness, up to grade level; manually compact up to 450 mm (18"), machine compact the balance.

.14 Do not use water for consolidation or during compaction of backfill, unless approved in writing by the Consultant.

.15 After a period has passed adequate to reveal any settlement fill all depressions to correct grade level with appropriate material, machine compacted. Pay all costs required to make good all damage caused by settlement.

.16 Store and dispose of excavated materials as follows:

- .1 During the progress of the contract place the material as directed in such a manner that a minimum of damage or disfigurement of the existing ground will result and the material will not in any way impede the progress of the work. Dispose of surplus material as directed by the Consultant.
- .2 Place surplus topsoil separately from subsoil. Leave the site clear and unencumbered.
- .3 Protect, brace, support as required existing pipes, ducts, cables, etc. encountered in the work. Do not disturb or interrupt the operation of any services without written approval from the Consultant.

3.11 CONCRETE ENCASED DUCT BANKS

.1 Provide PVC duct runs consisting of parallel ducts encased in concrete as indicated on drawings.

.2 Ducts and concrete encasement for Power Supply Authority service cables shall comply with their standards and requirements.

.3 Place and set all ducts and accessories and supervise to ensure integrity of complete installation.

.4 Comply with the requirements of the latest editions of CSA 22.2 No. 211.1, Rigid Types EB1 and DB2/ES2 PVC Conduit.

.5 Join ducts together with an approved coupling to provide a sound and watertight joint. Stagger joints in adjacent ducts by not less than 200 mm (8"). Where PVC and bell fittings are used make connections to duct with an approved PVC solvent.

.6 Install ducts with spacing of not less than 190 mm centre to centre both horizontally and vertically. Use only plastic or masonry spacers. Provide two (2) spacers minimum per 3000 mm (120") length of duct.

.7 Grade ducts not less than 75 mm (3") per 30 m (100') for drainage and provide drainage facilities as detailed.

.8 Encase ducts with 3000 pound concrete with a minimum cover of 75 mm (3") on all sides using pea gravel aggregate. Work concrete below and between ducts to product a homogeneous mass. Provide reinforcing steel. Anchor all ducts in place in such a manner as to ensure that there is no movement during the placing of concrete.

.9 Immediately after concrete has been placed test each duct with a mandrel not less than 300 mm (12") long and having a diameter 7 mm (1/4") less than the diameter of the duct. After all obstructions have been cleared pull a stiff bristle brush through each duct to remove all sand and other foreign material. Install a 225 kilogram (500 lb) test rope or other equivalent non-metallic cord in each duct and seal all ends with standard plastic duct plugs.

.10 Provide end bell fittings at duct bank finished end face.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 This Section of the Specifications is an integral part of the Contract Documents and shall be read accordingly.

.2 Comply with Section of Electrical General Requirements.

.3 Provide all grounding to comply with the Ontario Electrical Safety Code and the latest instructions of the Inspection Authority, with any further requirements as noted herein.

Part 2 Products

2.1 MATERIALS

.1 All grounding conductors shall be stranded copper, bare or insulated as required, in conduit sized to meet electrical safety requirements unless otherwise noted in the Contract Documents.

.2 Use Cadweld process for all weld connections. Burndy and/or AMP of Canada Ltd. mechanical grounding connectors are an acceptable equivalent to welded connections.

.3 All ground connectors shall be designed and approved for grounding purposes.

.4 Ground buses – 7 mm x 40 mm, 305 mm long or as required.

.5 Ground rods: 3040 mm x 20 mm copper clad steel ground rods.

2.2 Execution

2.3 INSTALLATION

.1 Provide minimum three (3) ground rods near main service, and grounding conductors connected to main ground buses in the main electrical room.

.2 Provide system grounding conduct in conduit from main ground buses in the main electrical room to the building watermain.

.3 Provide ground buses in all electrical rooms for use in bonding equipment in the room. Ground the buses in accordance with the Electrical Safety Code. Provide ground connections from buses to main low voltage switchboards and all exposed metal work. Provide ground connections to the main water supply pipe.

.4 Provide one ground bus on each telecommunication backboard. Provide #2 insulated ground conductor in 27mm conduit for ground connection of all ground buses, and ground connection to watermain. Where watermain would be plastic, provide three (3) ground rods near the main telecom room and connected to the ground buses in the main telecom room.

.5 Provide additional (4) ground rods for each on-grade power generator system.

.6 Connect the ground bus inside the switchgear assembly to the grounding system.

.7 Bond all interior non-electrical metallic piping systems to the electrical system ground including, but not limited to, water supply, wastewater, and gas systems.

.8 Bond all conduit, and all non-current carrying metal parts, equipment cases, frames, bases, brackets, etc.

.9 Bond each piece of fixed equipment back to the switchboard or panel feeding that equipment, by one of the following methods:

.1 Where equipment is fed by a steel conduit, provided sizing is adequate, utilize conduit for the ground return conductor. At switchboard provide a grounding bushing, and strap such conduits to the ground bus (size per Code).

.2 Where the size of the conduit is inadequate (per Code), or if the conduit is flexible, install a separate insulated copper ground inside the conduit. At the switchboard or distribution panel, provide a grounding bushing, loop the ground conductor through the bushing, and connect to the switchboard ground bus. At the fixed equipment, connect to an internal ground bus, or connect to the inside of the metal enclosure utilizing approved screws and connectors (remove all paint).

.3 For branch circuits, the conduits may be used for grounding, provided seamless steel fittings are used on EMT and threaded fittings are used on rigid conduit. At each receptacle connect a stranded copper ground wire from the outlet box to the grounding terminal on the receptacle. Install a separate grounding conductor in all PVC conduits.

.4 Where equipment is fed by a multi-conductor power cable, provide a ground conductor in the cable. At the switchboard or panel, connect to the ground bus. Use a grounding connector on the cable for positive grounding of the metallic sheath. Loop the ground wire to the grounding connector.

.10 Run a separate ground wire in all flexible conduits. Connect each end to ground bus or lug or connector.

.11 Where mechanical protection is required for insulated grounding conductors install in rigid conduit. Use rigid PVC conduit in concrete or below grade slab and aluminum conduit in other locations.

.12 Provide weld connection or mechanical grounding connectors for:

.1 All connections between grounding conductors

.2 All connections to building steel

.3 All connections between grounding conductors and cable lugs

.13 Where single ground conductor is in one conduit, the conduit must be non-ferrous.

.14 Arrange grounding to provide the minimum impedance paths for ground fault currents. Provide any additional grounding required for approval by the inspecting authorities.

.15 Provide system grounding to all low voltage neutral ‘XO’ of the transformer, neutral ‘XO’ also shall be bonded to the transformer enclosure/frame. The minimum conductor shall be sized as per Electrical Safety Code.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 This Section of the Specifications is an integral part of the Contract Documents and shall be read accordingly.

.2 Comply with Section of Electrical General Requirements.

1.2 SCOPE OF WORK

.1 Hydro connection/service fee will be paid by Cash Allowance.

.2 Provide Hydro service scope as required and to meet Hydro requirements.

.3 Electrical contractor to include fees for all inspection and/or testing as required by Electrical Safety Authority.

.4 Warning signs shall be fastened to each piece of apparatus as may be required by Hydro and Electrical Safety Authority.

.5 Obtain the approval from Hydro and the Electrical Safety Authority on complete service.

.6 Retain a testing company to provide the study and reports, and carry out testing and checking, as listed herein. Provide correction and maintenance on the system to direction of the testing and checking results.

1.3 SUBMITTALS

.1 Submit all required documentation to ESA for approval.

.2 Submit the co-ordination study for review to:

- .1 Consultant
- .2 Inspection Authority, if required.

.3 Submit arc flash hazard report.

.4 Following completion of all inspection, testing and commissioning, submit a report prepared by the testing company to include but not limited to:

- .1 All results recorded and referenced to the various sections of the electrical systems.
- .2 Comments and recommendations where variations occur to the co-ordination study or accepted testing and performance values.
- .3 Thermal photography where abnormal heating conditions are indicated and repeated photographs following correction

Part 2 Products

2.1 NOT USED.

Part 3 Execution

3.1 SYSTEM COORDINATION AND SHORT CIRCUIT STUDY

.1 Retain the services of an approved testing company to perform protective coordination study to establish optimum settings and selections for all protective devices. Provide system coordination study and short circuit study for HV switchgears and cables, power transformer, LV switchgears and cables, and emergency generator system.

.2 The study shall illustrate:

- .1 Study single line diagrams, showing steady-state and transient values.
- .2 Three phase bolted fault current, symmetrical and asymmetrical, and minimal arcing ground fault values.
- .3 Time-current characteristics curves of all pertinent relays, breakers, fuses, etc.
- .4 Thermal damage curves for cable, transformers, motors and the like.
- .5 Summation chart showing all ratings and settings referenced to the appropriate time-current characteristic curve.

.3 Provide all circuit breakers and protective devices with relays, trip settings, frame sizes and short circuit withstand ratings as determined from the co-ordination study.

.4 Testing companies:

- .1 Brosz and Associates
- .2 G.T. Woods
- .3 Cutler-Hammer
- .4 Schneider
- .5 Siemens

3.2 ARC FLASH PROTECTION

.1 Retain the services of an approved testing company to perform arc flash hazard study and calculation for all switchboards, panel boards, transformer, panels, control panels, MCC, meters, disconnect switches, breakers, etc, that require examination, adjustment, servicing, or maintenance while energized.

.2 The study and calculation shall meet IEEE 1584-2002, Guide for Performing Arc-Flash Hazard Calculations.

.3 Provide arc flash report to include the following, but not limited to:

- .1 Results of the study and calculation.
- .2 Detailed hazard/risk category (0 to 5).
- .3 Voltage shock hazard, incident current and energy.

.4 Flash protection boundary and shock approach boundaries.

.5 The protection plan including safe work procedures, preventive maintenance programs, personal protective equipment, etc. The protection plan shall meet CSA Z462-08, workplace electrical safety.

.4 Based on the arc flash report, provide required labels state the existence of arc flash hazard and the corrective action to take. The labels must meet ANSI Z535.4-2002, product Safety signs and Labels.

3.3 INSPECTION AND TEST

.1 Systems, equipment and all major items required in coordination study shall be tested to the satisfaction of the Engineer, and as required to establish compliance with plans and specifications, and with the requirements for the Supply and Inspection Authorities.

.2 Have the testing company retained for the co-ordination study carry out pre-service and in-service testing and checking as listed herein.

.3 The Owner reserves the right to retain, on his behalf, an independent testing company to witness the testing and to provide duplicate verification tests and any additional tests deemed necessary to ensure safety and proper operation of the system. Co-operate in every respect with the Owner's testing company and provide assistance as required to permit him to carry out his work.

.4 Faulty and defective equipment shall be replaced with new materials Conductors which are found to be shorted or grounded, or to have less than proper insulation resistance, shall be replaced with new conductors.

.5 Tests shall include but are not limited to the following:

.1 Visual inspections to ensure there are no obvious defects and determine adherence to allowable manufacturing tolerance and compliance with manufacturer's recommended installation requirements.

.2 Proper operation tests of all systems and devices.

.3 Insulation tests and torque tests. High potential tests where recommended by manufacturer.

.4 Test of all adjustable electrical protective devices of switchgear to establish calibration and operation in accordance with specifications and approved co-ordination curves.

.5 Calibration setting, and test-tripping, of all protective relays and devices, using "Primary-injection" equipment, in accordance with approved co-ordination schedule.

.6 Grounding tests and phasing inspections.

.7 Test of all alarm devices and contacts.

.8 Inspections after system is energized shall include infrared thermographic examination of current carrying parts in switchgear, transformers, busways and all bolted connections for feeders. Submit a written report on the infra-red testing.

.9 The Contractor shall cooperate with Inspection personnel, open all equipment enclosures to permit inspection, and make good defective conditions.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 This Section of the Specifications is an integral part of the Contract Documents and shall be read accordingly.

.2 Comply with Section of Electrical General Requirements.

.3 Provide factory assembled power distribution equipment as herein specified and as shown on the Electrical Drawings.

.4 Refer to the Electrical Drawings for more requirements on: voltage; phase; size and type of mains; size, type and quantity of the branch devices; location; surface or flush mounting.

1.2 REFERENCE

.1 Comply with the requirements of the latest edition of the following:

.1 CSA C22.2 No. 31, Switchgear Assemblies
.2 CSA C22.2 No. 29, Panelboards
.3 CSA C22.2 No. 5, Molded Case Circuit Breakers
.4 CAN/CSA C22.2 No.47, Air-Cooled Transformers (Dry-Type)
.5 CSA C9, Dry Type Transformers
.6 CAN/CSA-C802.2, Minimum Efficiency Values for Dry-Type Transformers
.7 CAN/CSA-C802.3, Maximum Losses for Power Transformers
.8 CSA C22.2 No. 4, Enclosed and Dead-Front Switches
.9 CSA C22.2 No. 39, Fuseholder Assemblies
.10 CSA C22.2 No. 248 (Part 1 to Part 16), Low Voltage Fuses
.11 CSA C22.2 No. 190, Capacitors for Power Factor Correction

1.3 SUBMITTALS

.1 Submit shop drawings in accordance with Section of Electrical General Requirements.

.2 Shop drawings shall include electrical details, dimensions, ratings, types, and quantity.

1.4 APPROVED MANUFACTUERS

.1 The manufacturer shall be the manufacturer of the major components within the assembly, including circuit breakers and fusible switches.

.2 Use the Products of one manufacturer for the entire project. Acceptable manufacturers are:

.1 Cutler-Hammer

.2 Schneider
.3 Siemens
.4 GE
.5 Approved equal

1.5 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section of Basic Materials and Methods.

.2 Identify circuits controlled by each breaker on directory cards provided with panels. Directories shall be typed and mounted in metal frame with clear plastic cover.

Part 2 Products

2.1 ENCLOSURES FOR ALL PRODUCTS

.1 Indoor dry locations: CSA type 1.

.2 Indoor sprinkler locations: CSA type 2.

.3 Outdoor locations: CSA type 3R.

2.2 SWITCHBOARD

.1 Provide main switchboard consisting of individual sections bolted together to form complete switchboard assemblies of uniform design, and to allow the installation of future units and sections. Switchboards shall include split-bus, metering, protective devices and equipment with necessary interconnections, instrumentation and control wiring.

.2 Switchboards shall be dead front, non-walk-in front access only, sprinkler-proof enclosure and with ventilation on the assembly.

.3 Design switchboard to permit disassembly into sections for shipment as required for site conditions.

.4 Steel channel base along the entire length of each switchboard assembly.

.5 All bus bars, joints and connections of tinned copper or aluminum and rated for current carrying capacity and short circuit bracing indicated on the Drawings. Design buses, joints and connections so that maximum temperature rise of any part of the switchboard will not exceed 50°C over an ambient temperature of 40°C.

.6 A full length bare ground bus solidly bolted to the steel assembly with a momentary current-rating equal to or greater than the momentary rating of any of the apparatus in the assembly, and at least of 6 mm x 50 mm size.

.7 A full capacity neutral insulated from the switchboard enclosure and run the full length of the board.

.8 One coat of primer paint to the switchboard assembly after the surfaces have been properly cleaned and two finish coats of ASA #61 light grey paint. Furnish touch-up paint in pressurized spray cans.

.9 Switchboard shall be suitable for service entrance application.

.10 Warning signs for in-house Generation

.1 Where generator is provided, the following warning signs shall be provided to warn people of the presence of in-house generation:

.1 CAUTION IN-HOUSE GENERATOR FEEDER

.2 CAUTION IN-HOUSE GENERATOR

.2 The first warning sign is to be posted at the generator feeder cell, and the second warning sign is to be posted at the door of the switchboard, one sign per door.

.11 Owner's metering:

.1 Digital metering units shall be provided as owner's check meter and shall provide/possess at least the following items:

.1 Volts each phase.

.2 Volts each phase to neutral.

.3 Current per phase.

.4 Real power (kW).

.5 Reactive power (kVAR).

.6 Apparent power (kVA).

.7 Power factor.

.8 Frequency

.9 Energy (kWh).

.10 Peak demand (kW, kVAR, kVA).

.11 THD

.12 Recording hourly load to generate a load profile.

.13 Communications port to allow multipoint communications with remote monitor, PC, printer, etc

.14 Metering accuracy shall be at least to 0.25% of reading plus 0.05% of full scale for voltage and current, and 0.5% of reading plus 0.05% of full scale for power and energy, all through the 31st harmonic.

.15 Accept metering inputs of up to 600 Vac direct connections.

.16 Complete with 5A secondary current transformers.

.2 Units shall be Canadian revenue metering approved to Measurement Canada Standards.

.12 Breakers

.1 Main breakers shall be 3-pole manually operated, quick-make, quick-break, solid state, 100% rated breaker equipped with field-adjustable ground fault protection as shown, field-adjustable long time, field-adjustable short time and field-adjustable instantaneous trip settings.

.2 Distribution circuit breakers shall be quick-make, quick-break type, for manual and automatic operation, with over centre toggle handle. The handle shall reside in a position between “ON” and “OFF”. Circuit breakers shall have thermal and magnetic trip mechanism, to provide inverse time current tripping and instantaneous tripping, trip-free and trip indicating. Circuit breakers rated at 125A and larger shall have thermal and adjustable magnetic trip mechanism.

2.3 PANELBOARDS

.1 Panelboards rated 120/208 volt AC shall have short-circuit rating as shown on the Drawings, but not less than 18 kA RMS symmetrical.

.2 Panelboards shall be labeled with the short-circuit rating.

.3 Where series ratings are applied, provide the labels in accordance with the requirements of Electrical Safety Code. The labels shall state the following, at a minimum:

.1 Size and type of upstream devices;

.2 Branch devices that can be used;

.3 Short-circuit rating.

.4 Interiors shall be completely factory assembled devices.

.5 Enclosure:

.1 Indoor dry locations: CSA type 1.

.2 Indoor sprinkler locations: CSA type 2.

.3 Outdoor locations: CSA type 3R.

.6 Provide doors with concealed hinges, combined locks and latches for all panelboards except fusible disconnect switch type distribution panelboards.

.7 Two (2) keys for each panelboard and key all panelboards alike.

.8 Interior trim shall be dead-front construction to shield users from energized parts.

.9 Main bus shall be tin finished high quality copper and extend the full length of the panel. Ground bus shall be sized to accommodate branch circuit grounding conductors. 200% neutral as required.

.10 Sequence phase bussing with odd numbered sections on the left and even on the right, with each section identified by permanent number identification as to circuit number and phase.

.11 Provide bolt-on type circuit breakers and/or disconnect switch units.

.12 Means of locking off shall meet CSA requirements of elevator power supplies (if an elevator is proposed for this project).

.13 Minimum circuits shall be 42, unless otherwise noted in the Contract Documents.

.14 Trims and doors shall be painted ANSI 61 grey. Factory applied paint finish on all exterior surfaces.

.15 All required lugs.

.16 Connectors for future breakers and switches. Drill and tap bus work.

.17 Custom built panelboard assemblies:

.1 Double stack panels as indicated
.2 Contactors and/or relays as indicated
.3 Feed-through and/or sub-feed lugs as indicated
.4 Special ground buses as indicated
.5 Special neutrals as indicated
.6 Connectors for future branch devices as indicated
.7 TVSS as indicated
.8 Isolated ground bus as indicated

.18 Circuit breakers shall be quick-make, quick-break type, for manual and automatic operation, with over centre toggle handle. The handle shall reside in a position between “ON” and “OFF”.

.19 Circuit breakers shall have thermal and magnetic trip mechanism, to provide inverse time current tripping and instantaneous tripping, trip-free and trip indicating. Circuit breakers rated at 125A and larger shall have thermal and adjustable magnetic trip mechanism.

.20 Multi-pole breakers shall be common trip type and have a common handle. Tie handles are not acceptable.

.21 Clearly marked with their rated ampacity and respective trip rating and visible without removing bolted covers.

.22 Provide handle locking devices on all branch circuit breakers controlling communication equipment, lighting control, exit signs, emergency lighting, fire alarm system and other life safety equipment.

.23 Circuit breakers feeding unswitched lighting circuits shall be “switching duty” type.

.24 Provide class ‘A’ ground fault protection with the circuit breaker, where required by the Electrical Safety Code.

2.4 DISCONNECT SWITCHES

.1 Provide all disconnect switches, whether an integral part of equipment or separately mounted.

.2 Enclosure:

.1 Indoor dry locations: CSA Type 1.

.2 Indoor sprinkler locations: CSA Type 2.

.3 Outdoor locations: CSA Type 3R.

.3 Provision for padlocking in off switch position by locks

.4 Mechanically interlocked door to prevent opening when handle in ON position.

.5 Fuses: size as indicated in the Contract Documents.

.6 Fuse holders: suitable without adaptors, for type and size of fuse indicated.

.7 Heavy-duty horsepower rated, quick-make, quick-break action, front operation, with integral handle mechanism and visible contacts in “OFF” position.

.8 ON-OFF switch position indication on switch enclosure cover

.9 Switches identified for use as service equipment are to be labeled for this application

.10 For elevator power supplies, disconnect switches shall be complete with means of locking off to meet CSA requirements, and auxiliary contact for emergency operation (if an elevator is proposed for this project).

.11 Furnish solid neutral assembly and equipment ground bar.

.12 Lugs suitable for copper and/or aluminum conductors

.13 Identify name of load controlled.

2.5 FUSES

.1 Fuses up to 600 volts and over 600amps:

.1 Where used in motor, transformer and other circuits with an inrush: Class L time delay. Ferraz Shawmut type A4BT or approved equal by Bussman.

.2 All remaining fuses: Class L non-time delay. Ferraz Shawmut A4BY or approved equal by Bussman.

.2 Fuses up to 600 volts and up to and including 600amps:

.1 Where used in motor, transformer and other circuits with an inrush: Class J time delay. Ferraz Shawmut type AJT or approved equal by Bussman.

.2 All remaining fuses: Class J non-time delay. Ferraz Shawmut type A4J or approved equal by Bussman.

.3 Fuse storage cabinet: Wall-mounted sheet metal cabinet with shelves, suitable size to store spare fuses and fuse pullers, complete with hinged door.

2.6 CONTACTORS

.1 Conform to the requirements of latest edition of CSA C22.2, No. 14 – Industrial Control Equipment.

.2 The contactors shall be fully rated and withstand the large initial in-rush currents of lamps without contact welding.

.3 Contactors shall be NEMA rated, magnetic, electrically operated, electrically held, and complete with suitable type enclosure and 120V coil.

.4 Fail open: contacts shall open upon the supply voltage drop below 75% of the rated voltage.

.5 Accessories

.1 Pilot lights (ON/OFF).
.2 On/Off/Auto selector switch for lighting control panel.
.3 Auxiliary contacts (NO and NC) and relays to match control function.
.4 Control circuit fuse-holders and fuses.
.5 Control transformers in each 347/600V enclosed contactor. Transformer shall be 120V secondary and furnished with primary and secondary fuses. Bond unfused leg of secondary to enclosure.

.6 Mount contactors in lighting control panel at 1500 mm AFF to operating handle/pushbutton.

.7 Mount power control contactors above power panels.

.1 Display power factor with indication for an inductive or capacitive power factor. Indicate the insufficient KVAR to achieve target power factor. Indicate harmonic condition.
.2 Calculate and store in memory the KVAR of each step.
.3 The time delay between switching of capacitors shall be field programmable.
.4 Programmable target selector.
.5 All output contacts shall be disabled after main power interruption. The controller shall retain its programming after the restoration of supply voltage.

.8 Install the equipment in accordance with the manufacturer’s instructions.

.9 Capacitors and the equipment shall be tested in compliance with CSA requirements.

Part 3 Execution

3.1 SWITCHBOARDS

.1 Provide 100mm concrete bases for switchboards.

.2 Provide watertight connections for all services entering the top of the switchboard.

.3 Completely assemble, wire and test the switchboard at the factory to ensure the accuracy of wiring and correct functioning of the equipment.

3.2 PANELBOARDS

.1 Install panelboards securely, plumb, true and square, to adjoining surface.

.2 Provide three (2) empty 35 mm (1 ¼") conduits from all recessed lighting and receptacle panelboards, terminated in ceiling space above.

.3 Provide three (3) empty 53 mm (2") conduits from all recessed distribution panelboards, terminated in ceiling space above.

3.3 DISCONNECT SWITCHES AND FUSES

.1 Install disconnect switches complete with fuses if applicable.

.2 In finished areas, where disconnecting devices are required, provide a circuit breaker in flush mounted enclosure.

.3 Provide three spare fuses of each type and size used above 600 amp and six spare fuses of each type and size used up to and including 600amp.

.4 Install fuses in mounting devices immediately before energizing circuit.

.5 Ensure correct fuses fit to physically match mounting devices.

.6 Ensure correct fuse fitted to assigned electrical circuit.

.7 Mount the fuse storage cabinets on the wall in electrical rooms. Mount the spare fuses in clip neatly arranged and labeled.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 This Section of the Specifications is an integral part of the Contract Documents and shall be read accordingly.

.2 Comply with Section of Electrical General Requirements.

.3 Provide all switches, receptacles, wiring devices and cover plates as required to complete the installation.

1.2 REFERENCES

.1 Comply with the requirements of the latest editions of the following:

.1 CSA-C22.2 No.42, General Use Receptacles, Attachment Plugs and Similar Wiring Devices

.2 CSA-C22.2 No.42.1, Cover Plates for Flush-Mounted Wiring Devices

.3 CSA-C22.2 No.55, Special Use Switches

.4 CSA-C22.2 No.111, General-Use Snap Switches

.5 CSA-C22.2 No. 144, Ground Fault Circuit Interrupters

1.3 SUBMITTALS

.1 Submit shop drawings and Product data in accordance with Section OF Electrical General Requirements.

1.4 MANUFACTURER

.1 Wiring devices shall be manufactured by 1) Hubbell; 2) Pass & Seymour; 3) Leviton; 4) Watt Stopper; 5) Lutron. Catalogue numbers are referred to below to indicate quality standard.

Part 2 Products

2.1 SWITCHES

.1 White premium specification grade, quite type

.2 Terminal holes approved for No. 10 AWG wire

.3 Silver alloy contacts

.4 Urea or melamine moulding for parts subject to carbon tracking

.5 Suitable for back and side wiring

.6 Fully rated for tungsten filament and fluorescent lamps

.7 Switches for 120 Volt lighting circuits shall be Hubbell CSB115W, CSB315W and CSB415W, 15 ampere for single pole, three-way and four-way switching as required for the application.

.8 Switches for 347 Volt lighting circuits shall be Hubbell HBL18221, HBL18223, 20 ampere for single pole, three-way switching as required for the application. Switch handles – white. Provide key operated switches where shown of the same series.

.9 Switches for motor or other control applications shall be horsepower rated, Hubbell, HBL7832D and HBL7810D 30Ampere for double-pole and three-pole for one application.

2.2 RECEPTACLES

.1 White premium specification grade, urea moulded housing.

.2 Suitable for No. 10 AWG for back and side wiring

.3 Break off links for use as split receptacles

.4 Eight back wired entrances, four side wiring screws

.5 Triple wipe contacts and riveted grounding contacts

.6 Impact-resistant nylon face

.7 U-ground

.8 GFCI receptacles shall meet UL 943 requirements and be complete with test and reset buttons, and LED indication light

.9 Duplex receptacle, 15 amp, 120 volt, 1 phase, 2 pole, 3 wire, Hubbell, BR15WHI (CSA 5-15R)

.10 Duplex receptacle, 20 amp, 120 volt, 1 phase, 2 pole, 3 wire, Hubbell, BR20WHI (CSA 5-20RA)

.11 GFCI duplex receptacle, 15 amp, 120 volt, 1 phase, 2 pole, 3 wire, Hubbell, GFST15W (CSA 5-15R)

.12 GFCI duplex receptacle, 20 amp, 120 volt, 1 phase, 2 pole, 3 wire, Hubbell, GF20STW (CSA 5-20RA)

.13 Isolated ground receptacle, orange, 15 amp, 120 volt, 1 phase, 2 pole, 3 wire, Hubbell, IG5262 (CSA 5-15R)

.14 Single 30 amp, 120 volt, 1 phases, 2 pole, 3 wire, Hubbell, HBL9308 (CSA 5-30R)

.15 Single 30 amp, 120/208 volt, 2 phases, 3 pole, 4 wire, Hubbell, HBL9430A (CSA 14-30R)

.16 Single 50 amp, 120/208 volt and 120/240 volt, 2 phases, 3 pole, 4 wire, Hubbell, HBL9450A (CSA 14-50R)

.17 TVSS duplex receptacle, gray, 15 amp, 120 volt, 1 phase, 2 pole, 3 wire, Hubbell, HBL5262GYWSA (CSA5-15R)

.18 Temper-resistant duplex receptacle, 15 amp, 120 volt, 1 phase, 2 pole, 3 wire, Hubbell, BR15WHITR (CSA5-15R)

.19 Weather-resistant duplex receptacle, 15 amp, 120 volt, 1 phase, 2 pole, 3 wire, Hubbell, BR15WHIWR (CSA5-15R)

.20 Cord receptacle, mounted on 30’ long power cable dropped from ceiling structure

2.3 COVER PLATES

.1 Stainless steel type 302, complete with matching screw or snap on type

.2 Weatherproof covers shall be while-in-use type polycarbonate body, cover and plates, conforming to NEMA3R. Hubbell # WP826MP

.3 Sheet metal cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes

.4 Weatherproof spring-loaded cast aluminum cover plates complete with gaskets for single receptacles or switches

.5 Water-tight hinged cover suitable for floor box for ganged receptacles, data/telephone outlets, finish to the approval of the Consultant

2.4 DIMMERS

.1 Slide dimmers, specification grade, white finish and cover plate shall match wall lighting switch

.2 Preset ON/OFF switches and LED indicator

.3 Minimum 1000W rating for incandescent lamp

.4 Minimum 10A rating for fluorescent ballast and/or low voltage transformer

2.5 OCCUPANCY SENSORS

.1 Wall sensor switches

- .1 Adaptive technology for time delay
- .2 No minimum load requirement
- .3 180° coverage up to 900 square feet
- .4 Dual technology, ultrasonic and passive infrared
- .5 Manual override for both on and off
- .6 Compatible with all electronic/magnetic ballast and incandescent lamp
- .7 Built-in photocell

.8 120VAC or 347VAC to suit application, 800W, dual switching circuits to suit application

.9 Installed in recessed single gang box, white finish and cover plate shall match wall lighting switch

.10 Watt Stopper #DW-100 series

.2 Ceiling Sensors

.1 Adaptive technology for time delay

.2 Complete with 120VAC (or 347VAC to suit application) power supply and switching relay, dual switching relay circuits to suit application

.3 Dual technology, ultrasonic and passive infrared

.4 360° coverage up to 2000 square feet

.5 Compatible with all electronic/magnetic ballast and incandescent lamp

.6 Watt Stopper #DT-300 series

2.6 CORD REELS RECEPTACLES

.1 Industrial cord reels, durable, corrosion resistant steel construction, yellow finish

.2 Ceiling mounted, multi-position guide arm, positive-latch mechanism automatically maintains desired cord length

.3 15A, 125V, 13.7 meter (45’), 12/3 SJEO cable

.4 Weather proof GFI 15A duplex receptacles

.5 Hubbell #HBL45123GF series or approved equal

Part 3 Execution

3.1 INSTALLATION

.1 Install single throw switches with the handle in "UP" position when switch closed.

.2 Install devices in gang type outlet box when more than one switch is required in one location. When supplied from different voltages or power sources, provide metal barriers in the ganged box.

.3 Permanently identify ‘347V’ on each 347V switch cover plate.

.4 Clean debris from outlet boxes.

.5 Install devices plumb and level.

.6 Connect wiring device grounding terminal to outlet box with bonding jumper and branch circuit equipment grounding conductor.

.7 Adjust devices and wall plates to be flush and level.

.8 Clean exposed surfaces to remove splatters and restore finish.

.9 Test each receptacle device for proper polarity.

.10 Test each GFCI receptacle device for proper operation.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 This Section of the Specifications is an integral part of the Contract Documents and shall be read accordingly.

.2 Comply with Section of Electrical General Requirements.

1.2 SCOPE OF WORK

.1 Provide a complete and operable Emergency/Standby electric generating system, including all devices and equipment specified herein, as shown on the drawings, or required for the service.

.2 Apply for approved (air) of M.O.E. and obtain the certificate of approval. Include all the modification work to improve the system performance in order to meet M.O.E. requirements of air and noise.

.3 The following work will be provided under Division of Mechanical:

.1 Natural gas fuel supply and connection to generator

1.3 REFERENCE

.1 Comply with the requirements of the latest edition of the following:

.1 CSA-C282, Emergency Electrical Power Supply for Buildings

1.4 SUBMITTALS

.1 Submit shop drawings in accordance with Section of Electrical General Requirements.

.2 Submit within the shop drawings short circuit decrement curves prepared by the generator set manufacturer for single phase and three phase conditions. Provide this information along with the Co-ordination Study submission. Base curves on:

.1 Single phase condition

.2 Three phase short circuit; no initial load; field at normal operating temperatures symmetrical current.

.3 Plot on the same scale as the decrement curves, the over-current characteristics of the main breaker and any secondary breakers supplied by the generator set manufacturer, to show co-ordination over the full range.

.4 Shop drawings shall show the following:

.1 Voltage drop report showing the voltage drop to be less than 15% under motoring-starting conditions. Emergency loads are fire pump, elevators and complete emergency lighting. (if an elevator is proposed for this project, then this note applies).

.2 Specification and data sheets.

.3 Manufacturer's certification of prototype testing.

.4 Manufacturer's published warranty documents.

.5 Shop drawings showing plan and elevation views with certified overall and interconnection point dimensions.

.6 Interconnection wiring diagrams showing all external connections required, with field wiring terminals marked in a consistent point-to-point manner.

.7 Manufacturer's installation instructions.

.8 Confirmation of exhaust pipe diameter.

.9 Brake horsepower versus rated speed curves. Include all accessories in horsepower curves.

.10 Fuel data and consumption

.11 Cooling water data.

.12 Radiator details such as dimensioned outlines and controls.

.13 Performance curves for local conditions and multipliers for ambient temperatures.

.14 Generator damage curves.

.15 Generator decrement curves showing current delivered for specified faults.

.16 Generator decrement curves against generator main breaker curve.

.17 Efficiency of generator.

.18 List of components.

.5 Submit three (3) copies of certified test reports upon completion of factory test and field test. The reports shall indicate all required tests.

1.5 WARRANTY

.1 A no deductible warranty shall be provided for all products against defects in materials and workmanship for a two year or 1,500 hour period from the start-up date, per the manufacturer’s Extended Coverage Limited Warranty.

1.6 MAINTENANCE

.1 Provide a complete set of tools necessary for the maintenance of the generator set. Package tools in adequately sized metal tool box.

.2 Submit a separate price for a maintenance contract to cover routine and major overhaul operations. List maintenance requirements in relation to operating hours.

.3 Include labour, equipment, tools and any other special requirements in the cost of the maintenance contract.

1.7 SPARE PARTS

.1 Submit an itemized price list of recommended spare parts required for routine and minor overhauls for a minimum period of two (2) years.

.2 Submit a separate price list for recommended spare parts required for one (1) complete overhaul.

1.8 APPROVED MANUFACTUERS

.1 Kohlor

.2 Generac

.3 Paramount

.4 Catepillar

Part 2 Product

2.1 GENERATOR SET

.1 Ratings

.1 The generator set shall be natural gas engine, 1800 rpm, AC, three-phase, 4-wire, 60 hertz, unless otherwise noted on the drawings.

.2 The generator set shall be rated as shown on drawing at 0.8 PF, based on site conditions of: Altitude 7300ft. (2097 meters), ambient temperatures up to 120 degrees F (49 degrees C).

.3 The generator set rating shall be based on emergency/standby service.

.2 Performance

.1 Voltage regulation shall be plus or minus 0.5 percent for any constant load between no load and rated load. Random voltage variation with any steady load from no load to full load shall not exceed plus or minus 0.5 percent.

.2 Frequency regulation shall be isochronous from steady state no load to steady state rated load. Random frequency variation with any steady load from no load to full load shall not exceed plus or minus 0.5%.

.3 Maintain the maximum voltage dip to be 15%, the peak starting KVA shall be 150% of the rated KW. The engine generator set shall accept a single step load of 150% nameplate rated KW while maintain voltage dip less than 15% and frequency dip less than 10%, with the engine generator set at operating temperature.

.4 Motor starting capability shall be a minimum of three (3) times rated capacity. Maximum voltage dip on application of one step total load equals to generator rated capacity, considering both alternator performance and engine speed changes shall not exceed 15%.

.5 The alternator shall produce a clean AC voltage waveform, with not more than 5% total harmonic distortion at full linear load, when measured from line to neutral, and with not more than 3% in any single harmonic, and no 3rd order harmonics or their multiples. Telephone influence factor shall be less than 40.

.6 The generator set shall be certified by the engine manufacturer to be suitable for use at the installed location and rating, and shall meet all applicable exhaust emission requirements at the time of commissioning.

.3 Construction

.1 The engine-generator set shall be mounted on heavy-duty steel bases to maintain alignment between components. Provide vibration isolators of spring/pad type. Isolators shall include seismic restraints if required by site location.

.2 All switches, lamps, and meters in the control system shall be oil-tight and dust-tight. All active control components shall be installed within a UL/NEMA 3R enclosure. There shall be no exposed points in the control (with the door open) that operate in excess of 50 volts.

.4 Connections

.1 The generator set load connections shall be composed of silver or tin plated copper bus bars, drilled to accept mechanical or compression terminations of the number and type as shown on the drawings. Sufficient lug space shall be provided for use with cables of the number and size as shown on the drawings.

.2 Power connections to auxiliary devices shall be made at the devices, with required protection located at a wall-mounted common distribution panel.

.3 Generator set control interfaces to other system components shall be made on a permanently labelled terminal block assembly. Labels describing connection point functions shall be provided.

.5 Engine and engine equipment

.1 The engine shall be 4 cycle, radiator and fan cooled. The horsepower rating of the engine at its minimum tolerance level shall be sufficient to drive the alternator and all connected accessories. Two cycle engines are not acceptable.

.2 An electronic governor system shall provide automatic isochronous frequency regulation. The governing system dynamic capabilities shall be controlled as a function of engine coolant temperature to provide fast, stable operation at varying engine operating temperature conditions. The control system shall actively control the fuel rate and excitation as appropriate to the state of the generator set. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, accelerating to rated speed. The governing system shall include a programmable warm up at idle and cool down at idle function. While operating in idle state, the control system shall disable the alternator excitation system.

.3 Skid-mounted radiator and cooling system rated for full load operation.

.6 Fuel system shall be natural gas, pressure of 1.74 to 2.74 KPA. Include fuel mixer, gas regulator, solenoid valve, and filter.

.7 Positive displacement, mechanical, full pressure, lubrication oil pump.

.8 Full flow lubrication oil filters with replaceable spin-on canister elements and dipstick oil level indicator.

.9 Fuel filter suitable for operation of the generator set at full rated load in the ambient temperature specified shall be provided if required for operation due to the design of the engine and the installation.

.10 Replaceable dry element air cleaner with restriction indicator.

.11 Flexible supply line.

.12 Engine mounted battery charging alternator, 40-ampere minimum, and solid-state voltage regulator.

.13 Coolant heater

.1 Engine mounted, thermostatically controlled, coolant heater(s) for each engine. Heater voltage shall be as shown on the project drawings. The coolant heater shall be UL499 listed and labelled.

.2 The coolant heater shall be installed on the engine with silicone hose connections. Steel tubing shall be used for connections into the engine coolant system wherever the length of pipe run exceeds 12 inches. The coolant heater installation shall be specifically designed to provide proper venting of the system. The coolant heaters shall provisions to isolate the heater for replacement of the heater element without draining the coolant from the generator set. The quick disconnect/automatic sealing couplers shall allow the heater element to be replaced without draining the engine cooling system or significant coolant loss.

.3 The coolant heater shall be provided with a DC thermostat, installed at the engine thermostat housing. An AC power connection box shall be provided for a single AC power connection to the coolant heater system.

.14 Starting and Control Batteries shall be calcium/lead antimony type, 24 volt DC, sized as recommended by the engine manufacturer, complete with battery cables and connectors.

.15 A UL listed/CSA certified 10 amp voltage regulated battery charger shall be provided for each engine-generator set. Charger shall include an Analog DC voltmeter and ammeter, 12 hour equalize charge timer, and AC and DC fuses.

.16 The AC generator shall be; synchronous, four pole, revolving field, drip-proof construction, single prelubricated sealed bearing, air cooled by a direct drive centrifugal blower fan, and directly connected to the engine with flexible drive disc.

.17 The generator shall be capable of delivering rated output (kVA) at rated frequency and power factor, at any voltage not more than 5 percent above or below rated voltage.

.18 A permanent magnet generator (PMG) shall be included to provide a reliable source of excitation power for optimum motor starting and short circuit performance. The PMG and controls shall be capable of sustaining and regulating current supplied to a single phase or three phase fault at approximately 300% of rated current for not more than 10 seconds.

.19 Alternator shall be brushless, connected directly to the engine flywheel and complete with digital voltage regulator.

2.2 GENERATOR SET CONTROL

.1 The generator set shall be provided with a microprocessor-based control system that is designed to provide automatic starting, monitoring, and control functions for the generator set. The control system shall also be designed to allow local monitoring and control of the generator set, and remote monitoring and control as described in this specification.

.2 The control shall be mounted on the generator set, or may be mounted in a free-standing panel next to the generator set if adequate space and accessibility is available. The control shall be vibration isolated and prototype tested to verify the durability of all components in the system under the vibration conditions encountered.

.3 The generator control panel shall include the following features and functions:

.1 Control Switches

.1 Mode Select Switch.

.2 EMERGENCY STOP Switch.

.3 RESET Switch.

.4 PANEL LAMP Switch.

.2 Digital metering set, 1% accuracy, to indicate generator RMS voltage and current, frequency, output current, output KW, KW-hours, operating hours, and power factor. Generator output voltage shall be available in line-to-line and line-to-neutral voltages, and shall display all three-phase voltages (line to neutral or line to line) simultaneously.

.3 The generator set control shall indicate, Generator status, the existence of the warning and shutdown conditions on the control panel. Conditions required to be annunciated shall comply with CSA-C282.

.4 Provisions shall be made for indication of four customer-specified alarm or shutdown conditions. Labelling of the customer-specified alarm or shutdown conditions shall be of the same type and quality as the above-specified conditions. The non-automatic indicating lamp shall be red, and shall flash to indicate that the generator set is not able to automatically respond to a command to start from a remote location.

.5 The following engine status information shall be available on the generator set control :

.1 engine oil pressure (psi or kPA)

.2 engine coolant temperature (degrees F or C)

.3 engine oil temperature (degrees F or C)

.4 engine speed (rpm)

.5 number of hours of operation (hours)

.6 number of start attempts

.7 battery voltage (DC volts)

.6 The control system shall also incorporate a data logging and display provision to allow logging of the last 10 warning or shutdown indications on the generator set, as well as total time of operation at various loads, as a percent of the standby rating of the generator set.

.7 The control system provided shall include a cycle cranking system, which allows for user selected crank time, rest time, and # of cycles.

.8 The control system shall include time delay start (adjustable 0-300 seconds) and time delay stop (adjustable 0-600 seconds) functions.

.9 The control system shall include sender failure monitoring logic for speed sensing, oil pressure, and engine temperature which is capable of discriminating between failed sender or wiring components, and an actual failure conditions.

.10 The generator set shall be provided with a network communication module to allow LonMark compliant communication with the generator set control by remote devices. The control shall communicate all engine and alternator data, and allow starting and stopping of the generator set via the network in both test and emergency modes.

.11 The control system shall provide four programmable output relays. These relay outputs shall be configurable for any alarm, shutdown, or status condition monitored by the control.

.12 A fused 10 amp switched 24VDC power supply circuit shall be provided for customer use. DC power shall be available from this circuit whenever the generator set is running.

2.3 OTHER EQUIPMENT TO BE PROVIDED WITH THE GENERATOR SET

.1 Provide a remote alarm annunciator with horn, located as shown on the drawings, or in a location that can be conveniently monitored by facility personnel. The remote annunciator shall provide all the audible and visual alarms required by CSA-C282 and OESC section 46-208.

.2 The generator set shall be provided with an integrated main line circuit breaker, sized to carry the rated output current of the generator set. The supplier shall submit time over current characteristic curves and thermal damage curve for the alternator, demonstrating the effectiveness of the protection provided.

.3 Outdoor Weather-Protective Enclosure

.1 The generator set shall be provided with an outdoor enclosure, with the entire package listed under UL2200. The package shall comply with the requirements of the Electrical Safety Code for all wiring materials and component spacing. The total assembly of generator set, enclosure, and sub-base fuel tank (when used) shall be designed to be lifted into place using spreader bars. Housing shall provide ample airflow for generator set operation at rated load in an ambient temperature of 100F. The housing shall have hinged access doors as required to maintain easy access for all operating and service functions. All doors shall be lockable, and include retainers to hold the door open during service. Enclosure roof shall be cambered to prevent rainwater accumulation. Openings shall be screened to limit access of rodents into the enclosure. All electrical power and control interconnections shall be made within the perimeter of the enclosure.

.2 Heavy-duty steel bases in enclosure.

.3 All sheet metal shall be primed for corrosion protection and finish painted with the manufacturers standard colour using a two step electrocoating

paint process, or equal meeting the performance requirements specified below. All surfaces of all metal parts shall be primed and painted.

.4 Painting of hoses, clamps, wiring harnesses, and other non-metallic service parts shall not be acceptable. Fasteners used shall be corrosion resistant, and designed to minimize marring of the painted surface when removed for normal installation or service work.

.5 Enclosure shall be constructed of minimum 10 gauge steel for framework and 14 gauge steel for panels. All hardware and hinges shall be stainless steel.

.6 A factory-mounted exhaust hospital grade silencer shall be installed inside the enclosure. The exhaust shall exit the enclosure through a rain collar and terminate with a rain cap. Exhaust connections to the generator set shall be through seamless flexible connections.

.7 The enclosure shall include the following maintenance provisions:

.8 Flexible coolant and lubricating oil drain lines that extend to the exterior of the enclosure, with internal drain valves External radiator fill provision.

.9 Provide an external emergency stop switch that is protected from accidental actuation.

.10 Provide fixed louvers for air flow through the enclosure. Louvers shall include provisions to prevent accumulation of ice or snow that might prevent operation.

.11 Inlet ducts shall include rain hoods.

.12 The generator set shall be provided with a sound-attenuated housing which allows the generator set to operate at full rated load in an ambient temperature of up to 100F. The enclosure shall reduce the sound level of the generator set while operating at full rated load to a maximum of 70 dBA at any location 7 meters from the generator set in a free field environment.

.13 The enclosure shall be insulated with non-hydroscopic materials.

.14 Provide neoprene isolator mounts for isolation off steel base from engine alternator.

.15 Supply and install Weatherproof (EEMAC4 4R) pull box on enclosure exterior as an entrance for all wiring. Location to be decided in accordance with site conditions.

.16 Provide a factory mounted and wired electrical distribution panel to serve the generator set and enclosure. The provisions and generator set loads to be provided shall be minimum, but not limited to, the below.

.17 60-amp 24 circuit panel board connected to a 120/208VAC 3-phase 4-wire utility service by the installer.

.18 Two duplex GFI receptacles, one inside the enclosure, and a weatherproof receptacle on the outside of the enclosure.

.19 Ventilation and heating systems complete with power supplies and controls, and thermal insulation shall be provided to meet the requirements of CSA-C282, 6.7 Ventilation and 6.8 Temperature.

.20 Two three-way switches controlling three AC lamps mounted in vapor tight and gasketed fixtures.

.21 Factory-wired normal AC service from the panel board to the engine coolant and alternator heaters, and battery charger.

.22 Supply and install electric strip heaters, thermostatically controlled. Heaters shall be rated for minimum 1000watts.

.23 Supply and install wiring access space within sub-base tank frame as an entrance for all wiring.

.24 Provide lights and control switch beside access door. Lights shall provide average lighting level of 200lux.

.25 Provide battery operated emergency lighting system for control panel. Battery system shall be rated for 1/2 hour. Lighting level shall be minimum 50lux.

2.4 TRANSFER SWITCH EQUIPMENT

.1 Transfer switches as shown on the drawings shall be equipped with accessories as follows:

.1 Signal module to delay the transfer and retransfer of the switch for up to 30 seconds to provide a pre-transfer warning signal contact. Contacts for these functions are to be from C type rated for 120VAC or 30 volt D.C. at 4 amps.

.2 Meters: an AC voltmeter, an ammeter, and a frequency meter, 2% accuracy. Provide a phase selector switch to read L-L voltage and current of both power sources.

.3 Exerciser Clock: Provide solid state exerciser clock to set the day, time and duration of generator set exercise/test period. Provide a with/without load selector switch for the exercise period.

.4 Status monitoring relay for remote annunciation: ATS in Bypass model.

.2 Complete factory assembled transfer equipment with electronic control designed for surge voltage isolation, voltage sensors on all phases of both sources, linear operator, permanently attached manual handles, positive mechanical and electrical interlocking and mechanically held contacts. Equipment rated 1,000 amps and less shall include quick-make, quick-break contact mechanisms for manual transfer under load.

.3 All transfer switches and accessories shall be UL listed and labelled, tested per UL Standard 1008 and CSA approved.

.4 Ratings

.1 Transfer switch equipment shall have withstand and closing rating (WCR) in RMS symmetrical amperes greater than the available fault currents shown on the drawings. minimum 18KA.

.2 Transfer switches shall be 3-pole, double-throw, electrically and mechanically interlocked and mechanically held in both positions.

.3 Transfer switches rated through 1,000 amperes shall be equipped with permanently attached manual operating handles and quick-make, quick-break over current mechanisms suitable for safe manual operation under load.

.4 Main switch contacts shall be high-pressure silver alloy. Contact assemblies shall have arc chutes for positive arc extinguishment. Arc chutes shall have insulating covers to prevent interphase flashover.

.5 Enclosures shall be sprinkler proof, CSA Type 2. Controls on cabinet door shall be key-operated. Provide switch position indicator lamps and power available lamps for both sources (four in total) on the outside cabinet door.

.5 Provided one set from C auxiliary contacts (minimum 6 contacts) on both sides, operated by transfer switch position, rated 10 amps 250VAC.

.6 Provide wires (4#12) in conduits from each group of elevator controllers to two (2) contacts in the transfer switch providing power to the elevators (if an elevator is proposed for this project). One contact is for transfer signal, open on normal power and close on emergency power. One for pre-transfer signal, normally open and close 10 seconds prior to transfer onto emergency power and back to normal power, and this contact should reopen immediately after the actual transfer of power.

.7 Automatic Controls

.1 Solid-state under-voltage sensors shall simultaneously monitor all phases of both sources. Pick-up and drop-out settings shall be adjustable. Voltage sensors shall allow for adjustment to sense partial loss of voltage on any phase. Voltage sensors shall have field calibration of actual supply voltage to nominal system voltage.

.2 Controls shall be provided with solid-state overvoltage sensors, adjustable from 100%-130% of nominal to monitor all phases of the emergency sources (s). Provide adjustable time delay of 0.5 to 2.2 sec.

.3 Controls shall be provided with a solid-state over frequency sensors, adjustable from a minimum of + 4% to a maximum of + 20% of nominal frequency. Dropout shall be + 5% of nominal wider than pick-up frequency bandwidth. Adjustable time delay shall be from 0.1 to 15 sec.

.4 Automatic controls shall signal the engine-generator set to start upon signal from normal source sensors. Solid state time delay start, adjustable from 0 to 5 seconds (factory set at 2 seconds) shall avoid nuisance start-ups. Battery voltage starting contacts shall be gold, dry type contacts factory wired to a field wiring terminal block.

.5 The switch shall transfer when the emergency source reaches the set point voltage and frequency. Provide a solid-state time delay on transfer, adjustable from 0 to 120 seconds.

.6 The switch shall retransfer the load to the normal source after a time delay retransfer, adjustable from 0 to 30 minutes. Retransfer time delay shall be immediately bypassed if the emergency power source fails.

.7 Controls shall signal the engine-generator set to stop after a time delay, adjustable from 0 to 10 minutes, beginning on return to the normal source.

.8 Power for transfer operation shall be from the source to which the load is being transferred.

.8 Bypass Isolation Switch

.1 Automatic transfer switches shall be included in a factory assembly with bypass-isolation switch equipment.

.2 The bypass-isolation switch shall provide a safe means for manually bypassing the transfer switch in accordance with CSA C282 - Manual Bypass Switch.

.9 Interlocks:

.1 Positive mechanical interlocks shall prevent all possible source to source interconnections. Designs which depend on electrical interlocks to prevent source to source interconnections, or which intentionally interconnect the sources, are not acceptable.

.2 The interlock system shall assure a properly sequenced, mechanically guided bypass and isolation action. The equipment shall utilize automatic, solenoid-activated mechanical stops to prevent manually bypassing to a dead source. Equipment that does not prevent dead source bypass is not acceptable.

.3 The transfer switches for non-life safety loads shall be provided with interlock means so that upon receiving signal from fire alarm system, the transfer switch must not transfer non-life safety loads to emergency power source.

.10 Warning sign

.1 Provide warning sign where 3-ploe transfer switches are used.

.2 A warning sign shall be installed at the generation connection point stating that the generator must have a floating neutral.

.3 Any neutral termination in the system shall be identified with proper signage, warning not to disconnect any system neutral when the stand-by system or normal system is operating.

Part 3 Execution

3.1 FACTORY TESTING

.1 The generator set manufacturer shall perform a complete operational test on the generator set prior to shipping from the factory. A certified test report shall be provided. Equipment supplied shall be fully tested at the factory for function and performance.

.2 Factory testing may be witnessed by the owner and consulting engineer. Costs for travel expenses will be the responsibility of the owner and consulting engineer. Supplier is responsible to provide two weeks notice for testing.

.3 Testing shall conform to the requirements of CAN/CSA-C282 section of Initial Installation Performance Tests.

.4 Submit test reports to consultant prior to shipping of equipment, indicating all the tests results.

3.2 INSTALLATION

.1 Provide grounding and grounding connections to OESC requirements.

.2 Equipment shall be installed by the contractor in accordance with final submittals and contract documents. Installation shall comply with applicable state and local codes as required by the authority having jurisdiction. Install equipment in accordance with manufacturer's instructions and instructions included in the listing or labelling of UL listed products.

.3 Installation of equipment shall include furnishing and installing all interconnecting wiring between all major equipment provided for the on-site power system. The contractor shall also perform interconnecting wiring between equipment sections (when required), under the supervision of the equipment supplier.

.4 Equipment shall be installed on concrete housekeeping pads. Equipment shall be permanently fastened to the pad in accordance with manufacturer's instructions and seismic requirements of the site.

.5 Equipment shall be initially started and operated by representatives of the manufacturer.

.6 All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly cleaned to remove all dirt and construction debris prior to initial operation and final testing of the system.

3.3 INITIAL INSTALLATION PERFORMANCE TESTING

.1 The complete installation shall be used for compliance with the specification following completion of all site work. Testing shall be conducted by representatives of the manufacturer, with required fuel supplied by Contractor. The Engineer shall be notified in advance and shall have the option to witness the tests. Provide a resistive load bank and make temporary connections for full load test.

.2 Testing shall conform to the requirements of CAN/CSA-C282 section of Initial Installation Performance Tests, and shall include: Operational Tests, Full Load Test, Cycle Crank Test, Safety shut down and Alarms Ventilation. Record all the data, tests and indications required and/or listed in CSA-C282, submit test report to consultant.

.3 After above tests have been successfully completed, the fuel tank shall be completely filled at no cost to the Owner.

3.4 TRAINING

.1 The equipment supplier shall provide training for the facility operating personnel covering operation and maintenance of the equipment provided. The training program shall be not less than 4 hours in duration and the class size shall be limited to 5 persons. Training date shall be coordinated with the facility owner.

3.5 SERVICE AND SUPPORT

.1 The manufacturer of the generator set shall maintain service parts inventory at a central location which is accessible to the service location 24 hours per day, 365 days per year.

.2 The generator set shall be serviced by a local service organization that is trained and factory certified in generator set service. The supplier shall maintain an inventory of critical replacement parts at the local service organization, and in service vehicles. The service organization shall be on call 24 hours per day, 365 days per year.

.3 The manufacturer shall maintain model and serial number records of each generator set provided for at least 20 years.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 This Section of Specifications is an integral part of the Contract Documents and shall be read accordingly.

.2 Comply with Section of Electrical General Requirements.

.3 Provide all lighting fixtures with lamps, ballasts and accessories as specified herein and as shown on the Electrical Drawings.

1.2 REFERENCE

.1 Comply with all requirements of the latest edition of CSA Standards.

1.3 SUBMITTALS

.1 Submit shop drawings in accordance with Section of Electrical General Requirements.

.2 Include fixture catalogue data sheets with shop drawings. Arrange the fixture catalogue data sheets and identify in the same sequence as the specified fixture list. Fixture catalogue data sheets shall indicate the following:

- .1 Dimensions, weight, material, finish and mounting details
- .2 Performance: Candle power distribution curves in two planes, C.V. chart of indoor fixtures and lumen output chart of outdoor fixtures and flood lights.
- .3 Pole wind loading, weight, dimension, anchoring details and finish
- .4 Lamps: type and base, burning hours, CRI, CCT and lumens
- .5 Ballasts: type, wiring diagram, watts, voltage, P.F., sound rating, starting temperature, efficiency and other required characteristics

.3 Submit photometric IES file for all substituted fixtures. Where requested, submit an electronic lighting level calculation analysis for the area with substituted fixtures.

.4 Where requested, submit fixture samples of each substituted fixtures.

.5 Submit a colour/finish chart for all lighting fixtures for final selection/approval.

.6 Where requested, submit certified heat-run test data for each type of ballast mounting.

.7 Where requested, within four (4) weeks of Contract award, provide information on the electronic ballast operating frequency for Owner’s co-ordination with Owner supplied equipment operating at high frequencies.

1.4 WARRANTY

.1 Warrant high intensity discharge (HID) lamps for a period of 24 months from the date of Substantial Completion of the Work. Include labour for replacing lamps in the warranty.

.2 Warrant fluorescent lamps for a period of 36 months from the date of Substantial Completion of the Work. Include labour for replacing lamps in the warranty.

.3 Warrant LED lamps and drivers for a minimum of 5 years from the date of Substantial Completion of the Work. Include labour for replacing lamps and drivers in the warranty.

.4 Warrant induction lamps and drivers for a minimum of 10 years from the date of Substantial Completion of the Work. Include labour for replacing lamps and drivers in the warranty.

.5 Warrant HID ballasts for a period of 24 months and fluorescent ballasts for a period of 60 months from the date of Substantial Completion of the Work. Include labour for replacing lamps in the warranty.

Part 2 Products

2.1 LAMPS

.1 High Pressure Sodium Lamps shall be a coated type with 2100°K CCT, minimum lamp life of 24,000 burning hours.

.2 Metal Halide lamps shall be warm deluxe white ‘styletone”, coated type with 3500°K CCT, minimum lamp life of 18,000 burning hours, minimum CRI of 80. Pulse start type. Provide double envelope lamps suitable for open fixtures.

.3 Fluorescent Lamps shall be 4100°K CCT, minimum CRI of 85, minimum lamp life of 26,000 burning hours. T8 lamp shall be energy advantage type with a minimum of 95 lumens/w.

.4 Compact Fluorescent Lamps shall be 4100°K CCT, minimum lamp life of 12,000 burning hours. Minimum CRI of 82, provide four (4) pin lamps for fixtures on dimming circuits.

.5 LED Lamps

.1 Minimum lamp and driver life of 50,000 burning hours

.2 3500°K CCT for indoor application. 5000°K CCT for outdoor application.

.3 Quietest electronic driver

.6 Induction Lamps

.1 Minimum lamp and driver life of 100,000 burning hours

.2 3500°K CCT for indoor application. 4000°K CCT for outdoor application.

.3 Quietest electronic driver

.7 Low mercury component, less than 70 picograms in one lamp.

.8 Manufacturers

.1 Philips
.2 Osram-Sylvania
.3 G.E.

2.2 BALLASTS

.1 Fluorescent

.1 Programmed start, high efficiency electronic fluorescent ballast, unless otherwise noted in the Contract Documents.
.2 CSA and UL listed, Class P and type 1 outdoor, integrated electronic circuitry, less than 10% of voltage and frequency sustained variations with no damage to ballast. Less than 10% THD. Ballasts shall have an average lamp crest factor of less than 1.6. Ballast shall have a frequency of operation in the range greater than 42KHz and shall operate without visible flicker. Power factor shall exceed 98%. No polychlorinated biphenyls (PCBs) will be permitted. Comply with ANSI C62.41 Category A for transient protection. Best performance on sound rating, quieter than Class A sound rating, including sound rating data in shop drawings. -18°C (0°F) starting temperature, minimum 0.95 ballast factor. Meet the FCC Standard for EMI/RFI.

.2 Where dimming ballasts are specified, the electronic dimming ballast shall have the following additional features:

.1 Ballast shall dim continuously between 100% and 10% light output at a minimum.
.2 Ballast shall maintain full filament heat throughout the dimming range.
.3 Ballast dimming circuitry shall be UL Class 2 and fully isolated from ballast input power.
.4 Ballast shall require no intermediate trimming controls between ballast and controlling device
.5 Dimming ballasts shall be compatible with the dimming system supplied.
.6 Where necessary, provide additional wire to suite ballast control requirements.

.3 High Intensity Discharge (HID) Ballasts

.1 Unless noted otherwise in the Contract Documents, all high pressure sodium, and metal halide ballasts for operation on single phase, 60 cycle power supply 347V or 120 volt as noted. All ballasts to be constant wattage high power factor 0.9 or better. The wave form of the ballast output shall provide the full rated lamp output without adversely affecting lamp life.
.2 Meet all applicable ANSI specifications.
.3 Constant wattage, isolated secondary
.4 Ballasts mounted integral with lighting fixtures shall be sealed, potted quiet type and be mounted with an approved vibration assembly and any required accessories to minimize noise transmission.

.5 Ensure trouble-free operation free of overheating for all proposed methods of ballast installation. Supply certified heat-run test data with each type of ballast mounting.

.6 Provide weatherproof ballasts with -30°C starting temperature for outdoor locations and indoor unheated locations.

.7 Provide F-can or potted core & coil type for indoor locations.

.8 Provide pulse start ballast where applicable.

.4 Manufacturers

.1 Advance

.2 Universal

.3 Magnetek

.4 Osram – Sylvania

.5 Lutron

2.3 LIGHTING FIXTURES

.1 Fixtures shall have CSA labels and shall be complete with lamps, ballasts and necessary accessories for installation.

.2 Unless otherwise indicated in the Contract Documents, fluorescent lighting fixture bodies shall be minimum 20 gauge, cold rolled prime steel of rigid construction with knockout as required. Fixture rigidity shall permit any suspension method without sag. Fluorescent fixtures shall be suitable for either individual or continuous mounting. Fixture sockets shall apply continuous holding pressure on lamps.

.3 Fluorescent fixtures shall be finished in baked white enamel (or other colour if specified) which shall resist chipping, corrosion and discolouration. Before finishing, all metal shall be chemically degreased and neutralized. Finish shall be not less than two coats of enamel, sprayed on and baked. Reflecting surfaces shall be white with an average reflectance of not less than 85%.

.4 All fixture types shall be designed with adequate heat sinks to dissipate the generated heat in order to prevent ballast and lamps from overheating with the resulting decrease in their rated life expectancy and/or light output. Fixtures shall be wired with type GTF fixture wire.

.5 All fixtures shall be complete with required safety disconnect means.

.6 Fixtures shall be designed so that minimum time is required for lamp or ballast replacement.

.7 Plastic lenses shall be 100% virgin acrylic not less than 3 mm thick.

.8 All metal halide fixtures shall be equipped with protective lenses.

.9 Include the cost of all necessary accessories for a complete installation in the Contract Price. No extras will be entertained as a result of the supplier or Contractor failing to provide such accessories.

2.4 LIGHTING CONTROL

.1 Provide a complete centralized networked lighting control and dimming system consists of multi relay panels, and with the following features:

- .1 ULC listed under both industrial control equipment and energy management equipment
- .2 Integrated astronomical time clock
- .3 Control all lighting circuits except exit signs
- .4 Compatible with the input controls from occupancy sensors, photocells, wall switches, and any other controls
- .5 Individually replaceable relays rated for all light sources. 20A, 120VAC, or 347VAC each circuit. Inputs and relays in each panel to suit the application.
- .6 PC-based programming
- .7 Ethernet module
- .8 Networked relay panels communicate with each other to form one centralized control system
- .9 Interface with other system, i.e. BAS (building automation system)
- .10 Sprinkler proof enclosures, with hinged removable door with key loack
- .11 Easy to program keypad control and LCD screen to display all information
- .12 Low voltage 4-zone, or 8-zone remote control stations, wall mounted in recessed single gang box
- .13 Leviton or equaled by Lutron
- .14 Lighting control system manufacturer shall provide functional testing on the entire installed lighting control system and devices. Submit test report.

.2 Outdoor photocell controls

- .1 Photo-electric controls shall be weatherproof, temperature compensated and shock and vibration resistant. Turn-on action shall be adjustable from 1.5 to 5.5fc. Turn-off is adjustable and approximately three (3) times turn-on.
- .2 Photo-electric control delay of up to 2 minutes prevents false switching due to temporary flashes of light. Contacts shall be 120 volt, single pole and shall fail in ‘ON’ position.
- .3 Photo-electric control shall be Tork #2100 Series or approved equal, and complete with B-Bracket for wall mount of the photo-electric control.
- .4 For outdoor lighting control, BAS system and photo-electric controls shall be wired to control exterior lights on at dusk and off at the selected time.
- .5 Mount exterior photo-electric control with photoelectric cell facing north up high. Adjust light level selector as instructed on the Site.

.3 The timer (time switch) shall be complete with the below features:

- .1 Digital type
- .2 Power outage back-up
- .3 Omitting devices, manual operation, sprinkler-proof enclosure.
- .4 Time switch contact shall be 20A, 120 volt, single pole.

.5 7-day, 24-hour, 20-set point per day, minimum setting is one minute, each day with different schedules.

.6 Tork #EW101B

.4 Indoor photo-electric controls

.1 Ceiling mounted on 4’ recessed back box or wall recessed as shown. Turn-on action shall be adjustable from 10fc to 200fc, and with 3-15 minute time delay. Turn-off action shall be the adjustable and approximately three (3) times turn-on with 3-15 minute time delay.

.2 Controls shall include sensor and power/control unit. Sensor shall have red LED indications. Control unit contact rating: 20A, 120VAC, or 347VAC.

Part 3 Execution

3.1 INSTALLATION

.1 Install all fixtures in the standard manner for the type of fixture and in accordance with the manufacturer's instructions. Support all fixtures from building structural members. The drop ceiling supports are not acceptable.

.2 In non-accessible ceilings, wire with not less than 1220 mm of AC90 or RW90 wire in flexible conduit to adjacent outlet boxes placed above the finished ceiling within reach of the fixture openings.

.3 In accessible ceilings wire with 1830 mm of AC90 or RW90 wire in flexible conduit to adjacent outlet boxes.

.4 Where fixtures are not installed in the approved ceiling system, provide steel fixture studs, brackets and hangers. Where fixtures are hung on chain hangers, provide chain of closed link type capable of supporting ten times the fixture weight. Use U-bolts for chain ends; S-hooks are not acceptable.

.5 Provide suitable trim for all fixtures installed in drywall ceiling or within lay in or snap in tiles.

.6 Provide I.C. frame/enclosure for all fixtures installed in insulated ceiling. Confirm the insulated ceiling areas.

.7 Provide fire rated boxes for all recessed fixtures in the fire rated ceiling area.

.8 Provide plaster frames for all fixtures recessed in plaster ceilings. Coordinate plaster frames installation with ceiling contractor and ensure that they are located correctly.

.9 Protect fixtures from dirt and damage during construction and clean when the installation is completed. Replace fixtures showing marks or scratches due to handling or tool marks.

.10 Align fixtures shown in continuous rows or broken lines so that all rows appear as straight lines. Crooked lines and misplaced fixtures will not be accepted.

.11 Where luminaries are surface mounted on inverted T-bar ceilings, they shall be supported directly from the building structure. Where this is not possible due to presence of mechanical ducts or other obstruction, supply and install galvanized steel channel, Unistrut or approved equal, above the ceiling, securely attached to the structure and not from the suspension system for the ceiling, and fasten the luminaires to the channel with clamping nut, bolt, flat washers and lock washer to the satisfaction of the Consultant. Provide bolts at least every 1.2m of the length of the fixture (i.e., 3 bolts for 2.4m fixture).

.12 Fixtures are shown on the Electrical Drawings in approximate locations only. Install fixtures in accordance with reflected ceiling plans, details and/or field instructions.

.13 Install lighting fixtures in service areas, underground parking areas, unfinished areas, mechanical and electrical rooms after the mechanical and electrical equipment is in place. Locate fixtures on Site to clear all obstructions to the approval of the Consultant. Provide auxiliary steel members for hanging fixtures below ducts and other equipment.

.14 Where the ceiling height is less than 3 metres, suspend ceiling surface mounted fixtures at 3 metres AFF. Where the ceiling height is more than 3 metres, suspend ceiling surface mounted fixtures at 3 metres AFF.

.15 Provide all mounting hardware for all fixtures.

.16 Check the latest ceiling finishes in all areas where recessed fixtures are specified to ensure that fixtures are purchased with suitable ceiling trim for the particular ceiling finish. Replace fixtures which are sent to the Site with the wrong ceiling trim or flanges with fixtures having the correct trims, flanges, etc. as required, at no cost to the Owner.

.17 Provide safety chains for all HID fixtures with integral ballasts. Attach chain to the fixture and building structure. Safety chain shall be designed and secured so as to sustain the sudden weight of the fixture.

.18 In stairs, provide a fixture on every main and half landing level. Coordinate with Architectural Drawings for number of landings.

.19 Fixtures shall be installed in accordance with the reflected ceiling layouts with due consideration for mechanical diffusers, bulkheads, sprinkler heads, and other obstructions. Check the Mechanical and Architectural Drawings before roughing-in to avoid any possible conflict.

.20 Fixtures connected to ground fault interruptor circuits shall have separate neutrals (common neutrals for 2 or 3 circuits are not acceptable).

.21 Exterior wall mounted lighting fixtures shall be mounted on recessed boxes except where fixtures with integral outlet boxes are specified, in which case the recessed outlet box is not required. Outlet boxes shall be firmly anchored to the wall.

.22 Unless otherwise indicated in the Contract Documents, supply and install concrete bases for lighting standards. Concrete bases shall be trowel finished

with all exposed corners bevelled at 45 degrees. Junction boxes shall be carefully set and anchored to ensure flush fit of junction box cover. Concrete bases shall be constructed of 20 Mpa concrete air entrained and steel reinforced as shown on the Drawings.

.23 Include third party functional testing of all lighting control devices and systems. Submit test report.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 This Section of the Specifications is an integral part of the Contract Documents and shall be read accordingly.

.2 Comply with Section of Electrical General Requirements.

.3 Provide an emergency lighting system including exit signs, remote heads, and battery units, as shown on the Drawings, as specified herein and as otherwise required.

1.2 REFERENCE

.1 Comply with the requirements of the latest edition of the following:

.1 CSA-C22.2 No. 9, General Requirements for Luminaires
.2 CSA-C22.2 No. 141, Unit Equipment for Emergency Lighting
.3 CSA-C22.2 C860, Performance of Internally Lighting Exit Signs
.4 CSA-C282, Emergency Electrical Power Supply for Buildings

1.3 SUBMITTALS

.1 Submit shop drawings and Product data in accordance with Section of Electrical General Requirements.

.2 Include fixture catalogue data sheets with shop drawings indicating dimensions, components, electrical characteristics and performance data for each fixture and device. Arrange the fixture catalogue data sheets and identify in the same sequence as the specified fixture list.

.3 Submit test report and verifications following the completion of testing.

1.4 WARRANTY

.1 For the complete system, provide a 2-year, no-charge, unconditional guarantee, and 5-year pro-rated charge guarantee on workmanship and parts.

.2 For batteries, on the second 5-year, provide a pro-rated charge guarantee on workmanship and parts.

1.5 MANUFACTURERS

.1 Emergi-Lite

.2 Lumacell

.3 Beghelli

Part 2 Products

2.1 STANDARD EXIT SIGNS

.1 Pictogram exit signs meet or exceed CSA 22.2 No.141-10 standard for pictogram exit signs

.2 The housing shall be constructed of rugged extruded aluminum

.3 The faceplate(s) shall be constructed of extruded Aluminum and shall incorporate a protective clear poly-carbonate panel.

.4 Each face plate shall come standard with two legend films for pictogram and directional indicators.

.5 Lamps: Less than 2.5W, LED.

.6 Inputs:

.1 DC: 12V as shown on the Drawings.
.2 AC: Universal: 120V/347V.

.7 Directional arrows: universal type for field adjustment.

.8 Mounting: universal for field selection of ceiling surface, wall surface, and/or pendent

.9 Provide white metal wire guard in rough areas and as required.

2.2 WEATHER-PROOF EXIT SIGNS

.1 Same as standard exit signs, except:

.1 Housing to be industrial grade polyvinyl chloride fully gasketted around lens and canopy.
.2 The sealed face plate shall be constructed of heavy duty vandal-resistant polycarbonate.

2.3 STANDARD REMOTE HEADS

.1 Single or double cast aluminum head(s), complete with mounting plates, 300 degree horizontal and 80 degree vertical minimum adjustment.

.2 Lamps: MR16 LED Narrow beam, 6W or as shown on the Drawings.

.3 Input: 12VDC as shown on the Drawings.

.4 Mounting: ceiling or wall as shown on the Drawings.

.5 Finish: white painted.

.6 Provide white metal wire guard as required.

2.4 BATTERY UNIT

.1 Supply voltage: as indicated on the Electrical Drawings.

.2 Output voltage: 12V DC.

.3 Operating time: 1/2 hour minimum.

.4 Battery: sealed, maintenance free, long-time lead with rated life of ten (10) years.

.5 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output of plus or minus 0.01V for plus or minus 10% input variations capable of restoring a discharged battery to the fully-charged state within twenty-four (24) hours, and switched to a float charge when not in full charge mode.

.6 Solid state transfer circuit

.7 Low voltage disconnect: solid state, modular, operates at 80% battery output voltage.

.8 Signal lights: solid state, for “AC Power ON’ and ‘High Charge’.

.9 Lamp heads: integral on unit and remote, 345° horizontal and 180° vertical adjustment, white painted cast aluminum head. Lamp type: wide beam flat MR16 LED, 2-6W, unless noted otherwise in the Contract Documents.

.10 Cabinet: suitable for direct or shelf mounting to wall and complete with knockouts for conduits. Removable or hinged front panel for easy access to batteries.

.11 Finish: standard factory finish.

.12 Auxiliary equipment:

- .1 Advanced diagnostic printed circuit board with auto self test and time delay
- .2 Test switch and LED trouble indicator
- .3 Battery disconnect device
- .4 AC input and DC output terminal blocks inside cabinet
- .5 Mounting shelf
- .6 Transient voltage surge suppressor on the supply side of power to the unit

2.5 WIRING

.1 Refer to Section of Basic Materials and Methods.

Part 3 Execution

3.1 INSTALLATION

.1 Pendant mount exit signs in service rooms and other areas where necessary to clear obstructions. Install suspended exit signs using pendants supported from swivel hangers.

.2 Install all unit equipment, remote heads, exit signs, and accessories in accordance with the manufacturer's instruction.

.3 Direct heads for illumination to meet OBC requirements.

3.2 TESTING AND VERIFICATION

.1 Arrange with the manufacturer to conduct a complete commission, inspection and test of all installed emergency lighting system.

.2 The manufacturer's representative shall be responsible for properly aiming remote heads, recording the light level readings, recording battery full load operation time, issuing a verification indicating that lighting levels meet CNBC requirements, and the system has been installed properly.

.3 Submit the report and verification to Consultant.

.4 Correct all deficiencies.

.5 Shall be witnessed by Consultant.

.6 All costs involved in the testing, verification, and corrections shall be included in the Contract Price.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 This section of specification is an integral part of the contract documents and shall be read accordingly.

.2 Comply with Section of Electrical General Requirements.

.3 Provide the following electric heating assemblies and system complete with all components/accessories and controls.

.4 Electric duct mounted heaters are excluded.

1.2 REFERENCE

.1 Comply with the requirements of the latest editions of the following:

.1 CSA C22.2 No. 130, Requirements for Electrical Resistance Heating Cables and Heating Device Sets

.2 CSA C22.2 No. 46, Electric Air Heaters

.3 CSA C22.2 No. 72, Heater Elements

.4 CAN/CSA C273.4, Performance Requirements for Electric Heating Line-Voltage Wall Thermostats

.5 CAN/CSA C828, Performance Requirements for Thermostats Used with Individual Room Electric Space Heating Devices

1.3 SUBMITTALS

.1 Submit shop drawings in accordance with Section of Electrical General Requirements.

.2 Product Data: dimensions, mounting methods, characteristics, performance criteria, materials, accessories, mechanical and electrical data, product characteristics and limitations.

.3 Manufacturer's Installation Instructions: Submit assembly, support details, and connection requirements.

.4 Submit color/finish chart for all lighting fixtures for final selection/approval.

1.4 QUALIFICATIONS

.1 Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

Part 2 Products

2.1 ELECTRIC BASEBOARD HEATERS

.1 Acceptable manufacturers:

.1 Chromalox
.2 Stelpro
.3 Ouellet
.4 Approved equal

.2 Assembly: ULC listed and labeled with terminal boxes on both ends, covers, controls and all mounting accessories.

.3 Heating Elements: Through-type nickel chromium element enclosed in mineral insulation in stainless steel sheath fitted with aluminum fins.

.4 Cabinet: Slop top, pre-drilled back for securing to wall. Integral air diffusion reflector with wireway at bottom. Front inlet top outlet. Minimum 11 gauge extruded aluminum equivalent in strength with front panel, end panel, end caps, corners, and joiner pieces to snap together. Furnish full-length damper.

.5 Finish: Clear anodized aluminum, unless otherwise required.

.6 Control: easy access built-in tamper-proof heating thermostat, factory wired.

.7 Surface wall-mounted at low level, but minimum 150mm AFF. Co-ordinate with Architect for more installation requirements.

.8 Ouellet #ODIA or equal.

2.2 ELECTRIC CABINET HEATERS

.1 Acceptable manufacturers:

.1 Chromalox
.2 Stelpro
.3 Ouellet.
.4 Approved equal

.2 Assembly: ULC listed and labeled assembly with terminal box, covers, controls and all mounting accessories.

.3 Heating Elements: Through-type nickel chromium element enclosed in mineral insulation in stainless steel sheath fitted with aluminum fins.

.4 Cabinet: Pre-drilled back for securing to wall. Adapter for ceiling mounted unit. Integral air diffusion reflector with wireway at bottom. Front inlet/front outlet. Minimum 20 gauge steel or extruded aluminum equivalent in strength with front panel, end panel, end caps, corners, and joiner pieces to snap together. Furnish full-length damper.

.5 Finish: Clear anodized aluminum or powder coated finish, almond colour, unless otherwise required.

.6 Fan: Direct-drive, statically and dynamically balanced, with fan guard.

.7 Motor: Permanently lubricated, totally enclosed, ball bearing type, built-in thermal overload protection, built-in safety disconnect switch or plug-in electrical

connection. Where power supply voltage is not matched with motor, provide built-in transformer for motor.

.8 Control: Built-in tamper-proof heating thermostat, factory wired.

.9 Applications: Wall and/or ceiling mounted as shown on drawings; recessed mounted. Verify the exact application and co-ordinate more installation requirements with Architect before ordering.

.10 Ouellet #OAC & #OACP series or equal.

2.3 ELECTRIC UNIT HEATERS

.1 Manufacturers:

.1 Chromalox
.2 Stelpro
.3 Ouellet

.2 Assembly: UL listed and labeled assembly with terminal box, covers, controls and mounting accessories.

.3 Heating Elements: Nickel-chrome resistance wire centered in tubes and embedded in refractory material.

.4 Cabinet: Minimum 18 gauge steel with easily removed front panel with integral air outlet and inlet grilles.

.5 Hangers: Quiet operating, ball bearing cradle type providing unrestricted longitudinal movement, on enclosure brackets suitable for the application.

.6 Fan: Direct-drive, statically and dynamically balanced, with fan guard.

.7 Motor: Permanently lubricated, totally enclosed, ball bearing type, built-in thermal overload protection, built-in safety disconnect switch or plug-in electrical connection. Where power supply voltage is not matched with motor, provide built-in transformer for motor.

.8 Control: Unit heater shall be controlled by remote thermostat. Provide wall-mounted thermostat, control relay, control transformer and control wiring.

.9 Applications: Wall-mounted and/or ceiling-suspended.

2.4 THERMOSTATS

.1 Programmable electronic thermostat, white finish.

.2 Temperature range: 0 - 30°C.

.3 Resolution and precision: 0.5°C.

.4 Digital display of ambient and set point temperature; temperature setting recorded permanently; 4-settings per week, and 4-setings per weekend.

.5 Complete with line-voltage built-in or remote switching relay to suite load requirements of voltage, phases, and wattage.

.6 Surface mounted at 1200mm AFF. Provide temper-resistant guard as required.

.7 Three (3) years warranty.

Part 3 Execution

3.1 INSTALLATION OF HEATERS

.1 For recessed units, verify recess dimensions are correct size.

.2 Verify wall construction is ready for installation.

.3 Verify concealed blocking and supports are in place and connections are correctly located.

.4 Install the electric heaters in accordance with the manufacturer’s instructions.

.5 Use wire in electric heaters, which is specifically approved for electric heater use.

.6 Install equipment exposed to finished areas after walls and ceilings are finished and painted. Avoid damage.

.7 Protection: Provide finished cabinet units with protective covers during remainder of construction.

.8 Unit Heaters: Provide at locations as indicated on Drawings. Coordinate to assure correct recess size for recessed units.

.9 Install electric heating equipment including devices furnished by manufacturer but not factory-mounted. Furnish copy of manufacturer's wiring diagram submittal. Install electrical wiring in accordance with manufacturer's submittals.

.10 The installation shall be inspected by the manufacturer’s approval for the completed installation.

.11 Perform the heater tests to ensure that all heaters, fans and heating controls are operating properly. Submit the test reports.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 This Section of Specifications is an integral part of the Contract Documents and shall be read accordingly.

.2 Comply with Section of Electrical General Requirements.

.3 Related Sections:

.1 Section 26 05 00 – Basic Materials and Methods

.2 Section 26 05 10 - Grounding

.4 Provide empty raceway systems including conduits, cable trays, terminal cabinets, plywood backboards, pull boxes, outlets and cover plates for enclosure of wiring.

.5 Telecommunication systems include, but are not limited to, telephone, data cabling, P.A., CCTV, security and access control, emergency alarm, etc.

.6 Coordinate with system contractors for all of the Work.

1.2 REFERENCE

.1 Comply with the requirements of the latest edition of the following:

.1 EIA/TIA-569-B, Commercial Building Standard for Telecommunications Pathways and Spaces

.2 J-STD-607-A, Commercial Building Grounding and Bonding Requirements for Telecommunications

Part 2 Products

2.1 MATERIALS

.1 Wall outlets shall be 115 mm square boxes with plaster rings to suit single gang devices unless otherwise noted in the Contract Documents. Provide stainless steel cover plates for the outlet boxes for future use.

.2 Conduit size shall be in accordance with systems contractor’s requirements and recommended standards.

.3 Minimum pull box and junction box size shall be as follows:

Maximum conduit size	Size of boxes in millimetres			For each additional conduit size increase width by:-
	Width	Length	Depth	
27mm	102mm	406mm	76mm	51mm
35mm	152mm	508mm	76mm	76mm
53mm	203mm	914mm	102mm	127mm

78mm	305mm	1219mm	127mm	152mm
103mm	381mm	1524mm	203mm	203mm

.4 Plywood backboards shall be a minimum of 1200 mm x 2400 mm, 19 mm thick, painted with 2 coats of fire retardant light grey enamel.

.5 Provide a minimum of 2 duplex receptacles on separate circuits at each backboard.

.6 Provide grounding at each backboard.

Part 3 Execution

3.1 INSTALLATION

.1 Vertically mount outlet boxes, unless noted otherwise in the Contract Documents, 300 mm to centre above floor, or 150 mm above countertop where shown at counters or benches.

.2 Fish conduit, clear blockages and outlet and clean out pull boxes at completion of installation. Leave conduit free of water or excess moisture. Install No. 12 gauge galvanized soft iron pull wire, or 1/8" nylon pull cord (minimum 400LB) continuously from outlet to outlet, through conduit and fasten at each box.

.3 Conduit bonds shall have a bending radius of not less than nine times the conduit diameter. Ream out conduit and identify ends with green paint.

.4 Install additional steel pull boxes in such a manner that, throughout the entire system, there shall be not more than two 90 degree or equivalent bends or more than 30,000 mm in each run, so that wire or cables may be pulled in or withdrawn with reasonable ease.

.5 Show as-installed conduit routing and location of all pull boxes on the record drawings, prior to project completion, for use by systems contractors to facilitate wiring and equipment installation. Include the above noted information on final record drawings at project completion.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment and services necessary for earthwork Work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 ASTM D698, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort.

.2 ASTM D4253, Test Method for Maximum Index Density and Unit Weight of Soil Using a Vibratory Table.

.3 OPSS, Ontario Provincial Standard Specification.

1.3 **SUBMITTALS**

.1 Shop drawings:
.1 Submit shop drawings in accordance with Section 01 33 00 indicating:
.1 Adjacent construction, elevations, sections and details, dimensions, and relationship to adjacent construction.
.2 Include design calculations, design concept, construction method, sequence and means by which existing structures, utilities and equipment will be protected; Location of in-use, maintained, re-routed and abandoned underground lines.

.2 Reports:
.1 Submit written laboratory test reports.
.2 Submit written field inspection and test report results after each inspection.

.3 Submit dewatering methods 30 days in advance for review by Consultant. If well point system is required, Engineer shall design system and supervise installation.

.4 Submit to Consultant details of locations where surplus soils and other materials are to be disposed of or reused. Include each disposal/reuse Site and type of surplus soil or other material, location of the disposal/reuse Site, operator's name and business address, type of license under which Site operates, and criteria used by Site to access suitability of surplus material for disposal.

.5 Submit to Consultant, within 48 hours of a load of surplus soil or other material leaving the Site, a daily register recording the time and place of disposal/reuse of each load signed by a representative of the disposal site. Such documentation must be submitted before payment for excavation will be made.

1.4 QUALITY ASSURANCE

.1 Have shop drawings signed and sealed by a Professional Engineer licensed in Province of Ontario and having experience in design and inspection of shoring, bracing, underpinning and dewatering (if required) required to complete Work.

1.5 SITE CONDITIONS

.1 Geotechnical conditions: For information on subsurface conditions refer to document appended to this Specification. See 02 32 00 & 02 32 00a

.2 Cultural heritage resources: If Cultural Heritage Resources (such as archaeological sites, artifacts, building and structural remains, and/or human burials) are encountered during performance of Work, contact Consultant immediately and suspend Work in immediate area until assessment has been completed by Ministry of Culture, Tourism and Recreation. Perform required measures to mitigate negative impacts on found resources to acceptance of Consultant.

1.6 PROTECTION

.1 Existing buried utilities and structures:
- .1 Size, depth and location of known existing utilities and structures are indicated for guidance only. Completeness and accuracy is not guaranteed.
- .2 Prior to commencing any excavation Work, have authorities stake out utility locations to prevent disturbance during Work.
- .3 Confirm locations of buried utilities by careful test excavations. Hand dig test excavations as necessary.
- .4 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered. Obtain permission of Consultant before moving or otherwise disturbing utilities or structures.

.2 Existing surface features:
- .1 Conduct with Consultant, a condition survey of existing trees and other plants, lawns, fencing, service poles, wires, rail tracks and paving, survey benchmarks and monuments which may be affected by Work.
- .2 Protect existing surface features which may be affected by Work from damage while Work is in progress and repair damage resulting from Work.
- .3 Where excavation necessitates root or branch cutting, perform Work in accordance with Authorities having Jurisdiction.
- .4 Confirm with Consultant, condition Survey of buildings and structures undertaken by Consultant.

.3 Temporarily cover local existing catch basins and maintenance holes to prevent entry of earth or debris. Ensure adequate surface drainage in affected area is maintained.

.4 Protect Work or work of other Contracts in progress or completed and protect existing properties, stored Products, services, utilities, trees, landscaping and natural features from damage.

.5 Protect excavations against flooding and damage and install and maintain appropriate warning devices during construction and during time when Work is closed down for any cause.

.6 Protect bottom of excavations that will support foundations, slabs, pavements etc. from frost or freezing.

.7 Keep access roads clear of debris and dirt resulting from Work of this Section to acceptance of Authorities having jurisdiction.

.8 Shoring, bracing and underpinning: Comply with local regulations, authorities having jurisdictions and requirements specified.

2 Products

2.1 **MATERIALS**

.1 Select fill: Subject to approval of Consultant consisting of reusable fill excavated from Site or imported fill that is free of organic matter, rubble and material other than soil. Maximum particle size of half thickness of lift specified, moisture content at time of placing 2% maximum over its optimum moisture content and is either non-plastic or has a plasticity index of 25% maximum.

.2 Granular A fill: Imported Granular A fill, free of organic matter and, in accordance with OPSS 1010.

.3 Granular B Fill: Imported Granular B fill free of organic matter and in accordance with OPSS 1010.

.4 Granular D fill: In accordance with OPSS-1004, containing 100% crushed aggregates, free of organic matter.

.5 Clear Stone fill: 19 mm clear stone in accordance with OPSS 1004, free of organic material.

.6 Unshrinkable fill: 0.7 MPa cement stabilized backfill conforming to requirements of CAN/CSA A23.1/A23.2-M.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

3.2 LINES AND ELEVATIONS

.1 Establish lines and elevations from Control Points shown on Contract Drawings.

.2 Have lines and elevations established by Registered Ontario Land Surveyor or qualified Civil Engineer registered in Province of Ontario.

.3 Protect and maintain Control Points and Bench Marks as long as they are required.

3.3 STRIPPING

.1 Do not handle topsoil while in wet or frozen condition or in manner in which soil composition is adversely affected.

.2 Strip topsoil from working area in locations shown.

.3 Strip topsoil to depths indicated. Avoid mixing topsoil with subsoil.

.4 Stockpile topsoil in locations directed by Consultant. Stockpile to height not exceeding 2 m. Remove excess topsoil from Site.

3.4 REMOVAL OF WATER

.1 Obtain letter of conditional approval from Municipality to dispose of ground water into sewer drainage system. Apply for and pay for water disposal permit, if applicable.

.2 Keep excavations and trenches free of water throughout construction period.

.3 Groundwater removal:

- .1 Lower groundwater level and maintain at depth below lowest point of excavation to ensure a dry stable surface.
- .2 Dewater to prevent loss of soil and maintain stability of sides and bottom of excavation and of adjacent structures.
- .3 Dispose of water in conformance with applicable by-laws and in a manner not detrimental to public and private property, or portion of Work completed or under construction.
- .4 Supply and install flocculation tanks, settling basins, or other treatment facilities to remove suspended solids or other materials before discharging to sewers, water courses or drainage areas in accordance with authorities having jurisdiction. Perform testing on settlement tank discharge to confirm that effluent meets sewer bylaw requirements. Locate tanks to acceptable area determined by Consultant.
- .5 Should method of dewatering fail to achieve conditions specified above, Consultant reserves right to revise methods and procedures at no cost to Owner.

.4 Surface water removal:
.1 Remove surface run-off in a manner that will prevent loss of soil and maintain stability of sides and bottom of excavation. Obtain Consultant's approval of dewatering method to be used.
.2 Discharge surface water into existing storm drainage system to acceptance of Consultant and local authorities.

.5 Do not obstruct flow of surface drainage or natural water courses.

3.5 EXCAVATION

.1 Remove concrete, masonry, paving, demolished foundations and rubble and other obstructions encountered during excavation Work.

.2 Do not disturb soil within drip line of trees or shrubs that are to remain. If excavating through roots, excavate by hand and cut roots with sharp axe or saw in a manner acceptable to authorities having jurisdiction.

.3 Excavate to required lines and grades shown on Contract Drawings with allowance for subsequent Work including shoring, bracing and formwork. Make excavation clean and clear of loose material and true to size.

.4 Protect stockpiles of fill against contamination and moisture absorption.

.5 Do not undermine adjacent structures. Where it is necessary to have footings at different levels, found upper footing below imaginary 10-horizontal-to-7 vertical line, or as otherwise indicated, drawn up from base of lower footing. Protect adjacent foundations from frost.

.6 Have excavations in excess of 1200 mm in depth conform to requirements of Occupational Health and Safety Act, and Regulations for Construction Projects.

.7 Do not expose shale at subgrade elevation to drying cycles and in any case, following inspection, cover with minimum 50 mm of lean concrete within 4 hours after exposure.

.8 Fill excavations for foundations which are, through error, carried below elevation shown or approved depth, with 15 MPa concrete, or as directed by Consultant.

.9 Trim, and remove loose material, debris and organic material from excavations. Where material at bottom of excavation is disturbed, remove disturbed material and re-compact to density equal to or better than undisturbed soil or backfill with lean concrete as directed by Consultant.

.10 When excavations are complete, prior to commencement of subsequent Work, request Consultant for inspection of excavation Work.

3.6 TRENCHING

.1 Excavate trenches to lines and grades indicated and to a depth of 75 mm minimum below invert elevation and slope established for pipe, and backfill to invert elevation of pipe with specified granular material.

.2 Unless otherwise authorized by Consultant, do not excavate more than 30 m of trench in advance of installation operations and do not leave open more than 15 m at end of day's operation. Remove unsuitable material from trench bottom to extent and depth as directed by Consultant.

.3 Backfill Over-excavation with granular material and compact.

.4 If unstable soil conditions are encountered, excavate trenches to depth directed by Consultant and backfill to correct elevation with backfill material.

.5 Remove loose material from bottom of trenches to ensure granular material is placed against undisturbed soil.

.6 Compact bedding and grade as required for even and uniform support on each length of pipe.

.7 Where excavating is required adjacent to and parallel with and below any footing, submit excavation and backfill procedures to Consultant for review prior to start of excavating.

.8 Keep width of trenches to a minimum to ensure minimum span for pipe to be supported.

.9 Make excavations for fire hydrants of sufficient size and depth to accommodate a minimum 0.75 m^3 of crushed stone. Hand place stone and tamp around and below hydrant elbow to ensure proper drainage of hydrant.

3.7 EXCAVATED MATERIAL DISPOSAL

.1 Except for material to be used as select fill, immediately remove and dispose of excavated material from Site.

.2 Remove and dispose of construction rubble, abandoned gas, water and sewer pipes, valves, valve boxes and fittings, maintenance holes, frames and covers and other material which may be encountered during excavation but not indicated on Contract Drawings.

3.8 BACKFILLING

.1 Do not proceed with backfilling operations until walls, slabs, waterproofing and below grade Work has been inspected and accepted by Consultant.

.2 Backfill areas which are free from debris, snow, ice, water and frozen ground.

.3 Do not use backfill material which is frozen or contains ice, snow or debris.

.4 Do not backfill on or against any membrane or protection board covered waterproofing with jagged rock or other sharp objects which might damage waterproofing.

.5 Limit vertical drop of backfill material to 2000 mm.

.6 Use only rubber-tired vehicles over roof of structure during backfilling, maximum tire pressure 70 kPa. Metal-tracked vehicles will not be allowed on roofs for compaction purposes.

.7 To avoid pockets and voids, remove sheathing and shoring materials that require removal, as backfilling progresses.

.8 Prior to backfilling or placing concrete on exposed soil subgrade, proof roll subgrade to identify soft or loose areas. Proceed with placing backfill or concrete only after inconsistencies identified by above procedure have been reworked and compacted or excavated, backfilled and compacted as required to eliminate such conditions to acceptance of Consultant.

.9 Place backfill material, grade and compact to levels shown on Contract Drawings.

.10 Place backfill materials in uniform layers 200 mm maximum loose thickness unless specified otherwise.

.11 Ensure each layer is compacted, and accepted by Consultant, before placing succeeding layers.

.12 Unless otherwise indicated, use specified granular material from bottom of trench to 300 mm above top of pipe or 150 mm above top of electrical conduits. Hand place in 150 mm layers and compact carefully to ensure proper backfilling and compaction around bottom quadrants and sides of pipe.

.13 For backfill from 300 mm above top of pipe or 150 mm above electrical conduits to sub-grade level, use select fill unless otherwise noted. Compact either by hand or by machine.

.14 Do not backfill trenches until piping, conduits and cables therein have been inspected, tested, and approved by inspection authorities having jurisdiction and Consultant.

.15 Prior to backfilling of trenches, remove wood block or wedges used to prevent movement of piping during tests.

.16 Where there is a common boundary between select fill and granular fill or unshrinkable fill, place select fill after granular fill has been compacted. Place and compact fill around free-standing structures evenly on all sides of structure simultaneously in layers sloping away from structure.

.17 During backfilling, take care to avoid displacing or damaging Utilities Work and Services.

.18 Notify Consultant prior to commencement of backfilling and compacting operations.

3.9 COMPACTION

.1 Compaction densities for select fill, granular fill, and sand fill materials will be determined by ASTM D698. Compaction densities for clear stone will be determined by ASTM D4253.

.2 Add water if necessary to obtain required densities. Correct irregularities or depressions that may develop during compaction by removing or adding material to form a smooth and uniform surface.

.3 Shape and roll alternately to obtain smooth, even and uniformly compacted base.

.4 If material is excessively moist, aerate by scarifying with suitable equipment until moisture content is corrected.

.5 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers acceptable to Consultant.

.6 Compact backfill materials in accordance with Geotechnical Report providing the following as a minimum:

.1 Imported fill: 98% standard Proctor maximum dry density (SPMDD).
.2 Under slabs, walks and pavements: 100% (SPMDD).
.3 All other areas: 95% (SPMDD).

3.10 GRADING

.1 Prior to placing fill over existing ground, scarify surface to depth of 150 mm. Maintain fill and existing surface at approximately same moisture content to facilitate bonding.

.2 Place material only on clean unfrozen surface, properly shaped and compacted and free from snow and ice. Ensure no frozen material is used in placing.

.3 Grade as necessary to bring Work areas to required elevations. Supply additional material required to obtain new grade levels. Place and compact as specified.

.4 Grade drainage ditches to elevations indicated on Contract Drawings.

.5 Maintain positive drainage.

.6 Grade materials using methods which do not lead to segregation or degradation of aggregate.

.7 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.

.8 Remove and replace that portion of layer in which material becomes segregated during spreading.

.9 Slope grade away from buildings 1:50 minimum.

.10 Make graded areas smooth to profile, free of debris, with local excavations and depressions filled and compacted.

.11 Do not disturb soil within branch spread of trees and shrubs remaining.

.12 Cultivate entire area which is to receive topsoil to a depth of 100 mm. Repeat cultivation in those areas where equipment used for hauling and spreading has compacted soil.

.13 Remove surface debris, roots, vegetation, branches and stones in excess of 50 mm in diameter.

3.11 FINISH GRADING

.1 Fine grade and loosen topsoil. Eliminate rough spots and low areas to ensure positive drainage. Prepare loose friable bed by means of cultivation and subsequent raking.

.2 Roll to consolidate topsoil for areas to be seeded or sodded leaving surface smooth, uniform, firm against deep foot printing, and with fine loose texture to approval of Consultant.

3.12 UNSHRINKABLE FILL

.1 Place unshrinkable fill in locations indicated on Contract Drawings or where Work area is too limited to permit proper placing and compaction. Obtain Consultants approval prior to placing unshrinkable fill. Place in accordance with supplier's written instructions.

.2 If embedded items occur in area being backfilled, coordinate with appropriate trades to ensure that disturbance of embedded items during backfilling is prevented.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Labour, Products, equipment, tools, and services necessary for asphaltic concrete paving Work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 ASTM D 698, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort.

.2 ASTM D1559, Test Method for Resistance to Plastic flow of Bituminous Mixtures Using Marshall Apparatus.

.3 CAN/CGSB 1.74, Alkyd Traffic Paint.

.4 OPSS, Ontario Provincial Standard Specification.

1.3 **SUBMITTALS**

.1 Shop drawings: Submit shop drawings in accordance with Section 01 33 00 indicating sections, materials, dimensions, and relation to adjacent construction.

.2 Reports:
- .1 Submit written mix designs for each type of asphalt concrete for acceptance.
- .2 8 weeks prior to commencing Work test materials for conformance with requirements of Specifications. Submit written test report verifying compliance 4 weeks minimum prior to commencing Work.
- .3 Submit written field inspection and test reports.
- .4 Submit certification that testing laboratory is accredited for asphalt mix design through the Canadian Council of Independent Laboratories (CCIL).

1.4 **QUALITY ASSURANCE**

.1 Pre-installation meetings: Arrange with Contractor, asphalt Subcontractor, and Consultant to inspect substrates, and to review installation procedures 48 hours in advance of installation.

1.5 **SITE CONDITIONS**

.1 Do not install Work of this Section outside of following environmental ranges without Consultant's and Product manufacturer's written acceptance:
- .1 Air and surface temperature: OPSS 310.
- .2 Precipitation: None within 24 hours prior to placement.

1.6 **EXTENDED WARRANTY**

.1 Submit a extended warranty for Work of this Section in accordance with General Conditions, except that warranty period is extended to two years.

2 Products

2.1 **MATERIALS**

.1 Granular base and sub-base material: Granular "A" OPSS 1010, crushed or screened stone or gravel.

.2 Asphalt materials:
- .1 Hot mixed, hot laid asphalt meeting OPSS 1150, designation H.L. 8 for binder course and H.L. 3 for surface course.
- .2 Tack and primer coat: OPSS 1103 Grade SS-1.

.3 Traffic paint: CAN/CGSB 1.74, new pavement markings, white or yellow as selected by Consultant.

2.2 **MIXES**

.1 Mix asphalt materials in accordance with OPSS 1003 for H.L. 8 and H.L. 3.

.2 Do not change mix without prior approval of Consultant.

2.3 **SOURCE QUALITY CONTROL**

.1 Source approval:
- .1 Inform Consultant of proposed source of Products and afford access for sampling and testing of quality of Products at least 4 weeks prior to commencing production.
- .2 Ensure that source of Products to be incorporated into Work or stockpiled is acceptable to Consultant.
- .3 Submit laboratory test results for samples of specified Products to be supplied by this Section. Include in laboratory test results those tests required to demonstrate that Product meets requirements of this Section.
- .4 If Products from proposed source do not meet, or cannot reasonably be processed to meet specified requirements, locate an alternative source or demonstrate that Products source in questions can be processed to meet specified requirements.
- .5 Should a change of Products source be proposed during Work, advise Consultant 14 days in advance of proposed change to allow sampling and testing.

.6 Acceptance of Product at source does not preclude future rejection if it is subsequently found to lack uniformity, or if it fails to conform to requirements specified, or if its field performance is found to be unacceptable. Remove and dispose rejected material.

.2 Production sampling:
- .1 Products may be subject to continual sampling by Consultant during production.
- .2 Afford Consultant ready access to source and processed Products for sampling and testing.
- .3 If Products fail to meet Specifications, bear cost of additional sampling and testing of aggregates and fill.
- .4 Supply necessary personnel and equipment to permit adequate investigation and sampling. Advise Consultant at least 14 days in advance of use of Products, to allow sufficient time for sampling and testing.

3 Execution

3.1 EXAMINATION

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

3.2 PREPARATION

.1 Verify grades of items set in paving area for conformity with elevations and sections before placing granular base and subbase material.

.2 Obtain approval of subgrade by Consultant before placing granular subbase and base.

.3 Coordinate elevations of maintenance holes and other appurtenances and make flush with top of finish asphalt concrete paving.

3.3 SUBBASE AND BASE

.1 Comply with OPSS 314.

.2 Prior to placing subbase and base proof roll subgrade to identify soft spots. Excavate soft spots and backfill with granular material to 100% standard Proctor maximum dry density in accordance with ASTM D698.

.3 Place granular base and subbase material on clean unfrozen surface, free from snow and ice.

.4 Place granular base and subbase to compacted thicknesses as indicated. Do not place frozen material.

.5 Place in layers not exceeding 150 mm compacted thickness. Compact to density not less than 100 % standard Proctor maximum dry density in accordance with ASTM D698.

.6 Finished base surface to be within 5 mm of specified grade, but not uniformly high or low.

3.4 ASPHALT PRIMER

.1 Apply primer coat in accordance with OPSS 302.

.2 Do not apply primer when air temperature is less than 5 degrees Celsius or when rain is forecast within 2 hours.

.3 If asphalt primer fails to cure within 24 hours, spread sand blotter material in amounts required to absorb excess material. Sweep and remove excess blotter material.

3.5 EQUIPMENT

.1 Pavers: mechanical grade-controlled self-powered pavers capable of spreading mix within specified tolerances, true to line, grade and crown indicated.

.2 Rollers: sufficient number of rollers of type and weight to obtain specified density of compacted mix.

.3 Vibratory rollers:
- .1 Minimum drum diameter: 750 mm.
- .2 Maximum amplitude of vibration (machine setting): 0.5 mm for lifts less than 40 mm thick.

.4 Haul trucks: of sufficient number and of adequate size, speed, and condition to ensure orderly and continuous operation and as follows.

.5 Suitable hand tools.

3.6 ASPHALT PAVING

.1 Comply with requirements of OPSS 310.

.2 Obtain approval of tack coat base and primer from Consultant before placing asphalt mix.

.3 Place asphalt mix only when base or previous course is dry and air temperature is above 5 degrees Celsius.

.4 Place asphalt concrete in compacted layers not exceeding 50 mm per lift.

.5 Minimum 135-degree Celsius mix temperature required when spreading.

.6 Maximum 160-degree Celsius mix temperature permitted at any time.

.7 Compact each course with roller as soon as it can support roller weight without undue cracking or displacement.

.8 Compact paving to density not less than 97% of density obtained with Marshall specimens prepared in accordance with ASTM D1559. Roll until roller marks are eliminated.

.9 Keep roller speed slow enough to avoid mix displacement and do not stop roller on fresh pavement.

.10 Moisten roller wheels with water to prevent pick up of material.

.11 Compact mix with hot tampers or other equipment approved by Consultant, in areas inaccessible to roller.

.12 Finish surface to be within 5 mm of design elevation and with no irregularities greater than 10 mm in 4.5 m.

.13 Repair areas showing checking, rippling or segregation as directed by Consultant.

3.7 **JOINTS**

.1 Remove surplus material from surface of previously laid strip. Do not deposit on surface of freshly laid strip.

.2 Paint contact surfaces of existing structures such as catchbasins, manholes, curbs or gutters with tack coat prior to placing adjacent pavement.

.3 For cold joints, cut back to full depth vertical face and tack face with hot asphalt.

.4 For longitudinal joints, overlap previously laid strip with spreader by 25 to 50 mm.

3.8 **PAVEMENT MARKINGS**

.1 Spray paint parking zone lines and other pavement markings indicated, included, but not limited to, hash marks for no parking areas, direction arrows and handicap parking symbols.

.2 Use suitable compressor type striping machine. Use templates for symbols, arrows, lettering.

.3 Unless otherwise indicated, paint lines 125 mm wide.

.4 Paint lines straight, or uniformly curved, with well defined edges and full paint coverage in all locations.

3.9 FIELD QUALITY CONTROL

.1 Conduct following field tests, submit report to Consultant:
- .1 Granular materials for composition and gradation.
- .2 Granular material and asphalt concrete compaction.

3.10 PROTECTION

.1 Keep vehicular traffic off newly paved areas until paving surface temperature has cooled below 38 degrees Celsius. Do not permit stationary loads on pavement until 24 hours after placement.

3.11 SCHEDULE

.1 Refer to Geotechnical Report for compacted thicknesses of pavement structures for asphaltic concrete paving, unless otherwise indicated.

.2 Paving on public property, meet requirements of municipality.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

.1 Design, labour, Products, equipment and services necessary for concrete curbs and pavements Work in accordance with the Contract Documents.

1.2 **REFERENCES**

.1 ASTM A53/A53-M, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

.2 ASTM A185/A185-M, Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.

.3 ASTM C260, Specification for Air-Entraining Admixtures for Concrete.

.4 ASTM C309, Specification for Membrane-Forming Compounds for Curing Concrete.

.5 ASTM C494/C494-M, Specification for Chemical Admixtures for Concrete.

.6 ASTM D994, Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).

.7 CAN/CSA A23.1/A23.2-M, Concrete Materials and Methods of Concrete Construction/Methods of Tests for Concrete.

.8 CAN/CSA A3000, Cementitious Materials Compendium.

.9 CAN/CSA G30.18-M, Billet-Steel Bars for Concrete Reinforcement.

.10 CSA O121, Douglas Fir Plywood.

.11 CAN/CSA S269.3-M, Concrete Formwork.

1.3 **DESIGN REQUIREMENTS**

.1 Concrete: 30 Mpa unless otherwise indicated on drawings. Exterior concrete to have 5-7% entrained air.

.2 Design concrete so that material will not segregate and excessive bleeding will not occur.

.3 Comply to the MTC Manual of Uniform Traffic Control Devices for signs and flagging when working within existing road ways. Any requirements to restrict local traffic due to the contractors works, must be reviewed and approved by the Consultant.

1.4 **SUBMITTALS**

.1 Product data:
- .1 Submit duplicate copies of manufacturer's Product data in accordance with Section 01 33 00 for each material indicating:
  - .1 Performance criteria, compliance with appropriate reference standard(s), and characteristics.
  - .2 Product transportation, storage, handling and installation requirements.

.2 Shop drawings: Submit shop drawings in accordance with Section 01 33 00 indicating elevations, sections, details, materials, joint assemblies, finishes and relationships to adjacent construction.

1.5 **QUALITY ASSURANCE**

.1 Inspection and testing:
- .1 Materials: CAN/CSA A23.1/A23.2-M; Inspect and test for conformance to requirements of this Standard and to Specifications.
- .2 Tests will be made in accordance with CAN/CSA A23.2-M.
- .3 Remove defective materials and completed Work which do not conform to the Contract Documents.

1.6 **DELIVERY, STORAGE, AND HANDLING**

.1 Deliver and store materials on Site in accordance with CAN/CSA A23.1/A23.2-M.

1.7 **SITE CONDITIONS**

.1 Conform to CAN/CSA A23.1/A23.2-M.

.2 Do not deposit concrete on frozen ground. When deposited in forms concrete shall have a temperature between 10 degrees Celsius and 30 degrees Celsius and these limits shall be maintained for 72 hours.

2 Products

2.1 **MATERIALS**

.1 Forms: Plywood to CSA O121, G1S; Douglas Fir plywood, seven ply, exterior grade, waterproof glue, edges sealed with oil based sealer.

.2 Form ties: Adjustable snap ties, formed to break 25 mm or more from surface of concrete after form removal, with a minimum working strength of 1360 kg.

.3 Form release agent: Chemically active, non-staining, VOC compliant, release agents containing compounds that react with free lime present in concrete forming water insoluble soaps, preventing concrete from sticking to forms.

.4 Reinforcing steel: CAN/CSA G30.18-M; Billet-steel bars, deformed unless indicated otherwise, Grade 400R.

.5 Welded steel wire fabric: ASTM A185/A185-M; Resistance welded in size and spacing shown for smooth wire fabric, in flat sheets only.

.6 Chairs, bolsters, supports, spacers: CAN/CSA A23.1-M with sufficient strength to rigidly support weight of reinforcement and construction loads. Manufactured by NCA/Acrow - Richmond or Dayton Superior.

.7 Cement: CAN/CSA A3000; Portland, Type 10.

.8 Coarse and fine aggregate: CAN/CSA A23.1/A23.2-M.

.9 Water: CAN/CSA A23.1/A23.2-M.

.10 Water reducing admixture: ASTM C494/C494-M, Type A.

.11 Set retarding admixture: ASTM C494/C494-M, Type D.

.12 Air entraining admixture: CAN/CSA A23.1/A23.2-M and ASTM C260.

.13 Pigmented curing compound: ASTM C309, Type 2, Class B; White pigmented resin based.

.14 Joint filler: ASTM D994, Asphalt impregnated; 'Asphalt Joint Expansion Joint Filler' by W. R. Meadows Ltd., in thickness shown on Contract Drawings. Furnish kraft paper or polyethylene sheet as bond breaker between sealant and joint filler

.15 Joint Sealant: Two component, non-tracking, chemically reactive urethane/coal tar modified sealant; 'Sealtight Gardox' by W. R. Meadows Ltd. or 'Vulkem 202' by Tremco.

.16 Bonding Agent: Furnish 'Sika-Dur' by Sika, or 'Intralock' by W. R. Meadows.

2.2 MIXES

.1 Acceptance of any concrete mix proportion or material, does not preclude its future rejection if it is subsequently found to lack uniformity, or if it fails to conform to requirements specified, or if its field performance is found to be unacceptable.

.2 Mix concrete and concrete proportions in accordance with CAN/CSA A23.1/A23.2-M.

2.3 ADMIXTURES

.1 Use admixtures for concrete from single manufacturer, unless otherwise acceptable to Consultant.

.2 Have manufacturer certify that admixtures are compatible.

.3 Add admixtures to concrete mix in accordance with manufacturer's recommendations.

.4 Except as specified otherwise, comply with requirements of CAN/CSA A23.1/A23.2-M.

.5 Use of calcium chloride or additional admixtures, other than those specified, is not acceptable.

3 Execution

3.1 **EXAMINATION**

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

3.2 **GENERAL**

.1 Give Consultant at least 2 working days' notice prior to placement of concrete to permit a review of compaction, placement of formwork, reinforcing steel, and associated items embedded in concrete for conformance to reviewed shop drawings and Contract Documents.

.2 Do not place concrete on surfaces which contain frost, water or debris.

.3 Provide concrete curb cuts and sidewalk handicap access ramps as indicated, in accordance with the authorities having jurisdiction.

3.3 **PREPARATION**

.1 Verify grades of items set in paving area for conformity with elevations and sections before placing granular base and subbase material.

.2 Obtain approval of subgrade by Consultant before placing granular subbase and base.

.3 Set out work from lines and levels shown on drawings.

.4 Prevent damage to adjacent and/or existing buildings and/or properties, and existing curbs, sidewalks and asphalt paving.

.5 Accurately saw-cut and modify existing sidewalks to nearest adjacent dummy/expansion joint as directed on site by Consultant.

.6 Remove and dispose of debris from the work of this section in accordance with authorities having jurisdiction.

.7 Fine grade, shape and compact subgrade to minimum of 95% Standard Proctor Density.

.8 Wet base immediately in advance of concreting to ensure a firm moist surface without ponding.

.9 Repair damage to base resulting from hauling or equipment operations.

3.4 **FORMWORK**

.1 Construct formwork in accordance with CAN/CSA S269.3-M to produce finished concrete conforming to shape, dimensions, locations and elevations indicated. Ensure no lumber remains in concrete.

.2 Set forms true to line and grade, join neatly and tightly, and stake securely to resist concrete pressure and impact from tampers without springing.

.3 Apply release agent by spray in accordance with manufacturer's recommendations. Ensure form surfaces receive a uniform coating.

3.5 **REINFORCING**

.1 Place reinforcing steel as shown on reviewed shop drawings and in accordance with CAN/CSA A23.1-M. Make bars as long as possible.

.2 Make splices in locations shown on Drawings. Lap lengths in accordance with CSA A23.3 unless otherwise shown.

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

3.6 **PLACING OF CONCRETE**

.1 Before placing fresh concrete against set or partially set concrete, clean surfaces to remove dirt, scum, shavings, debris, laitance, etc. on set surfaces, brush generously with bonding agent.

.2 Place concrete in accordance with CAN/CSA A23.1/A23.2-M.

.3 Slope concrete to levels shown on Contract Drawings.

.4 Do not place concrete at such a rate as to endanger formwork or to prevent proper compaction.

.5 Place concrete to prevent cold joints and segregation and vibrate sufficiently to ensure thorough compaction, maximum density in accordance to CAN/CSA A23.1/A23.2-M

.6 Check Work frequently with accurate instruments during placing of concrete.

.7 When completing concrete placement for day, carry placement through to a scheduled joint location.

.8 Where concrete placement is stopped for more than 30 minutes due to breakdowns, weather or any other reasons, construct extra bulkhead and construction joint as directed.

3.7 CONCRETE CURBS

.1 Align concrete curbs with curves and tangents indicated on drawings. Concrete curb to be in accordance to details indicated on drawings.

.2 Where existing curb is met, the contractor must make the required transition to style and grade of existing curb to the satisfaction of the Consultant.

.3 Curbs shall have expansion joints at minimum 4500 mm o.c. and in accordance with authorities having jurisdiction. Place reinforcing bars at top and base of curb, with minimum 50 mm concrete cover.

.4 All restoration of the existing road structure for the transition to existing curb is the responsibility of the contractor.

.5 Finish edges of dummy joints and expansion joints with 3 mm radius edging tool.

3.8 CONCRETE PAVEMENTS

.1 Concrete sidewalk to be in accordance with details indicated on drawings.

.2 Concrete for standard sidewalk to be 150 mm thick, except through entrances where the concrete shall be 200 mm thick with wire mesh. The compacted granular ‘A’ is to be 150 mm thick at all locations.

.3 Where existing sidewalk is met, make the required transition to grade, to the satisfaction of the Consultant. Furthermore, co-ordinate with the municipality and Consultant, to insure compatibility of existing and or future adjacent works by municipality forces.

.4 All structural concrete, such as but not limited to, concrete walkway adjacent to building, concrete pads for loading docks, and concrete slabs for loading areas to be constructed in accordance with reviewed shop drawings.

.5 Dummy joints: 6 mm deep at 1500 mm o.c. Tool joints with 6 mm wide steel trowel, radiusing edges 6 mm.

.6 Expansion joints: 6000 mm o.c. maximum.

.7 Tool edges of sidewalk with 50 mm wide steel trowel, radiusing edges 6 mm.

.8 Install sealant in expansion/isolation joints as shown and specified.

3.9 CONSOLIDATING

.1 Consolidate concrete in accordance with CAN/CSA A23.1/A23.2-M

.2 Work concrete into complete contact with forms and embedded items. Consolidate concrete adjacent to side forms and along entire length of forms to ensure a smooth surface finish after stripping of formwork.

3.10 CURING AND PROTECTION

.1 Cure and protect concrete in accordance with CAN/CSA A23.1/A23.2-M.

.2 Apply curing compound after finishing operations have been completed, at rate recommended by compound manufacturer. Ensure compound application is uniform and continuous over entire area being cured.

3.11 CONSTRUCTION JOINTS

.1 Obtain Consultant's acceptance to install construction joints in locations other than those shown.

.2 Construct construction joints to CAN/CSA A23.1-M and as shown. Supply and install dowels in construction joints unless otherwise detailed.

.3 Joints at building face or other abutments: place 12 mm joint filler keeping top 12 mm below concrete surface; apply kraft paper or polyethylene bond over filler and fill with self-levelling sealant applied in accordance with manufacturer’s printed instructions.

.4 For sawn joints:

- .1 Do sawn joints in accordance with drawing details. Prepare sample sawn joint for approval by Consultant.
- .2 Ensure joints are straight. Mark alignment with chalk line or other suitable guide. Layout to be approved by Consultant.
- .3 Saw joints using approved equipment and methods to produce joint dimensions indicated.
- .4 Supply sufficient men and equipment including standby equipment, to maintain a satisfactory sawing schedule.
- .5 Schedule sawing operations on 24 hour basis and consistent with concrete placing.
- .6 Make initial saw cuts in a progressive manner and as soon as possible without excessive ravelling.
- .7 If a crack occurs ahead of saw cut, stop immediately. Move ahead several joints and cut one or more joints before returning to saw intermediate joints. Where cracking persists, make 1060 mm saw cut from one edge and complete sawing from opposite edge. Adjust sawing schedule accordingly.
- .8 If uncontrolled cracking or other surface damage results from inadequate or improper sawing techniques suspend further concrete operations until situation is corrected and immediately remove and replace damaged slabs.

.9 Immediately on completion of sawing, flush joints with water to remove laitance.

3.12 **FINISHING**

.1 When striking off concrete surface, maintain a uniform roll of concrete ahead of first screed for its full length when finishing machine is on first pass.

.2 Where joints are formed rather than sawn, form longitudinal and transverse joints after final pass of finishing machine.

.3 Hand finish areas inaccessible to finishing machine to same quality and surface characteristics as machine finished surfaces.

.4 Finish concrete surface with an approved float at proper time. Operate from edge to edge with a wiping motion while advancing, with each succeeding pass overlapping previous one.

.5 Check surface with approved straightedge 4500 mm long. Correct irregularities exceeding 5 mm before concrete takes initial set.

.6 Finish edges of slabs with edging tool to form a smooth squared surface. Do not patch with cement paste.

3.13 **IDENTIFICATION STAMP**

.1 For sidewalks in the public right-of-way, mark concrete at each end of the work and at least every 18000 mm or such other places as the Consultant may select.

.2 The stamp shall be located on the centre of the bay of walk, next to and parallel to a transverse joint.

.3 The size and shape of the stamp shall be as shown on the Municipalities drawings.

.4 The imprint shall be clear and legible and satisfactory to the Consultant.

3.14 **BROOM FINISH**

.1 Commence texturing immediately after float finishing.

.2 Use soft bristled broom to produce an approved light, non-slip concrete surface finish with fine granular or sandy texture free from disfigurations. Finishes to be approved by Consultant.

.3 Apply broom finish at right angles to curb and parallel to joints. All trowel and tool marks to be removed with broom. Do not contaminate joints by over-brooming.

.4 Finish to match existing striped concrete sidewalk to remain, and to Consultant's approval.

3.15 REMOVAL OF FORMS

.1 Do not disturb forms until concrete has hardened and developed sufficient strength to safely support its own weight and load on it.

.2 Strip formwork in accordance with CAN/CSA A23.1-M.

3.16 DEFECTIVE CONCRETE

.1 Concrete is defective when:
- .1 Containing excessive honeycombing or embedded debris.
- .2 Concrete damaged by freezing or which is unsatisfactory due to placement at too high a temperature.
- .3 Average 28 day strength of any three consecutive strength tests is less than specified minimum 28 day strength.
- .4 Any 28 day strength test result is less than 80% of specified minimum 28 day strength.
- .5 Surface texturing, joint type and placement and tolerances are unacceptable in the opinion of the Consultant.

.2 Repair of defective concrete work:
- .1 Repair defective areas while concrete is still plastic, otherwise wait until curing is completed. Use repair methods approved by Consultant.
- .2 Grind off high surface variations where directed.

.3 Remove and replace defective concrete where directed.
- .1 Remove minimum 3000 mm of pavement by sawing through concrete across full lane width.
- .2 Replace with new concrete to this specification.
- .3 Construct dummy contraction joint between sawn face of existing concrete and face of new concrete.

3.17 PROTECTION

.1 Do not open concrete pavement to traffic or construction equipment until concrete reaches 70% of specified strength or until approved by Consultant.

END OF SECTION